

FLAT BUBBLES IN LONG-HORIZON EXPERIMENTS: RESULTS FROM TWO MARKET CONDITIONS

Documents de travail GREDEG
GREDEG Working Papers Series

TOMOE HOSHIHATA
RYUICHIRO ISHIKAWA
NOBUYUKI HANAKI
EIZO AKIYAMA

GREDEG WP No. 2017-32

<https://ideas.repec.org/s/gre/wpaper.html>

Les opinions exprimées dans la série des **Documents de travail GREDEG** sont celles des auteurs et ne reflètent pas nécessairement celles de l'institution. Les documents n'ont pas été soumis à un rapport formel et sont donc inclus dans cette série pour obtenir des commentaires et encourager la discussion. Les droits sur les documents appartiennent aux auteurs.

The views expressed in the GREDEG Working Paper Series are those of the author(s) and do not necessarily reflect those of the institution. The Working Papers have not undergone formal review and approval. Such papers are included in this series to elicit feedback and to encourage debate. Copyright belongs to the author(s).

Flat bubbles in long-horizon experiments: Results from two market conditions*

Tomoe Hoshihata[†] Ryuichiro Ishikawa[‡] Nobuyuki Hanaki[§] Eizo Akiyama[¶]

GREDEG Working Paper No. 2017-32

Abstract

We report the results of asset market experiments with a long horizon of 100 periods conducted under two market conditions: *call markets* and *continuous double auctions*. In both market formats, we observe *flat bubbles*, i.e., situations where market prices remain steady while fundamental values decrease as the experiments proceed, as well as *multiple bubbles*. We confirm the stylized facts found in short-horizon experimental asset markets such as bubble–crash price dynamics, and the similarity of the price dynamics between call markets and continuous double auctions. We also examine the relationship between individual trading performance and cognitive ability.

Keywords: Experimental asset markets, call markets, continuous double auctions, long horizon, multiple bubbles, cognitive reflection test

JEL Code: C90, D84

*This research was partially supported by a grant-in-aid from the Zengin Foundation for Studies on Economics and Finance and by the ANR ORA-Plus project “BEAM” (ANR-15-ORAR-0004). We thank Yaron Lahav for sharing his experimental data and for providing some useful comments. We also thank participants at the 2016 North-American ESA Conference held in Arizona and the BEAM workshop 2017 held at Waseda University for their comments and suggestions. In particular, we thank Yukihiro Funaki, Charles Noussair, Stefan Palan, and Sebastien Duchene for their helpful comments. In addition, we thank Geoff Whyte, MBA, from Edanz Group (www.edanzediting.com/ac) for editing a draft of this manuscript.

[†]Toshiba Mitsubishi-Electric Industrial Systems Corporation

[‡]Corresponding author: School of International Liberal Studies, Waseda University, 1-6-1, Nishi-Waseda, Shinjuku, Tokyo 169-8050, Japan. E-mail: r.ishikawa@waseda.jp

[§]Université Côte d’Azur, CNRS, GREDEG. E-mail: Nobuyuki.HANAKI@unice.fr

[¶]Faculty of Engineering, Information and Systems, University of Tsukuba. E-mail: eizo@sk.tsukuba.ac.jp

1 Introduction

Several stylized facts are widely known following the large experimental studies of asset markets pioneered by Smith et al. (1988).¹ In this study, we report new price dynamics, called *flat bubbles*, in long-horizon experimental asset markets with 100 periods. We formally define these flat bubbles and detect them using our long-horizon experimental data.

One of the most prominent stylized facts in the experimental asset markets is that the price starts below the fundamental value (FV), forms a bubble, and finally crashes back to the FV in periods close to the end of the experiment. The FVs are given as the sum of the remaining expected dividends per share, and the subjects are informed about the FV of the asset in each period. This bubble–crash price dynamics contradicts the standard financial economic wisdom based on common knowledge among homogeneous traders (in terms of their beliefs, degree of rationality, and preferences), which shows that transaction prices that differ from FVs cannot be realized.

On one hand, the price dynamics commonly observed in these experimental asset markets are considered to be the result of confusion (Huber and Kirchler, 2012; Kirchler et al., 2012), non-profit-related motives (Lei et al., 2001), and the low cognitive ability (Bosch-Rosa et al., 2017) of participants. On the other hand, there are studies demonstrating that they result from interactions among heterogeneous participants who face uncertainty regarding other participants’ understanding of FVs (Cheung et al., 2014), behavior (Akiyama et al., 2017), or cognitive abilities (Hanaki et al., 2017).

One hypothesis regarding subjects’ cognitive ability as well as uncertainty about that of others they face points out that the bubble–crash pattern is the result of limitations in the subjects’ ability to carry out the backward induction reasoning from the final trading period or the uncertainty that subjects face regarding others’ ability to do so. If this hypothesis is true, a bubble should only burst once, in the periods near the end of the experiment,

¹Palan (2013) and Powell and Shestakova (2016) provide good summaries of the relevant literature.

regardless of the number of trading periods.

Lahav (2011) was the first asset market experiment with a very long horizon (200 periods). Lahav (2011) employs a call market format and shows that multiple bubbles and crashes are observed during the 200 periods of the experiment. Some of the crashes take place in earlier periods, rejecting the above hypothesis about the limitations of (and uncertainty about) the participants' ability to carry out backward induction reasoning.

We aim to reexamine the experimental results in Lahav (2011) by conducting long-horizon asset market experiments (100 periods) under two market conditions: *call markets* (CMs) and *continuous double auctions* (CDAs). The literature suggests that these two market formats generate similar market outcomes, although the trading volume is larger in CDAs than in CMs (Palan, 2013, Observation 27). However, these two market conditions have never been compared in a long-horizon setup such as that used in this study.

Similar to Lahav (2011), we observe multiple bubbles and crashes in our experiment. However, our results also demonstrate a new price pattern that we call *flat bubbles*. In fact, in our experiment, a flat bubble involving a single crash was observed more often than multiple bubbles and crashes.² We also find, as the literature demonstrates, that while there is no significant difference in terms of the magnitude and direction of mispricing between the two market conditions, the trading volume is larger in CDAs than in CMs.

The rest of the paper is organized as follows. In the next section, we explain our experimental settings for both the CMs and CDAs. Section 3 presents a formal definition of flat bubbles, and examines which market format demonstrates flat bubbles. We also compare the outcomes between the two market formats and examine the relationship between subjects' cognitive ability and trading performance. Section 4 concludes.

²Smith et al. (2014) also conducted long-horizon experiments of 50 periods using CMs and observed a single bubble rather than multiple bubbles in most markets. However, their motivation was to measure the neural activity of subjects facing price bubbles using functional MRI. To simplify the trading task for subjects for this purpose, Smith et al. (2014) restricted the trading volume to a maximum of one unit per subject per period, and thus their results are not directly comparable to those of Lahav (2011) or ours.

2 Experimental settings

Our experimental asset market is based on those of Smith et al. (1988) and Lahav (2011). We consider a market with 12 traders that lasts for 100 periods. Each trader is initially given six units of an asset and 7,500 experimental currency units (ECUs). A dividend of either 0 or 30 ECUs is randomly determined and paid for each unit of the asset that a trader holds at the end of each period. The assets and cash holdings of each trader are carried over from one period to the next for 100 periods. After the final dividend payment at the end of the 100th period, the asset loses its value. Therefore, the FV at the beginning of period t is calculated as $1/2 \times 30 \times (100 - (t - 1))$ ECUs following the payment of the dividends.

We conducted experiments under two different market conditions: CMs and CDAs. In CMs, subjects can submit one buy order and/or one sell order (or none of either type) in each period of 60 seconds. For a buy order, a subject needs to specify the maximum price s/he is willing to pay for a unit of the asset, and how many units s/he is willing to buy. The buy orders have to satisfy her/his budget constraint. For a sell order, s/he must specify the minimum price at which s/he is willing to sell a unit of the asset, and how many units s/he is willing to sell. The number of units s/he specifies in the sell order cannot exceed the number of units s/he holds.

After all of the traders have submitted their orders, we compute a single market-clearing price for the asset in the period. The CM structure we employ follows that of Lahav (2011), van Boening et al. (1993), Haruvy et al. (2007), and Akiyama et al. (2014, 2017). In our CMs, the market price of each period is determined by the minimum price at the intersection of the demand and supply curves derived from subjects' orders. At the end of each period, subjects are informed of the market price, how many net units they have traded (this will be a negative value if they sold more than they bought), and their cash and asset holdings after the transactions. They are not informed of the orders submitted by other subjects in the market, nor of the total volume of transactions in the period.

In our CDAs, each period also last for 60 seconds. Following Smith et al. (1988), subjects can post as many buy orders (bids) and sell orders (asks) as possible. Here, a bid and an ask correspond to a price for a unit of the asset. Subjects can trade as many units of the asset as they wish (while respecting their budget constraint) during a period. Similar to CMs, a subject cannot post a bid that exceeds her/his current cash holding, nor post an ask when s/he has no units of the asset. Similarly, no subject can accept an ask posted by another subject that exceeds her/his current cash holdings or a bid posted by another subject when s/he holds no units of the asset. Subjects receive a warning message when trying to post such orders.

All of the outstanding orders that subjects have posted are shown on their screens in descending (ascending) order according to the selling (buying) price. A transaction is completed when a subject selects one of the outstanding orders shown in the screen and presses a button to buy or sell, depending on which side of the transaction the subject is on, to conclude the transaction. When a transaction is completed between two subjects, all of the remaining outstanding asks posted by the seller and all of the remaining outstanding bids posted by the buyer are deleted from the screen. Note that it is only the orders posted by the two subjects involved in the transaction that are deleted; all of the bids and asks posted by other subjects are retained.

