Expectations and Stock Market Participation: Theory and Evidence

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June 24, 2019

10th International Workshop on Theoretical and Experimental Macro

Limited Stock Market Participation

	Average	Top 5%
US	48.9%	93.7%
UK	31.5	83.9
Switzerland	31.4	65.8
Netherlands	24.1	72
Germany	22.9	61.2
Italy	8.2	64.8

Table 1: Direct and Indirect Stockholding by Country *(Guiso and Sodini 2013)*

Why Limited Participation?

- One of the oldest household finance puzzles *(Campbell 2006)*
- Can help explain asset pricing phenomena *(Vissing-Jorgensen 2003)*
- Liquid vs illiquid assets important *(Kaplan et al 2018)*

Motivation

- Limited stock market participation is robust
  - $\approx$ 35 - 48% in U.S. *(SCF, PSID, SIPP)*
- Main explanations:
  1. Liquidity constraints
  2. Participation costs
- Limited participation among wealthy
  - 80th pct of U.S. wealth distribution 20% do not hold stocks *(Campbell 2006)*

Motivation

- Stylized Facts on Beliefs:
  1. Correlation between subjective returns and participation *(Hurd et al 2011)*
  2. Heterogeneity in subjective returns *(Dominitz and Manski 2011)*
- **Q: What is the role of subjective expectations due to differences in stock market returns on stock market participation?**

Motivation

- Stylized Facts on Beliefs:
  1. Correlation between subjective returns and participation *(Hurd et al 2011)*
  2. Heterogeneity in subjective returns *(Dominitz and Manski 2011)*
- Q: What is the role of subjective expectations due to differences in stock market returns on stock market participation?
- **A: Stock market experiences are important for differences in subjective beliefs**

Motivation

- Data Limitations:
  - Expectations and participation panel data unavailable
  - No control over information sets and DGP
- Experimental Method:
  - Joint elicitation of *subjective expectations* and *participation*
  - Diagnose specific causes of deviations from theory
  - Disentangle expectations, learning, and participation costs

Motivation

- My Approach:
  - Model of limited participation with participation costs
  - Elicit expectations and participation in the laboratory
    - Standard design does not allow for participation
    - Participation $\Longrightarrow$ potential different histories
- **Result: Investors who receive low returns have lower subjective returns and are less likely to participate in the stock market**
  - Experience Hypothesis *(Malmendier and Nagel 2011)*

External and Internal Validity

- External Validity - Generalizability
  - Robust experimental design *(Hommes 2011)*
  - Large-scale experiments *(Hommes et al 2019)*
- Internal Validity - Cause and effect
  - High level of control

Overview

- Experimental Goal
- Model
  - CARA
  - Participation costs
  - Rational expectations
- Experimental Design
  - LtF asset pricing experiment
- Data
- Econometric Results

Experimental Goal

- Link between expectations and participation not well understood
- Simple model linking *expectations* and *participation decision*
- Model:
  1. *Expectations = F(Price)*
  2. *Participation = G(Expectations)*
  3. *Price = H(Participation, Expectations)*
- Preserve belief-outcome interaction
- Elicit *expectations* and *participation decision* from subjects

Model

Model Overview

- Environment:
  - CARA preferences: $u(c_t) = -e^{-\rho c_t}$
  - Heterogeneous participation costs k^i
  - Rational expectatations
- 2 decisions:
  - Participation decision n_t^i
  - Portfolio decision x_t^i
- 2 assets:
  - Risky asset (stocks): Stochastic supply S_t
  - Risk-free bond

Household's Problem

- F.O.C.:

$$\underbrace{x_t^i}_{\text{Asset Holdings}} = \frac{\overbrace{E_t p_{t+1} + \mu - R p_t}^{\text{Expected Return}}}{\underbrace{\gamma}_{\text{Risk Adjustment}}}$$

- Aggregate Asset Demand:

$$X_t = \sum_M x_t^i$$

Pricing Equation

- Market Clearing:

$$\underbrace{X_t N_t}_{\text{Total Asset Demand}} = \underbrace{S_t}_{\text{Supply}}$$

- Pricing Equation:

$$p_t = R^{-1}\left[\underbrace{E_t p_{t+1} + \mu}_{\text{Expected Payoff}} - \underbrace{\frac{S_t}{N_t}\gamma}_{\text{Risk Adjustment}}\right]$$