3 Results

The experiments were conducted at the University of Tsukuba (Ibaraki, Japan) between June 2013 and January 2014. We recruited 144 subjects (72 for both CMs and CDAs) who had never participated in similar experiments. Each subject only participated in one session. The experiments lasted for approximately three hours, including time spent on providing instructions, one practice period, and a post-experimental questionnaire using the Cognitive

Reflection Test (CRT). For the CRT, no monetary incentive was provided for correct answers. We took a 10-minute break between periods 50 and 51 to allow subjects to visit the toilet if necessary. The exchange rate between ECUs and Japanese yen (JPY) was 10 ECUs = 2 JPY. On average, each subject earned 3,800 JPY, including a participation fee of 500 JPY. Both the CM and CDA experiments were computerized using z-Tree (Fischbacher, 2007).

3.1 Flat bubbles

Figures 1 & 2 show the observed price dynamics, along with FVs, in six CMs and six CDAs. The CMs consist of Groups 1–6, while the CDAs consist of Groups 7–12. In the figures, there is no dot in some periods, making the graph discontinuous. The absence of a dot means that there was no trade in the corresponding period.

The trading prices remain constant for a long time in Groups 1, 2, and 6 in CMs and Groups 7, 9, 11, and 12 in CDAs. We first characterize this constant price behavior using the following criteria that are independent of the price scale.

Let FV_t be the FV at the beginning of period $t \in \{1, \dots, 100\}$. Since the FVs decrease by 15 ECUs in each period in our setting, the FV's rate of change in period t is defined as $RF_t \equiv (FV_t - FV_{t-1})/FV_{t-1} = -15/FV_{t-1}$ for $t \in \{2, \dots, 100\}$. In the same way, let p_t be the realized price of a group in period $t \in \{1, \dots, 100\}$. Then, the rate of return in period t is defined as $R_t \equiv (p_t - p_{t-1})/p_{t-1}$ for $t \in \{2, \dots, 100\}$. We now formally define a *flat bubble* in terms of price dynamics.

Definition 1 A price sequence, $\{p_t, p_{t+1}, \dots, p_{t+k}\}$, is called a *flat bubble* between t and $t+k$ if it satisfies the following conditions:

1. $|R_s| < |RF_s|$ for any $s \in \{t, t+1, \dots, t+k\}$ with $k > 1$

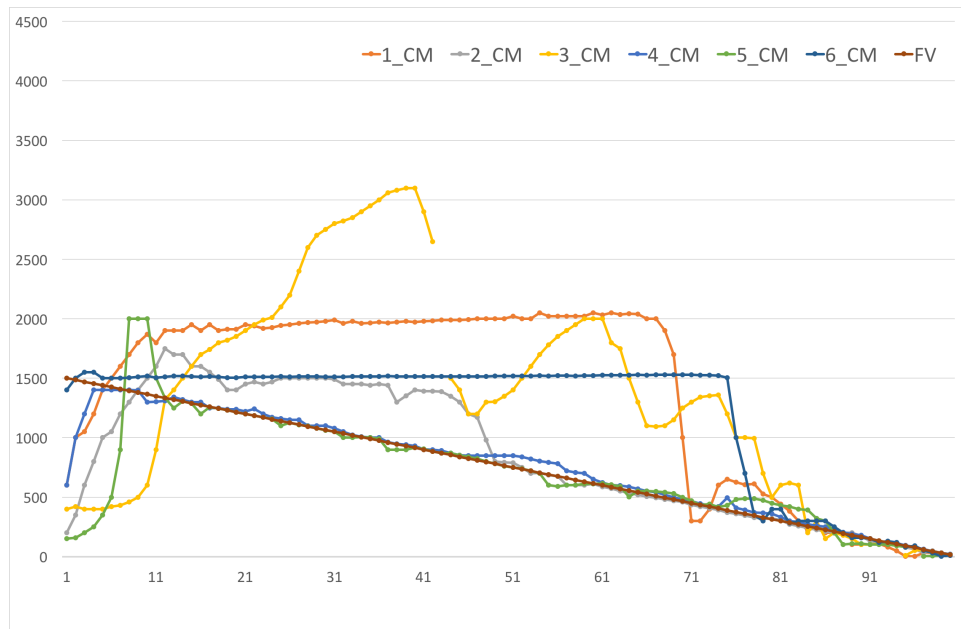


Figure 1: Price Dynamics of CMs.

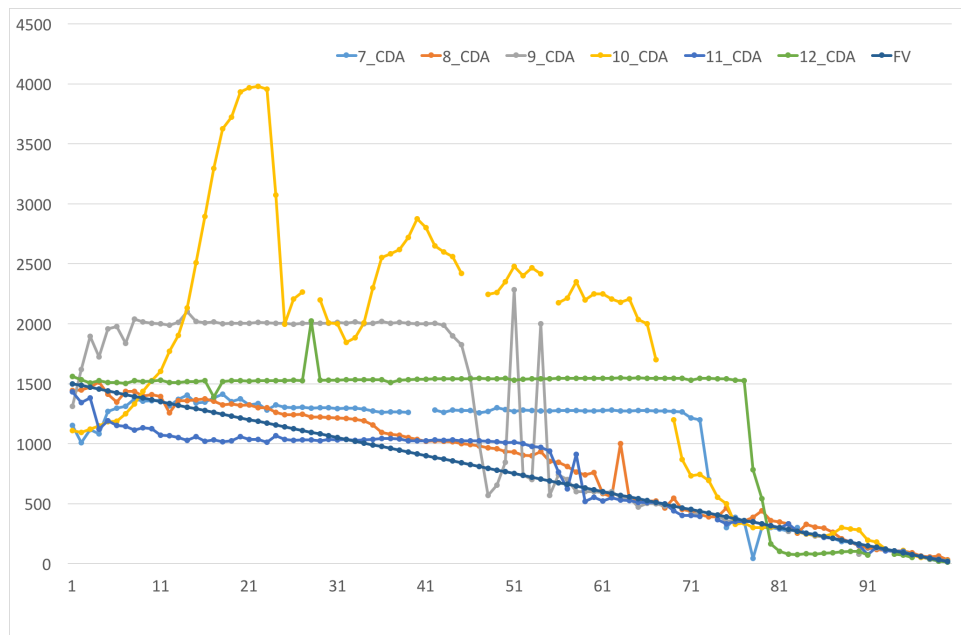


Figure 2: Price Dynamics of CDAs.

2. There exists a price sequence that encompasses $\{p_t, p_{t+1}, \dots, p_{t+k}\}$ such that it is either constant or not significantly different from a random walk with no drift.

The first condition requires the rate of return to be smaller than the FV's rate of change. Note that this condition does not necessarily mean that the deviation from FV increases. For instance, imagine that the price changes from 1000 ECUs to 910 ECUs between periods 90 and 91. The FVs at the beginning of periods 90 and 91 are 165 ECUs and 150 ECUs, respectively. In this case, $R_{91} = 0.099$ and $RF_{91} = 0.100$, which satisfies the condition. Such a situation occurs when the bubble has been already sustained at much higher prices than the FV. Our first condition allows such situations to occur even when the price falls quite drastically.

For the second condition, we test whether or not the price dynamics is significantly different from a random walk: $p_{s+1} = p_s + \sum_k \epsilon_k$ for each period $s \in \{t, t+1, \dots, t+k\}$, where $\{\epsilon_s\}$ is independently and identically distributed and its mean is zero. Then, even when the price dynamics includes a price fall satisfying the first condition, we can examine the flatness of the price dynamics on average. In addition, when ϵ_s is always zero, the dynamics is not a random walk, but rather is constant. The second condition includes such a case. Note that we still need both conditions to identify the periods in which flat bubbles form.

Table 1 shows periods that satisfy condition 1 for those groups that had such periods. Some groups demonstrate several spells intermittently. We examine whether a consecutive sequence including these intermittent spells has a unit root, using a standard time series analysis, to test for the second condition. We use the augmented Dickey–Fuller (ADF) test with neither trend nor intercept for the minimum consecutive price sequence of each group, which encompasses the prices of all the periods³ listed in Table 1 to examine whether the

³The price dynamics we tested in each group did not include the period where the bubble bursts. Thus, we are not concerned with the structural change of sequences as mentioned in Enders (2009, Ch. 4), for instance.

null hypothesis that the sequence has a unit root can be rejected. For instance, the minimum consecutive price sequence in Group 1 in the CM consists of the prices between periods 13 and 67, and that of Group 12 in the CDA consists of the prices between periods 6 and 77.

Next, we identified the flat bubbles in each group. The columns of t -statistics and p -values in Table 1 are the results of the ADF test. The null hypothesis is only rejected for Group 8 in the CDAs. For this group, we also checked for various sub-sequences of intermittent spells to determine whether any subsets of periods satisfied condition 2, but the null hypothesis was also rejected for these. Therefore, we concluded that no flat bubble was observed in Group 8 in the CDAs.

Next, we examine why flat bubbles both form and burst suddenly. We first consider the hypothesis that a specific set of subjects in each group trades repetitively during a flat bubble. If trades only occur among a specific set of subjects who tend to trade around a constant price, they may form a trading price pattern such as a flat bubble as a result of, for example, inertia in their trading behavior. To test whether this is the case, we compute the ratios of both individual selling and buying trades to total trades in all of the periods during the flat bubbles. Figure 3 shows the outcomes for each of the eight groups that demonstrate flat bubbles. In the figure, the vertical axis represents the trader IDs, while

Table 1: Identification of flat bubbles using the second condition

Group	time periods satisfying condition 1	t -statistics	p -value
1 CM	13-14; 19-20; 22-31; 33-53; 55-67	1.150950	0.9337
2 CM	26-31; 33-37; 41-43;	-0.733149	0.3839
4 CM	46-52	-1.128440	0.2076
6 CM	5-74	-0.363085	0.5502
7 CDA	26-39; 50-70	-0.952891	0.2985
8 CDA	14-16; 19-21; 26-27; 29-33; 37-38; 40-43; 46-49	-4.483727	0.0000
9 CDA	10-12; 16-43	-1.015684	0.2725
11 CDA	26-52	-0.931577	0.3026
12 CDA	6-7; 9-11; 13-16; 18-26; 30-37; 39-77	0.022670	0.6865

the horizontal axis represents the ratios of both successful asks and successful bids during flat bubbles. The negative values show the ask ratios, while the positive values show the bid ratios.

There are cases where some subjects do not trade at all (subjects 10, 11, and 12 in Group 2 and subjects 1, 2, 5, 6, 7, and 8 in Group 4 in the CMs). However, all of the subjects trade with each other in Groups 1 and 6 in the CMs and all of the groups in the CDAs. Therefore, it is not the case that only a specific subset of subjects trades during flat bubbles.

We also consider another hypothesis involving subjects' budget constraints before the flat bubbles burst and the markets face liquidity constraints. If subjects do not have enough cash to continue trading, they must stop trading. To test whether this was actually the case, we examined the histories of subjects' cash holdings over nine periods centered around the bursting of flat bubbles. Figure 4 shows the outcomes. The horizontal axis represents the four periods before and after the bursting of the flat bubble, while the vertical axis represents each subject's cash holding. The subjects' IDs are identical to those in Figure 3.

In Group 1 in the CMs, subject 2 increased her cash holdings drastically around the end of the flat bubble (period 67), while subjects 4 and 6 decreased their cash holdings. However, even after decreasing their holdings, these two subjects still had more than 5000 ECUs. In addition, subjects 9 and 12 already had a relatively small amount of cash even before the bubble burst, and thus their small amount of cash did not contribute to the bursting of the bubble. We can see similar tendencies in other groups. Therefore, we fail to conclude that the liquidity constraint triggers the bursting of bubbles.

3.2 Comparison between the two market conditions

We now address the difference between the two market conditions and examine how it impacts on trading. Recall that each of the 12 subjects in a market commences with six

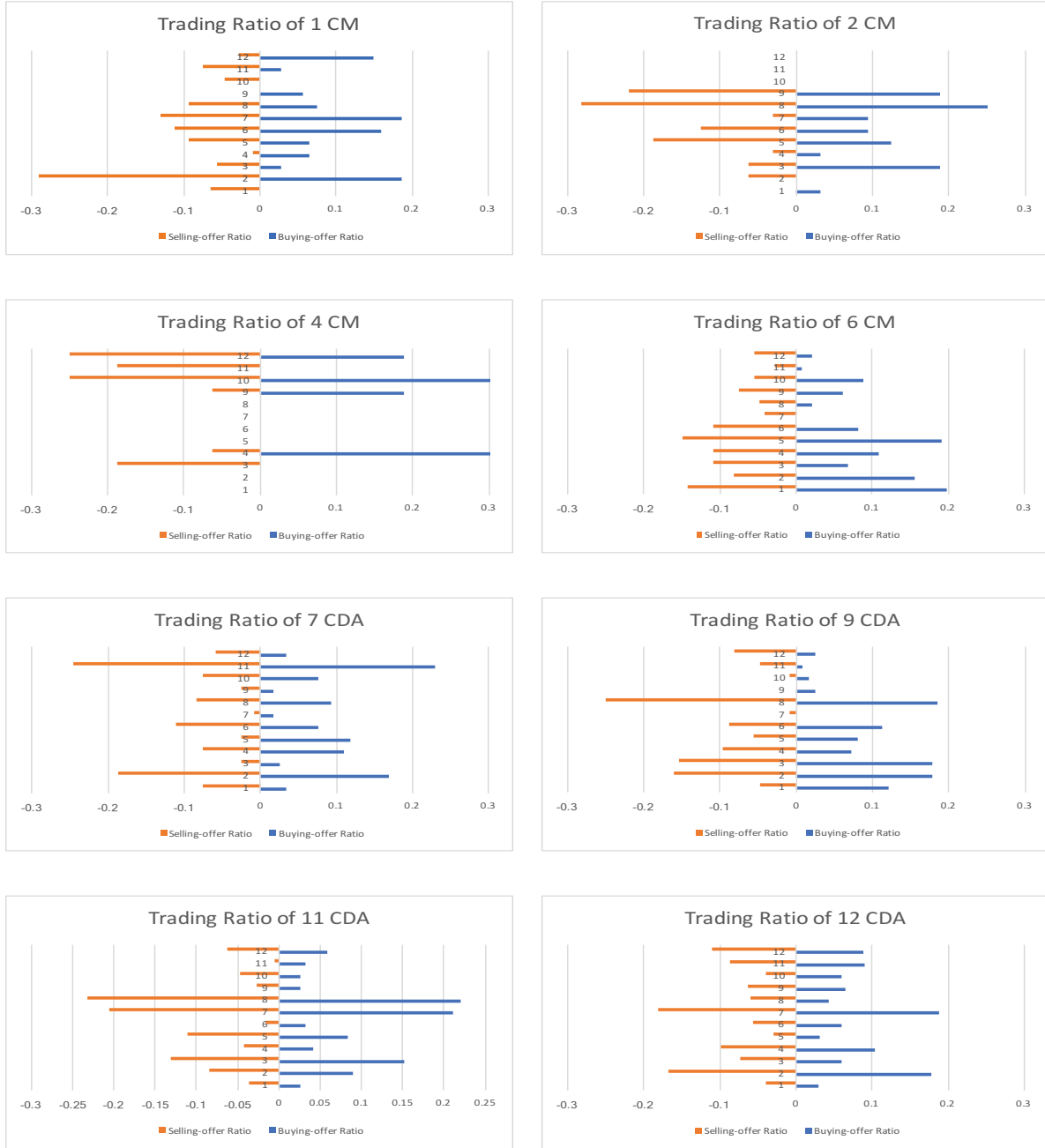


Figure 3: Trading Ratio.

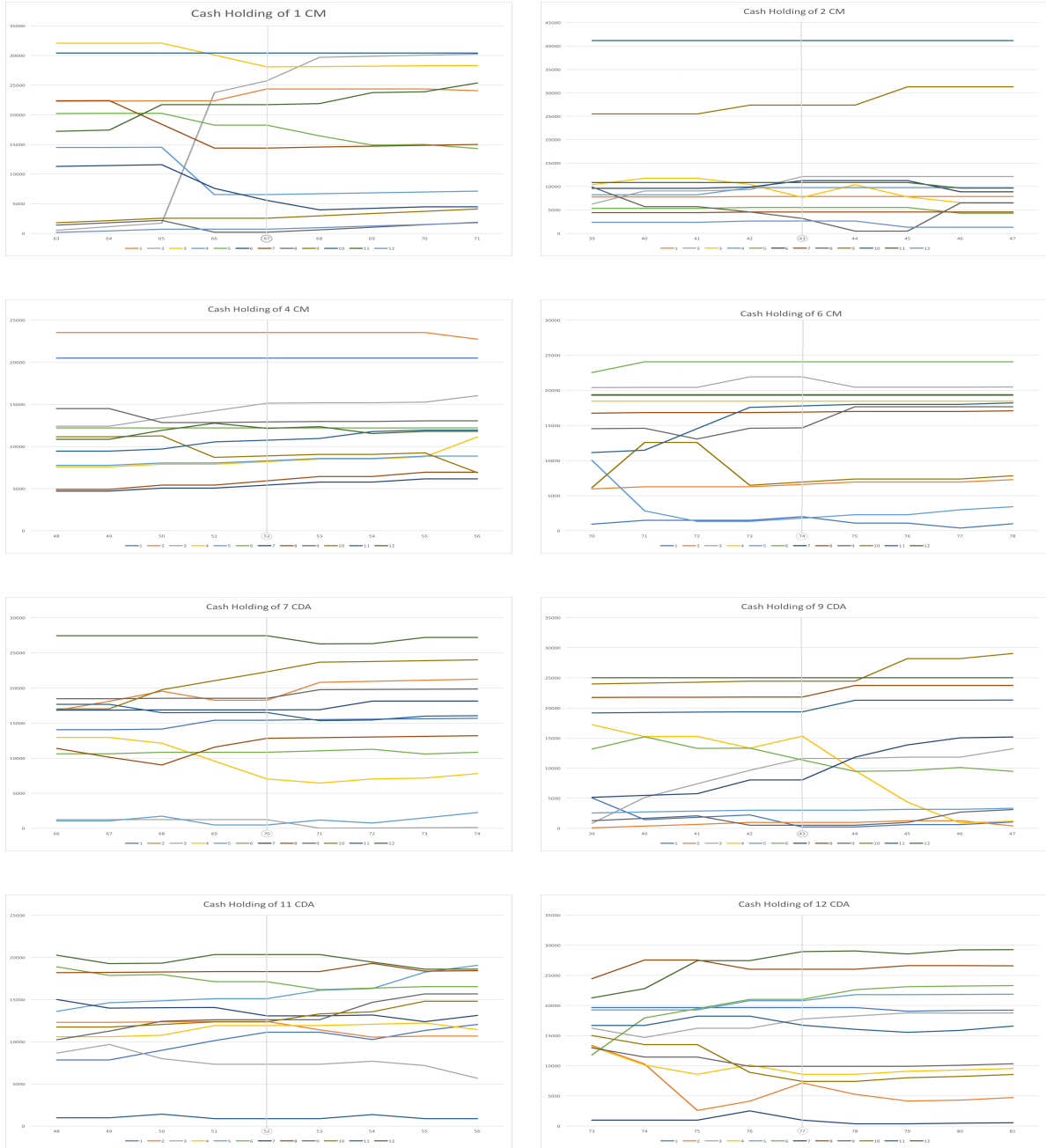


Figure 4: Cash holdings: each vertical line in the middle shows the period in which the bubble burst.

units of the asset, and thus there are 72 units of the asset in the market. Figure 5 shows the dynamics of relative mispricing, $((p_t - FV_t)/FV_t)$, red lines⁴) and relative trading volumes ($Q_t/72$, blue lines) for each of the six CMs. Figure 6 shows the same information for the six CDAs.