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- Set $\gamma = 1$:

$$p_t = R^{-1}\left[E_t p_{t+1} + \mu - \frac{S_t}{N_t(E_t p_t, E_t p_{t+1}, \bar{k})}\right]$$

Steady-state Equilibrium

- Steady-state:

$$\bar{p} = \frac{\mu - \frac{S}{\bar{N}}}{R - 1}$$

$$\bar{N} = \min\left\{\frac{\sqrt{S}}{\bar{k}}, 1\right\}$$

- **Key**:
  - Higher cost agents leave market
  - $\bar{k} \uparrow \Longrightarrow \bar{N} \downarrow \Longrightarrow \bar{p} \downarrow$

Model Hypotheses

Hypothesis 1: *Subjects with higher participation costs* $k^i \implies$ *lower net subjective returns and lower mean participation rates.*

Hypothesis 2: *With RE, net subjective returns only differ due to* k^i*. That is, all subjects agree on* $p^e_{t+1} + \mu - Rp^e_t$*.*

Experiment

Experimental Overview

- Elicit p^e_{t+1}
- Pricing Equation:

$$p_t = R^{-1}\Big[\underbrace{\boldsymbol{p^e_{t+1}}}_{\text{Average Expectations}} + \mu - S_t\Big]$$

Experimental Overview

- Elicit $p^e_{t+1}, \underbrace{\boldsymbol{p^e_t}, \boldsymbol{n^i_t}}_{\text{new}}$
- Pricing Equation:

$$p_t = R^{-1}\Bigg[\underbrace{\boldsymbol{p^e_{t+1}}}_{\text{Average Expectations}} + \mu - \underbrace{\frac{S_t}{\boldsymbol{N_t(p^e_t, p^e_{t+1}, \bar{k})}}}_{\text{Participation Decision}}\Bigg]$$

- *Net Subjective Expected Returns*: $\underbrace{p^e_{t+1} + \mu - Rp^e_t}_{\text{1-period return}} - \underbrace{k^i}_{\text{cost}}$

Learning-to-Forecast (LtF)

- *Hommes et al (2005)*
- Split decisions:
  - Subjects *forecast*
  - Given forecasts, decisions *optimized*
- Subjects are given qualitative information of DGP and fundamentals
  - Removes strategic considerations
  - Faster convergence *(Bao and Duffy (2016), Hommes et al (2018))*
- Compensated for forecasting accuracy

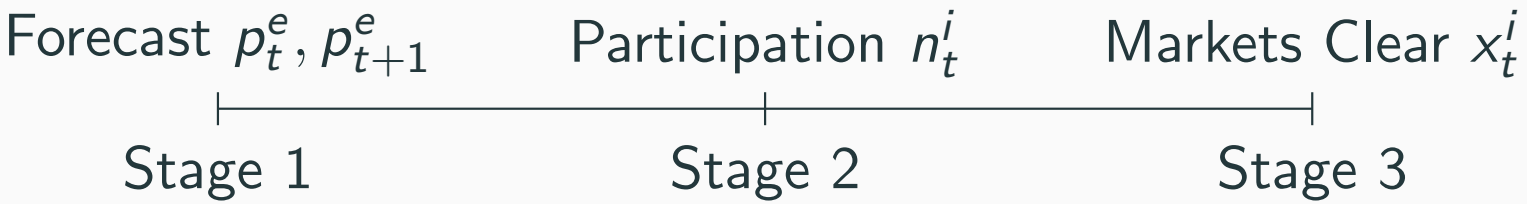
Subjects and Logistics

- 3 Treatments, 12 Sessions, 96 Subjects
- UC Irvine undergraduates
  - Diverse majors
  - Ages from 18 - 22
  - 40:60 Male to Female
- Average session $=$ 2 hours
- Average payment $=$ \$19
- Logistics
  - No communication
  - Instructions and quiz
  - Random seating