As can be seen in Group 3 in the CMs and Group 10 in the CDAs, there are markets that have multiple price peaks under both market conditions. In this sense, the price dynamics in some of these 100-period CMs and CDAs are similar to those in the 200-period CMs examined by Lahav (2011). On another front, it is noteworthy that the markets with flat bubbles do not have multiple price peaks except for Group 1 in the CMs and Group 9 in the CDAs. Even in these two markets, the impacts of the multiple price peaks are negligible. Indeed, in Group 1 in the CMs, there is another peak after the flat bubble bursts, but it is much smaller. In Group 9 in the CDAs, there are two peaks after the flat bubble, but they are temporary.

In the other markets with flat bubbles, Groups 2, 4, and 6 in the CMs and Groups 7, 11, and 12 in the CDAs, as shown in Figures 5 and 6, most of the relative mispricing after the bursting of the flat bubbles is so small that it is close to zero, or the no trade situation. Therefore, we can conclude that either markets with flat bubbles do not have multiple price peaks or there is little impact from the peaks. This observation is consistent with the hypothesis that the flat bubbles are the result of limitations in the traders' backward induction reasoning, and the bursting of the flat bubbles means that their backward reasoning begins to work.

To compare the market outcomes between the two conditions more precisely, we measure the magnitude of mispricing in terms of the relative absolute deviation (RAD) and relative deviation (RD) proposed by Stöckl et al. (2010) and the trading volume by the turnover

⁴ When no trade occurs, the price is set at one and zero in CMs and CDAs, respectively. Then, nearly and exact '-1' of the relative mispricing corresponds to the periods in which no trade occurs in CMs and CDAs, respectively.

Call Markets

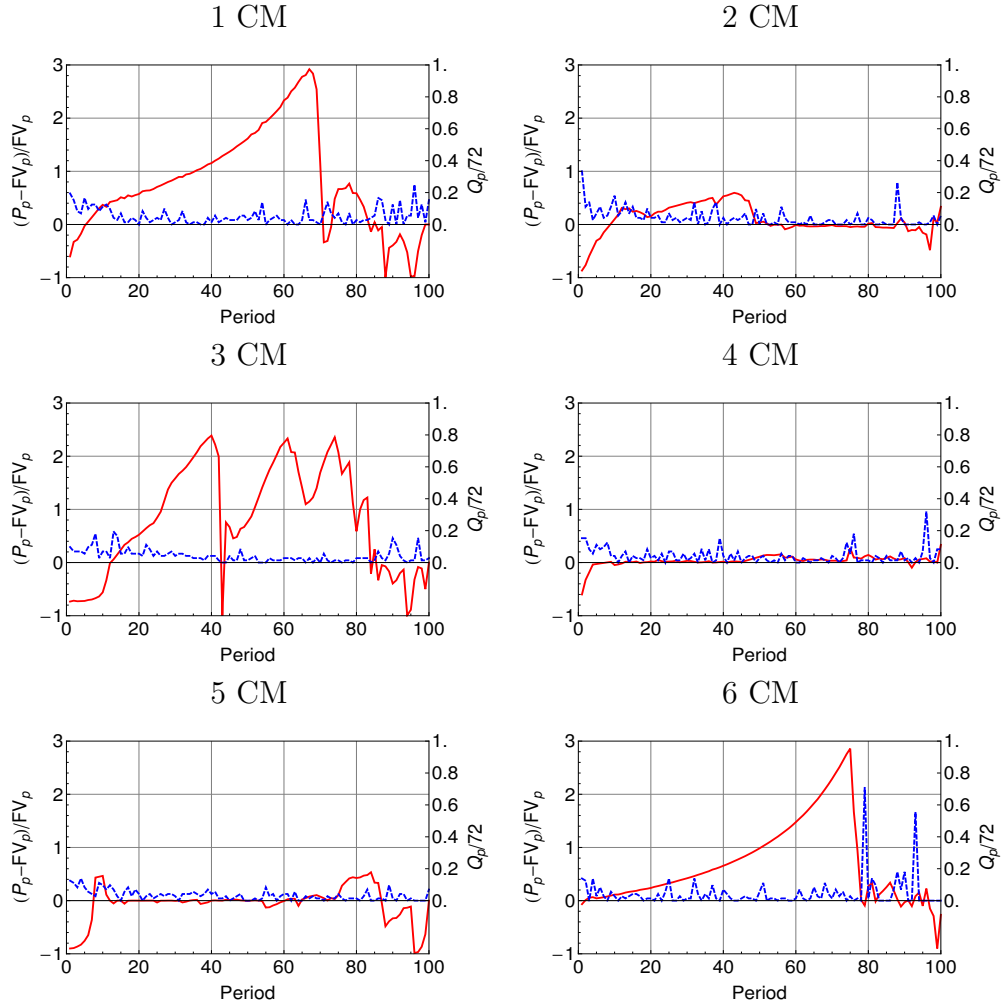


Figure 5: Dynamics of relative mispricing ($(p_t - FV_t)/FV_t$, red lines) and share of trading volumes ($Q_t/72$, blue lines) for each group under CMs.

Continuous double auctions

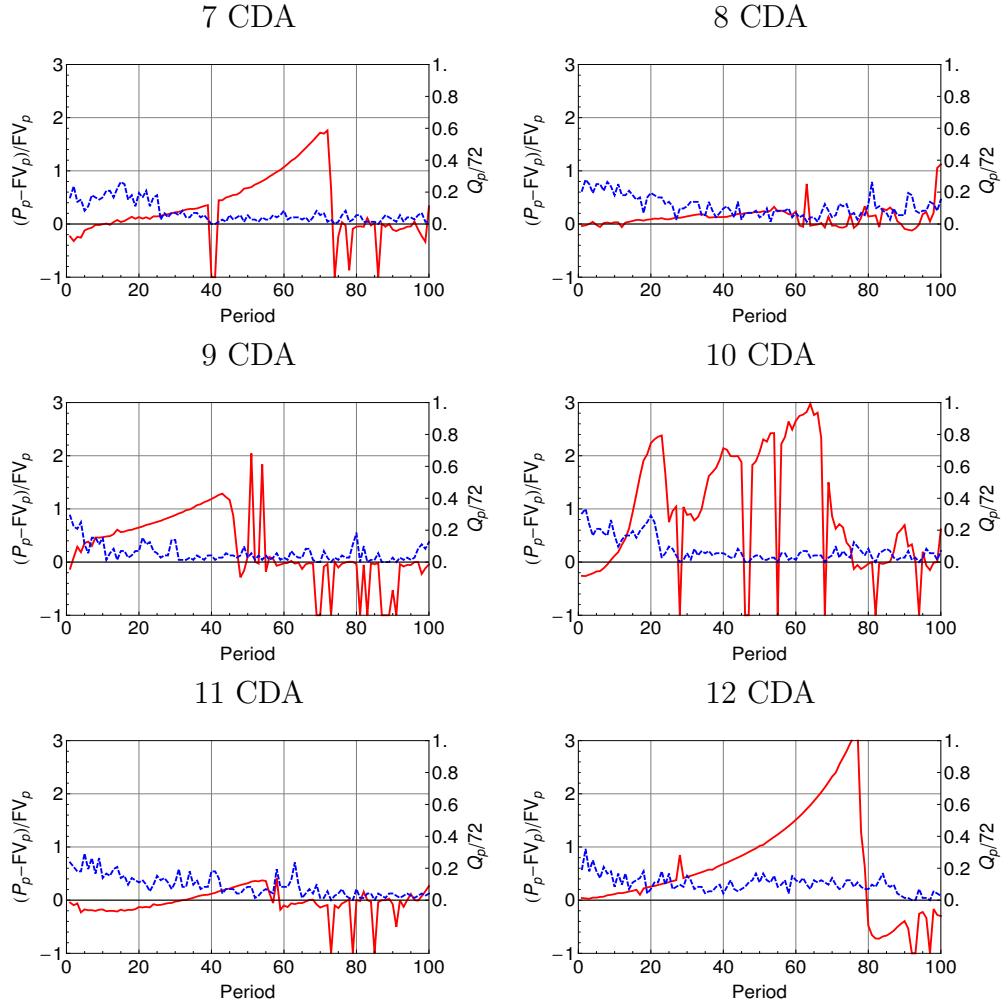


Figure 6: Dynamics of relative mispricing ($(P_p - FV_p)/FV_p$, red lines) and share of trading volumes ($Q_p/72$, blue lines) for each group under CDAs.

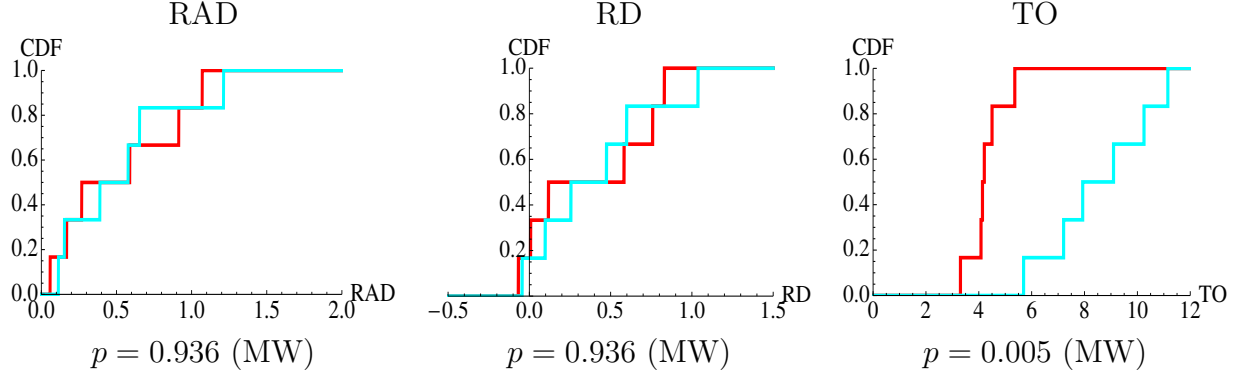


Figure 7: Distribution of RAD (left), RD (center), and TO (right) in CMs (red) and CDAs (light blue). P-values from the Mann–Whitney test are also shown.

(TO) measure proposed by van Boening et al. (1993). For each group n , RAD, RD, and TO are defined as

$$\text{RAD}^n = \frac{1}{100} \sum_{t=1}^{100} \frac{|p_t^n - FV_t|}{\overline{FV}} \quad (1)$$

$$\text{RD}^n = \frac{1}{100} \sum_{t=1}^{100} \frac{p_t^n - FV_t}{\overline{FV}} \quad (2)$$

$$\text{TO}^n = \sum_{t=1}^{100} \frac{q_t^n}{72}, \quad (3)$$

where p_t^n and q_t^n are the realized price and number of units of the asset traded in period t in group n . $\overline{FV} = \frac{1}{100} \sum_{t=1}^{100} FV_t$. Since there are several trading prices in each period of the CDAs, we use the average trading price of group n in period t of the CDAs for p_t^n .

Figure 7 shows the cumulative distribution of the RAD (left), RD (center), and TO (right) in CMs (red) and CDAs (light blue). We test them using the Mann–Whitney test, as shown at the bottom of figure, and find that the median RAD and RD in the CMs and CDAs are not statistically significantly different, while the TO is. Thus, just as in the standard shorter markets in the literature, the two trading conditions generate similar mispricing, with trading volumes being larger under CDAs than under CMs.

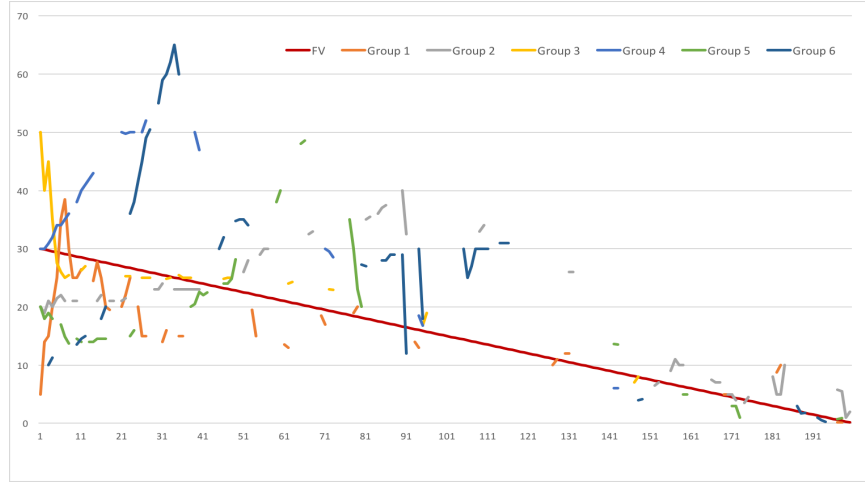


Figure 8: Price dynamics of all the groups in Lahav (2011).

Lahav (2011) also examined price data from CMs using the same measures. However, his data⁵ include many no-trade periods, as can be seen in Figure 8, and do not show the prices in periods without trade. Therefore, we do not compare the mispricing measures between our data and those of Lahav (2011).

3.3 Trading behavior, profits, and cognitive ability

Recent studies have reported interesting relationships between subjects' cognitive ability and gender, and their trading behavior and performance. Corgnet et al. (2015) and Breaban and Noussair (2015) report a positive relationship between the subjects' CRT scores and their final earnings. Eckel and Füllbrunn (2015) report that male subjects tend to earn more than female subjects, and also that an increase in the number of female subjects in the market reduces the magnitude of mispricing. We test whether similar findings can be obtained in the long-horizon experiments.

Table 2 shows the distribution of the CRT scores in the two treatments. There is no statistically significant difference in the CRT scores between subjects who participated in

⁵We are grateful to Prof. Lahav for providing his experimental data.

Table 2: Distribution of CRT Scores

	0	1	2	3	Mean Score
CM (n=72)	13 (8)	12 (5)	25 (5)	22 (4)	1.78
CDA (n=72)	11 (5)	9 (2)	26 (4)	26 (4)	1.93

ⁱThe numbers in parentheses represent female subjects.

Table 3: Relationships among profits, CRT scores, gender, and flat bubbles

Final profits	(1) CMs		(2) CDAs		(3) Pooled	
CRT	104.04 (93.25)	103.41 (91.22)	-24.65 (105.67)	-19.94 (112.06)	39.94 (56.57)	41.10 (58.08)
Gender	1016.83 (505.73)	1011.06 (531.67)	1051.93** (315.68)	1049.18** (315.09)	1047.33*** (221.49)	1037.75*** (217.26)
Flat bubbles		26.14 (190.02)		75.18 (87.37)		65.59 (61.55)
Constant	2372.61*** (233.50)	2372.61*** (231.50)	2622.80*** (274.83)	2565.78*** (299.07)	2489.72*** (158.87)	2450.96*** (180.49)
adj. R^2	0.089	0.089	0.077	0.078	0.084	0.084
N	72		72		144	

ⁱMale = 1 and female = 0 in gender dummies. Groups 1, 2, 4, 6, 7, 9, 11, and 12 = 1 in flat bubbles, otherwise 0.

ⁱⁱRobust standard errors corrected for the within-group clustering effect are shown in parentheses.

ⁱⁱⁱ * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the two market conditions ($p = 0.377$) according to the Mann–Whitney test.

Table 3 shows the results of regressing final profits on CRT scores and the gender dummy with/without the dummy variable indicating the occurrence of flat bubbles. The gender dummy takes a value of 1 if a subject is male and 0 otherwise. The flat bubble dummy takes a value of 1 if a flat bubble was observed in the market in which the subject participated. We performed linear regressions of the individuals' final results in CMs, CDAs, and the pooled data from both CMs and CDAs. Contrary to the findings of Corgnet et al. (2015) and Breaban and Noussair (2015), the CRT score is not a significant predictor of final profit in any of the regressions. However, in the regressions of the CDAs and pooled data,

gender is significantly correlated with final profit. In our experiment, males made more profit than females, which is consistent with the findings of Eckel and Füllbrunn (2015).

To better understand the differences between the final profits of males and females, we analyze the orders submitted by subjects. We use a measure of the maximum losses that can potentially be generated by orders submitted by a subject over the 100 periods. Because the types of orders submitted by subjects differ between CMs and CDAs, we define them separately.

For CMs, we follow Akiyama et al. (2014) and define the potential loss for subject i , PL^i , as follows:

$$PL_{CM}^i \equiv \frac{1}{16500} \sum_t (d_t^i \max(pd_t^i - FV_t, 0) + s_t^i \max(FV_t - ps_t^i, 0)),$$

where pd_t^i and ps_t^i are the maximum price at which i is willing to buy and the minimum price at which i is willing to sell a unit of asset, respectively, as specified by subject i 's orders submitted in period t . d_t^i and s_t^i are the maximum quantities demanded or supplied in association with pd_t^i and ps_t^i , respectively. The potential loss is normalized by the value of the initial endowment (=16500, 7500 ECUs plus six units of the asset with FV_1 of 1500) so that PL^i denotes the share of the initial endowment subject i would potentially lose if his or her orders were executed at the prices submitted.⁶

For CDAs, we define PL^i as

$$PL_{CDA}^i \equiv \frac{1}{16500} \sum_t \left(\sum_u \max(b_{t,u}^i - FV_t, 0) + \sum_k \max(FV_t - a_{t,k}^i, 0) \right),$$

where $b_{t,u}^i$ is the bid (or price paid when responding to others' asks) of the u -th buy order the subject posted in period t . Similarly, $a_{t,k}^i$ is the ask (or price received when responding

⁶It should be noted that submitting such orders may not result in any losses in our experiment because the actual trading prices can differ from those submitted by the subjects.

to others' bids) of the k -th sell order the subject posted in period t .

Table 4: Relationships among potential losses, CRT scores, gender, and flat bubbles

Potential losses	(1) CMs		(2) CDAs		(3) Pooled	
CRT	-0.38 (0.33)	-0.39 (0.35)	-1.11 (2.90)	-1.37 (3.36)	-0.59 (1.58)	-0.62 (1.71)
Gender	1.32 (0.95)	1.18 (0.78)	3.91 (5.04)	4.07 (5.50)	3.54 (2.85)	3.82 (3.66)
Flat bubbles		0.67 (1.08)		-4.23 (9.52)		-1.94 (6.60)
Constant	1.90** (0.64)	1.58* (0.72)	10.12* (4.75)	13.32 (9.95)	5.07* (2.24)	6.22 (5.86)
adj. R^2	0.061	0.077	0.009	0.019	0.011	0.015
N	72		72		144	

ⁱMale = 1 and female = 0 in gender dummies. Groups 1, 2, 4, 6, 7, 9, 11, and 12 = 1 in flat bubbles, otherwise 0.

ⁱⁱRobust standard errors corrected for the within-group clustering effect are shown in parentheses.

ⁱⁱⁱ * $p < 0.10$.

Table 4 shows the results of regressing potential losses on CRT scores, the gender dummy, and the flat bubble dummy. We do not observe any statistically significant gender differences in potential losses. This lack of a significant relationship between potential losses and the gender dummy is puzzling given the significant gender difference in relation to final profits. However, we note that regressing the final profit on a constant term and PL , while adjusting the standard error at group level, results in a negative and significant estimated coefficient under CMs. For CDAs, the estimated coefficient is also negative, but not significantly different from zero. Note that in the above regression of final profits on gender and CRT scores, gender was significantly correlated with final profits under CDAs but not under CMs. The lack of a significant relationship between final profits and potential losses in CDAs and the lack of a significant relationship between gender and final profits in CMs explain this result.

4 Summary and conclusion

In this study, we identified new price dynamics in experimental asset markets that we called *flat bubbles* and formulated them based on two criteria: a smaller rate of return than that of FV and the random-walk property of price time series. Our long-horizon setting enables us to examine the relevant properties of the observed prices. Our experiments were conducted under two different market conditions: CMs and CDAs. Flat bubbles were observed in both CMs and CDAs. While the magnitude of mispricing was not statistically significantly different between the two market conditions, trading volume was. We also tried to identify the reason for the flat bubbles through two hypotheses relating to liquidity constraints and the concentration of trades among a small fraction of traders in a market. However, we did not find support for these hypotheses.

Except for the existence of flat bubbles, our experimental results basically confirmed the stylized facts found in the standard short-horizon experimental asset markets, namely, bubble–crash price dynamics and the similarity of price dynamics between CMs and CDAs.

We also examined the relationships between trading performance and CRT scores and gender while controlling for the occurrence of flat bubbles. While we observed a statistically significant difference in trading performance between males and females, the subjects’ CRT scores were not significantly correlated with their trading performance.

One of the motivations for conducting long-horizon asset market experiments is to examine price dynamics in a setting that is closer to that of real-world markets. The long-horizon setting can be especially useful in examining the effects of various policies, both monetary and fiscal, on the future expectations of market participants and price dynamics. Indeed, these policies are increasingly being viewed as highly influential on people’s expectations (Honkapohja, 2015; Mertens and Ravn, 2014). Recently, some researchers have begun to investigate the effects of monetary policy on mispricing and trading behavior in experimental asset markets a la Smith et al. (1988) (e.g., Fischbacher et al., 2013), as well as on

expectation dynamics in learning-to-forecast experiments (e.g., Hennequin and Hommes, 2017; Bao and Zong, 2017). On one hand, typical experimental asset markets use a rather short horizon (10 to 15 periods) and are conducted without eliciting future price expectations from the subjects. On the other hand, typical learning-to-forecast experiments use a longer horizon of 50 periods or more, but in these experiments, subjects are only required to forecast future prices, and do not trade. Therefore, it would be of great interest to investigate the long-run and short-run effects of policies on future expectations, trading behavior, and market outcomes using long-horizon asset markets in which subjects both forecast and trade.

References

- AKIYAMA, E., N. HANAKI, AND R. ISHIKAWA (2014): “How do experienced traders respond to inflows of inexperienced traders? An experimental analysis,” *Journal of Economic Dynamics and Control*, 45, 1–18.
- (2017): “It is not just confusion! Strategic uncertainty in an experimental asset market,” *Economic Journal*, 127, F563–F580.
- BAO, T. AND J. ZONG (2017): “Seeing is Believing: the Impact of Interest Rate Policy Announcement on Asset Bubbles in Experimental Markets,” Mimeo.
- BOSCH-ROSA, C., T. MEISSNER, AND A. BOSCH-DOMÈNECH (2017): “Cognitive bubbles,” *Experimental Economics*, forthcoming, DOI: 10.1007/s10683-017-9529-0.
- BREABAN, A. AND C. N. NOUSSAIR (2015): “Trader characteristics and fundamental value trajectories in an asset market experiment,” *Journal of Behavioral and Experimental Finance*, 8, 1–17.

- CHEUNG, S. L., M. HEDEGAARD, AND S. PALAN (2014): “To See is To Believe: Common Expectations in Experimental Asset Markets,” *European Economic Review*, 66, 84–96.
- CORGNET, B., R. H. GONZALEZ, P. KUJAL, AND D. PORTER (2015): “The Effect of Earned vs. House Money on Price Bubble Formation in Experimental Asset Markets,” *Review of Finance*, 19, 1455–1488.
- ECKEL, C. C. AND S. C. FÜLLBRUNN (2015): “Thar SHE Blows? Gender, Competition, and Bubbles in Experimental Asset Markets,” *American Economic Review*, 105, 906–920.
- ENDERS, W. (2009): *Applied Econometric Time Series*, Wiley, 3rd edition ed.
- FISCHBACHER, U. (2007): “z-Tree: Zurich toolbox for ready-made economic experiments,” *Experimental Economics*, 10, 171–178.
- FISCHBACHER, U., T. HENS, AND S. ZEISBERGER (2013): “The impact of monetary policy on stock market bubbles and trading behavior: Evidence from the lab,” *Journal of Economic Dynamics and Control*, 37, 2104–2122.
- HANAKI, N., E. AKIYAMA, Y. FUNAKI, AND R. ISHIKAWA (2017): “Diversity in Cognitive Ability Enlarges Mispricing in Experimental Asset Markets,” Working paper 2017-08, DREDEG.
- HARUVY, E., Y. LAHAV, AND C. N. NOUSSAIR (2007): “Traders’ Expectations in Asset Markets: Experimental Evidence,” *American Economics Review*, 97, 1901–1920.
- HENNEQUIN, M. AND C. HOMMES (2017): “Managing coordination on bubbles in experimental asset markets with monetary policy,” Paper presented at 2017 Annual Meeting of the Society for Experimental Finance.
- HONKAPOHJA, S. (2015): “Monetary policies to counter the zero interest rate: An overview of research,” Research Discussion Paper 18/2015, Bank of Finland.

- HUBER, J. AND M. KIRCHLER (2012): “The impact of instructions and procedure on reducing confusion and bubbles in experimental asset markets,” *Experimental Economics*, 15, 89–105.
- KIRCHLER, M., J. HUBER, AND T. STÖCKL (2012): “Thar She Bursts: Reducing Confusion Reduces Bubbles,” *American Economic Review*, 102, 865–883.
- LAHAV, Y. (2011): “Price patterns in experimental asset markets with long horizon,” *Journal of Behavioral Finance*, 12, 20–28.
- LEI, V., C. N. NOUSSAIR, AND C. R. PLOTT (2001): “Nonspeculative Bubbles in Experimental Asset Markets: Lack of Common Knowledge of Rationality vs. Actual Irrationality,” *Econometrica*, 69, 831–859.
- MERTENS, K. R. S. M. AND M. O. RAVN (2014): “Fiscal policy in an expectations-driven liquidity trap,” *Review of Economic Studies*, 81, 1637–1667.
- PALAN, S. (2013): “A review of bubbles and crashes in experimental asset markets,” *Journal of Economic Surveys*, 27, 570–588.
- POWELL, O. AND N. SHESTAKOVA (2016): “Experimental asset markets: A survey of recent developments,” *Journal of Behavioral and Experimental Finance*, 12, 14–22.
- SMITH, A., T. LOHRENTZ, J. KING, P. R. MONTAGUE, AND C. F. CAMERER (2014): “Irrational exuberance and neural crash warning signals during endogenous experimental market bubbles,” *Proceeding of National Academy of Science, U.S.A.*, 111, 10503–10508.
- SMITH, V. L., G. L. SUCHANEK, AND A. W. WILLIAMS (1988): “Bubbles, Crashes, and Endogenous Expectations in Experimental Spot Asset Markets,” *Econometrica*, 56, 1119–1151.

STÖCKL, T., J. HUBER, AND M. KIRCHLER (2010): “Bubble measures in Experimental Asset Markets,” *Experimental Economics*, 13, 284–298.

VAN BOENING, M. V., A. W. WILLIAMS, AND S. LAMASTER (1993): “Price bubbles and crashes in experimental call markets,” *Economics Letters*, 41, 179–185.

Appendix: English translation of the instructions

This Appendix contains an English translation of the instructions. We distributed handouts containing these instructions to all subjects. The Japanese version of the handout is available from the authors upon request. Please note that our two treatments, CMs and CDAs, share many common elements, which are presented in black text. After the common elements have been presented, we then show the script for CMs, followed by that for CDAs. Further common elements follow the separate scripts for CMs and CDAs.

Instructions for the Asset Trading Experiment

Please do not turn over any page until instructed to do so. Before the experiment begins, we kindly request that you:

- confirm that you are seated in your designated seat
- do not log in until instructed to do so
- inform us immediately if your computer is not working correctly.

[Today's schedule]

Today, we will be conducting an experiment consisting of three games following the four steps outlined below.

1. Explanation of the experiment (games) and a practice round.
 2. First session of games (about 70 minutes, followed by a break, and then a second session of games (about 70 minutes).
 3. Quizzes.
 4. Payment: The attendance fee (500 yen) plus any profit that you earn in the games will be paid in cash at the end of the experiment.
- The quizzes do NOT affect the results of the games.

[Today's experiment]

Today, you will participate in stock trading games in which you trade stocks in an artificial stock market. Please listen to the instructions carefully. If you do not understand any part of an instruction, please raise your hand. If you have any questions during the experiment, raise your hand and an instructor will come to you and answer your question.

Throughout the experiment, please respect the following rules:

1. Do not talk to the other participants during the experiment or the breaks, as this may affect the results of the experiment.

2. Use your mouse or keyboard only when instructed to do so by the instructor, otherwise this may cause a problem. If any malfunction occurs, all participants will have to restart the game.

[Outline of stock trading game]

- You have been divided into groups, but you do not know the identity of the other members of your group.
- Your group will buy and sell dummy stocks in an artificial market.

[Trading period]

In the experiment, a period lasts for 60 seconds. You will trade with the other members in your group for 100 periods.

[Objectives of the game]

Your objective in this game is to maximize your trading profit. We have termed the currency used in the experiment the 'Mark'. At the end of the experiment, your total profits in Marks will be converted into Yen and paid to you.

There are two ways of making a profit:

- Buying and selling stocks
- Receiving dividends on your stock holdings.

[Earning profits]

Here, we explain how to make a profit by buying and selling stocks.

To earn a profit from trading, you need to buy stocks and then sell them at a higher price. For example, suppose you buy a stock for 100 Marks, and then the price of the stock increases to 120 Marks. If you sell the stock, you will earn $120 \text{ (selling price)} - 100 \text{ (purchase price)} = \underline{20 \text{ Marks profit}}$. Later, we will explain how the prices are determined.

Now we will explain how to use the experimental program interface. We will also explain how to trade assets. Please do not perform any operations other than those you are instructed to perform, otherwise this could jeopardize the results of the experiment.

<The common elements end here. The instructions for CMs are presented next, followed by those for CDAs. Then, more common elements are presented.>

[CM] [Order-entry screen]

The following screen will appear, through which you can enter your orders for each period.

残り時間 [秒] 0
決めてください!!

現在の所持金	現在の保有株数	最高購入希望価格	買い注文数	最低売却希望価格	売り注文数
7500	6				

OK

株取引ゲーム
第 1 / 100 Period

売り・買い注文の価格と注文数を入力してください。売り注文をしないときは売り注文数に「0(ゼロ)」を入力してください。(買い注文も同様)

- (1) This shows the time remaining for you to enter your orders. You will be given 60 seconds to enter your orders. When that period of time has elapsed, a red warning message will flash in the top right corner of your screen and you must enter your order as soon as possible if you haven't already done so. A period ends when every member of the group has pressed "OK"; note that this could occur prior to the expiry of the 60-second time limit.
- (2) This indicates your cash balance, i.e. the amount of money at your disposal; you may buy stocks up to this value.
- (3) This shows the number of stocks that you have. This is the maximum number of stocks you can sell.
- (4) This is where you enter the maximum price you are willing to pay for a stock in this period. You must enter a whole number between 1 and 10000.
- (5) This is where you enter the maximum number of stocks you want to purchase in this period. If you do not want to purchase any stocks, you should enter 0. The product of (4) and (5) must be no greater than the cash balance shown in (2). An error message will appear if (the number of stocks you wish to purchase) $\times$ (the maximum price you are prepared to pay for each stock) exceeds your cash balance.

In practice, the price you actually pay for a stock may not be the same as the maximum price you are willing to pay. This is because the market price is set based on all the orders placed by market participants. If the market price is greater than the maximum you are willing to pay, your order will

not be processed. This will be explained in more detail later.

- (6) This is where you enter the minimum price at which you are prepared to sell your stocks in this period. You must enter a whole number between 1 and 2000. The price you enter here should not be greater than that entered in (4).
- (7) This is where you enter the number of stocks you want to sell in this period. If you do not want to sell any stocks, you should enter 0. The maximum number of stocks you can sell is the number of stocks you hold, as shown in (3). If the number of stocks you want to sell exceeds the number of stocks you hold, an error message will appear.

In practice, the price at which you sell a stock may not be the same as the minimum price at which you are willing to sell. This is because the market price is set based on all the orders placed by market participants. If the market price is lower than your minimum selling price, your order will not be processed. This will be explained in more detail later.

- (8) After entering appropriate values in fields (4)~(7), press the “OK” button. Once all market participants have pressed this button, the current period ends.

[Remarks on trading]

You can simultaneously place both buy and sell orders, or you can place only a buy order or a sell order. You can also decide not to submit any orders at all. If you do not want to submit a buy order, please enter 0 as the quantity you want to buy. If you do not want to submit a sell order, please enter 0 as the quantity you want to sell.

- The screen displays an error message if any of the following conditions are violated:
 1. The maximum purchase price you are willing to pay multiplied by the quantity you wish to buy must be less than or equal to the cash you have available at the time. That is, you cannot buy stocks valued above your cash holding.
 2. If you simultaneously place both buy and sell orders, the maximum price at which you are prepared to buy must be less than or equal to the minimum selling price you are prepared to accept.

[End-of-period screen]

- (1) Market prices

The price is set according to the order book within your market. There is a single price for all stocks in each period. The price is set to equate the number of buy orders and sell orders.

残り時間 [秒] 24

1

取引価格	0
今期(Period)購入した株の数	0
現在の所持金	392
現在の保有株数	1
Next Value	108
取引価格の上下10%以内に入っていた予測の総数	0

The following two examples explain how the market price is determined.

[Example 1]

Consider the following buy/sell orders placed by four traders:

- Trader 1: One sell order, which can be executed at 10 Marks or higher
- Trader 2: Two sell orders, which can be executed at 40 Marks or higher
- Trader 3: One buy order, which can be executed at 60 Marks or lower
- Trader 4: One buy order, which can be executed at 20 Marks or lower.

A graph summarizing these orders is shown below.



A seller is willing to sell at the price requested or a higher price. A buyer is willing to buy at the price specified or a lower price. As shown above, there is only one stock supplied at 10 Marks or higher. If the price rises to 40 Marks, the number of stocks supplied increases to three. Conversely, only one stock is demanded at 60 Marks. If the price falls to 20 Marks, the quantity demanded increases to two. Therefore, the quantity demanded is equal to the quantity supplied at prices between 21 Marks and 39 Marks. The market price is set to the minimum price in this range, i.e., 21 Marks.

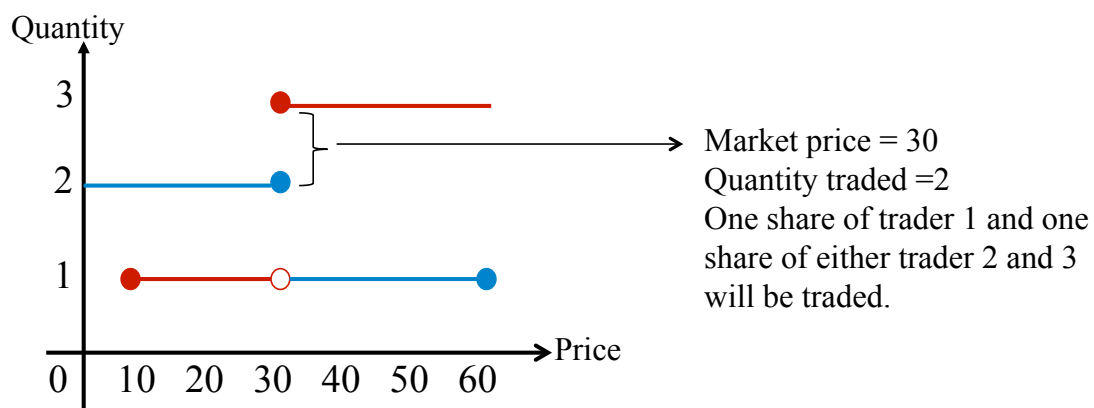
Now let us consider the second example.

[Example 2]

Consider the following buy/sell orders placed by five traders:

- Trader 1: One sell order, which can be executed at 10 Marks or higher
- Trader 2: One sell order, which can be executed at 30 Marks or higher
- Trader 3: One sell order, which can be executed at 30 Marks or higher
- Trader 4: One buy order, which can be executed at 60 Marks or lower
- Trader 5: One buy order, which can be executed at 30 Marks or lower.

A graph summarizing these orders is shown below.



As shown above, only one stock is supplied at 10 Marks or higher, as in the previous example. If the price rises to 30 Marks, the number of stocks that are supplied increases to three. However, there is only one stock demanded at 60 Marks or lower. If the price falls to 30 Marks, the quantity demanded increases to two. As a result, two transactions can be completed at 30 Marks. In this case, the market price is set to 30 Marks. Which orders will be fulfilled is determined as follows.

Priority is given to Trader 1, because he/she requested a price less than the market price. In addition to the order of Trader 1, the order of either Trader 2 or Trader 3 will be filled. This is determined randomly by the computer program.

[End-of-period screen]

At the end of each period, the following screen is displayed containing the information described below.

- (1) This shows the market price, as explained previously.
- (2) A positive value denotes the number of stocks you have purchased in the current period, while a negative value denotes the number of stocks you have sold in the current period.

- (3) This shows your cash holding after the transactions and dividend payments have been processed for the current period.
- (4) This is the number of stocks you currently hold.
- (5) The next slide provides an explanation of *Next Value*.
- (6) This is the number of correctly predicted prices. This is explained in the slide entitled “Earning a profit by predicting future prices correctly.”
- (7) The remaining time (maximum of 20 seconds) for which this screen will be visible is displayed here. After observing the information on the screen, press the “Continue” button (8). Once all of the participants have pressed this button, the next screen is displayed.

The screenshot shows a financial simulation interface. At the top right, a red circle with the number 7 is next to the text '残り時間 [秒] 24'. The main area contains a table of financial data with several items circled in red and numbered:

① 取引価格	0
② 今期(Period)購入した株の数	0
現在の所持金	392
④ 現在の保有株数	1
Next Value	108
取引価格の上下10%以内に入っていた予測の総数	0

At the bottom right, there is a button labeled 'CONTINUE' with a red circle and the number 8 next to it.

[End of instructions for CMs]

<These instructions for CDAs follow the initial common elements>

[CDA] [Order-entry screen]

The figure on the right shows the actual screen you will use in trading.

The screenshot shows a trading interface with the following elements:

- 1**: Period indicator showing '1 / 100'.
- 2**: Time remaining indicator showing '残り時間 [秒]: 35'.
- 3**: Cash and stock holdings section on the left, showing '現金 225' and '株数 3'.
- 4**: '売注文価格' (Sell order price) input field.
- 5**: 'Buy' button.
- 6**: '買注文価格' (Buy order price) input field.
- 7**: 'Sell' button.
- 8**: 'Traded' column showing the executed trade price '1340'.

The order book displays the following prices:

SellOrder	Traded	BuyOrder
1500		1800
1400		1500
1490		1400
1450		1350
1400		
1340	1340	

- ① shows the present period out of 100 periods.
- ② shows the time remaining in this period.
- ③ shows your cash and stock holdings. These amounts will change following each trade.
- ④ If you want to sell some or all of your stocks, enter the price at which you are willing to sell and click the **Order(Sell)** button. Your sell order will appear in blue in the SellOrder column. Other traders' sell orders are shown in black in the same column.
- ⑤ When you see the price at which you are willing to buy stock in the SellOrder column, select the price and click the **Buy** button. When you select a price, its color changes to blue.
- ⑧ When a trade is executed, the trade price appears.
- ⑥ If you want to buy a stock, enter the price you are willing to pay and click the **Order(Buy)** button.
- ⑦ When you see the price at which you are willing to sell stock in the BuyOrder column, select the price and click the **Sell** button.

[End-of-period screen]

At the end of each period, the following screen is displayed containing the information described below.

平均取引価格	2000
現金(配当前)	5500

配当金額	30
株数	7
配当	210

現金(配当後)	5710
株数	7
next value	1485

The first line in the top red rectangle shows the average trade price in the current period, while the second line shows your cash holding before adding the dividend for this period.

The first line in the middle red rectangle shows the dividend for the current period, the second line shows the number of stocks you hold, and the third line shows the total dividend you received in this period, which is the standard dividend for this period multiplied by the number of stocks you hold.

The first line in the bottom red rectangle shows your total cash holding after adding the dividend for the current period, while the second line shows the number of stocks you will carry forward to the next period. This number is always identical to that in the second line in the middle rectangle. The last line shows the *Next Value* per stock in this period, which is explained later.

[Remarks]

- All of the orders are reset at the start of each period.
- You cannot buy stock valued at more than your cash holding.
- You cannot submit any buy order valued at more than your cash holding.
- Once you submit a buy/sell order, you cannot cancel it.
- You can submit more than one buy/sell order.
- Once a buy order is executed, all the other buy orders disappear. The same applies to sell orders.
- When you buy a stock in the SellOrder column while you are submitting buy orders, all of your other buy orders disappear. The same applies when you sell a stock in the BuyOrder column while submitting sell orders.

[End of instructions for CDAs]

<Additional common instructions>

[Earning dividends]

In each game, there are 100 periods in which you can submit buy/sell orders and trade with other traders in your market.

[Expected dividend values]

You will be offered a dividend of either 0 or 30 Marks per stock with equal probability. Thus, the expected dividend value is calculated as $(30 + 0)/2 = 15$ Marks. Note that 15 Marks is only the expected value; you will actually receive either 0 or 30 Marks.

[Next value]

As noted above, at the end of each period, a *Next Value* amount is displayed. This is **the sum of the expected dividend value** per stock that will be offered in the remaining periods. For example, consider *Next Value* at the end of the second period. There are 98 periods remaining. The expected value of 15 Marks per stock will be offered 98 times. Thus, *Next Value* is $15 \times 98 = 1470$ Marks.

[List of Next Values]

Turn to the next page to see a table of *Next Values*. Before the beginning of the first period, the *Next Value* is $(100 \text{ remaining periods} \times 15 \text{ Marks} = 1500 \text{ Marks})$. After period 100, a dividend is also paid according to your final stock holdings. Then, the value of the stocks becomes zero.

[Questions regarding Next Values (1)]

To confirm your understanding of *Next Values*, please answer the following questions:

- Q1. After period 40, how many periods remain?
- Q2. After period 40, what is the *Next Value*?

Please turn to the next page.

[Questions regarding Next Values (2)]

To confirm your understanding of *Next Values*, please answer the following questions:

- Q1. After period 90, how many periods remain?
- Q2. After period 90, what is the *Next Value*?

[Summary of ways to make a profit]

There are two ways of making a profit: (1) buying and selling stocks and (2) receiving dividends on your stock holdings.

On average, you can earn 16500 Marks. The exchange rate is 10 Marks = 2 Yen. Thus, on average, you can earn 3300 Yen. Your total reward will be your profit from the game plus the participation fee of 500 yen. Therefore, the average total reward is 3800 Yen.

DOCUMENTS DE TRAVAIL GREDEG PARUS EN 2017

GREDEG Working Papers Released in 2017

- 2017-01** LAUREN LARROUY & GUILHEM LECOUTEUX
Mindreading and Endogenous Beliefs in Games
- 2017-02** CILEM SELIN HAZIR, FLORA BELLONE & CYRIELLE GAGLIO
Local Product Space and Firm Level Churning in Exported Products
- 2017-03** NICOLAS BRISSET
What Do We Learn from Market Design?
- 2017-04** LISE ARENA, NATHALIE ORIOL & IRYNA VERYZHENKO
Exploring Stock Markets Crashes as Socio-Technical Failures
- 2017-05** IRYNA VERYZHENKO, ETIENNE HARB, WAËL LOUHICHI & NATHALIE ORIOL
The Impact of the French Financial Transaction Tax on HFT Activities and Market Quality
- 2017-06** FRÉDÉRIC MARTY
La régulation du secteur des jeux entre Charybde et Scylla
- 2017-07** ALEXANDRU MONAHOV & THOMAS JOBERT
Case Study of the Moldovan Bank Fraud: Is Early Intervention the Best Central Bank Strategy to Avoid Financial Crises?
- 2017-08** NOBUYUKI HANAKI, EIZO AKIYAMA, YUKIHIKO FUNAKI & RYUICHIRO ISHIKAWA
Diversity in Cognitive Ability Enlarges Mispricing in Experimental Asset Markets
- 2017-09** THIERRY BLAYAC & PATRICE BOUGETTE
Should I Go by Bus? The Liberalization of the Long-Distance Bus Industry in France
- 2017-10** AYMERIC LARDON
On the Coalitional Stability of Monopoly Power in Differentiated Bertrand and Cournot Oligopolies
- 2017-11** ISMAËL RAFAÏ & MIRA TOUMI
Pay Attention or Be Paid for Attention? Impact of Incentives on Allocation of Attention
- 2017-12** GÉRARD MONDELLO
Un modèle d'accident unilatéral: incertitude non-radical et estimations différenciées
- 2017-13** GÉRARD MONDELLO
Lenders and Risky Activities: Strict Liability or Negligence Rule?
- 2017-14** FRÉDÉRIC MARTY
Économie des algorithmes et ordre concurrentiel : réflexions sur les abus d'exploitation et les collusions fondés sur des algorithmes de prix
- 2017-15** AGNÈS FESTRÉ, PIERRE GARROUSTE, ANKINÉE KIRAKOZIAN & MIRA TOUMI
The Pen is Might Be Mightier than the Sword: How Third-party Advice or Sanction Impacts on Pro-environmental Behavior
- 2017-16** EDWARD LORENZ & SOPHIE POMMET
Innovation, Credit Constraints and National Banking Systems: A Comparison of Developing Nations
- 2017-17** PATRICE BOUGETTE & CHRISTOPHE CHARLIER
Antidumping and Feed-In Tariffs as Good Buddies? Modeling the EU-China Solar Panel Dispute
- 2017-18** NOBUYUKI HANAKI, EIZO AKIYAMA & RYUICHIRO ISHIKAWA
Behavioral Uncertainty and the Dynamics of Traders' Confidence in their Price Forecasts

- 2017-19** ADNANE KENDEL, NATHALIE LAZARIC & KEVIN MARÉCHAL
What Do People 'Learn By Looking' at Direct Feedback on their Energy Consumption? Results of a Field Study in Southern France
- 2017-20** NICOLAS VALLOIS & DORIAN JULLIEN
Estimating Rationality in Economics: A History of Statistical Methods in Experimental Economics
- 2017-21** NICOLAS VALLOIS & DORIAN JULLIEN
Replication in Experimental Economics: A Historical and Quantitative Approach Focused on Public Good Game Experiments
- 2017-22** BENJAMIN MONTMARTIN, MARCOS HERRERA & NADINE MASSARD
R&D Policy regimes in France: New Evidence from a spatio-temporal Analysis
- 2017-23** THOMAS BOYER-KASSEM & SÉBASTIEN DUCHÊNE
On Discrimination in Health Insurance
- 2017-24** MICHELA CHessa & PATRICK LOISEAU
On Non-monetary Incentives for the Provision of Public Goods
- 2017-25** NICOLAS BRISSET
Models as Speech Acts: The Telling Case of Financial Models
- 2017-26** NOBUYUKI HANAKI, EIZO AKIYAMA & RYUICHIRO ISHIKAWA
Effects of Eliciting Long-run Price Forecasts on Market Dynamics in Asset Market Experiments
- 2017-27** CHARLES AYOUBI, MICHELE PEZZONI & FABIANA VISENTIN
The Important Thing is not to Win, it is to Take Part: What If Scientists Benefit from Participating in Competitive Grant Races?
- 2017-28** FRÉDÉRIC MARTY
Le prix des services juridiques : entre défaillance de la réglementation et défaillance de marché ?
- 2017-29** JOAO V. FERREIRA, NOBUYUKI HANAKI & BENOÎT TARROUX
On the Roots of the Intrinsic Value of Decision Rights: Evidence from France and Japan
- 2017-30** GUILHEM LECOUTEUX
Bayesian Game Theorists and Non-Bayesian Players
- 2017-31** BENJAMIN MONTMARTIN & MATHIEU ESCOT
Local Competition and Physicians' Pricing Decisions: New Evidence from France
- 2017-32** TOMOE HOSHIHATA, RYUICHIRO ISHIKAWA, NOBUYUKI HANAKI & EIZO AKIYAMA
Flat Bubbles in Long-Horizon Experiments: Results from two Market Conditions