Experimental Design

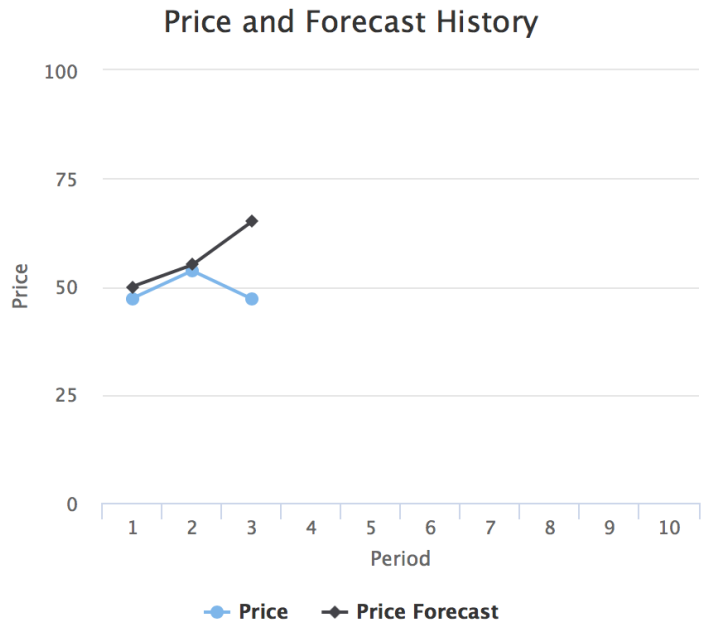
- 8 subjects are *advisors* to households
- 1 automated trader that always participates
- Subjects are told fundamentals: μ, R
- Subjects are paid on *forecasting accuracy* and *1-period return*
- *2 Tasks (50 periods)*: Payoffs
  1. Forecast stock prices p_t^e, p_{t+1}^e
  2. Participate in the stock market n_t^i
- *Automated auctioneer*: households' portfolio choice and clears market

Experimental Timeline



Experimental Screens

Forecast Price - Round 4



Round	Expected Price	Price	Participation Rate	Entry Payoff	Forecast Payoff
1	50.00	47.3	100%	0.00	3.40
2	55.00	53.65	100%	5.00	1.65
3	65.00	47.14	67%	0.00	0.70

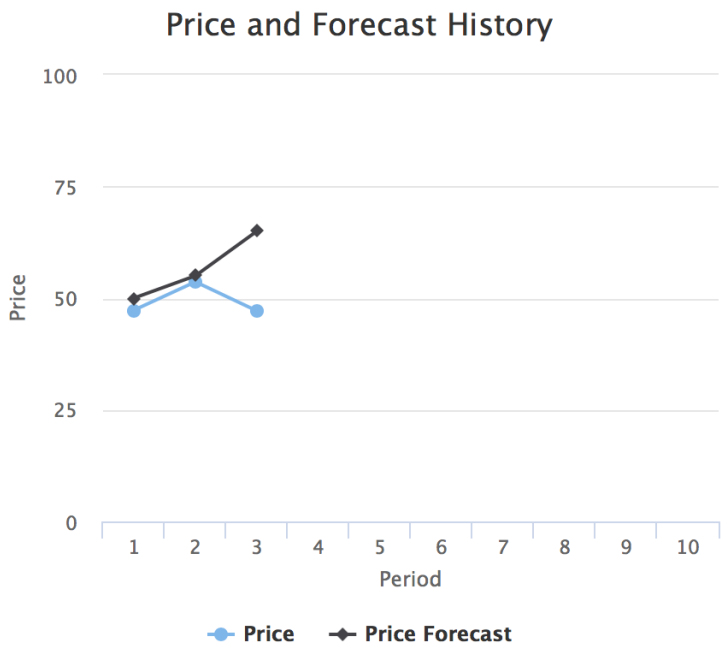
Predict the price in this round (your last prediction for this round was 54.00):

Predict the price in the next round:

Next

Experimental Screens

Participation - Round 4



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Do you want to participate this period? (Your cost of participating is 2.0. Your prediction for this round is 50.00 and next round is 55.00. You expect the manager's profits to be 4.5). :

- ○ No
- ○ Yes

Next

Parameterization and Treatments

Parameter	Meaning	Value
μ	Mean Dividend	3
R	Interest Rate	1.05
S	Supply	1
σ_S^2	Supply Shock	0.25

Table 2: Experimental Parameters

Treatment

	1	2	3
Part. Cost	$U[0, 0]$	$U[0, 1.5]$	$U[0, 4]$

Data

Individual Subjective Returns

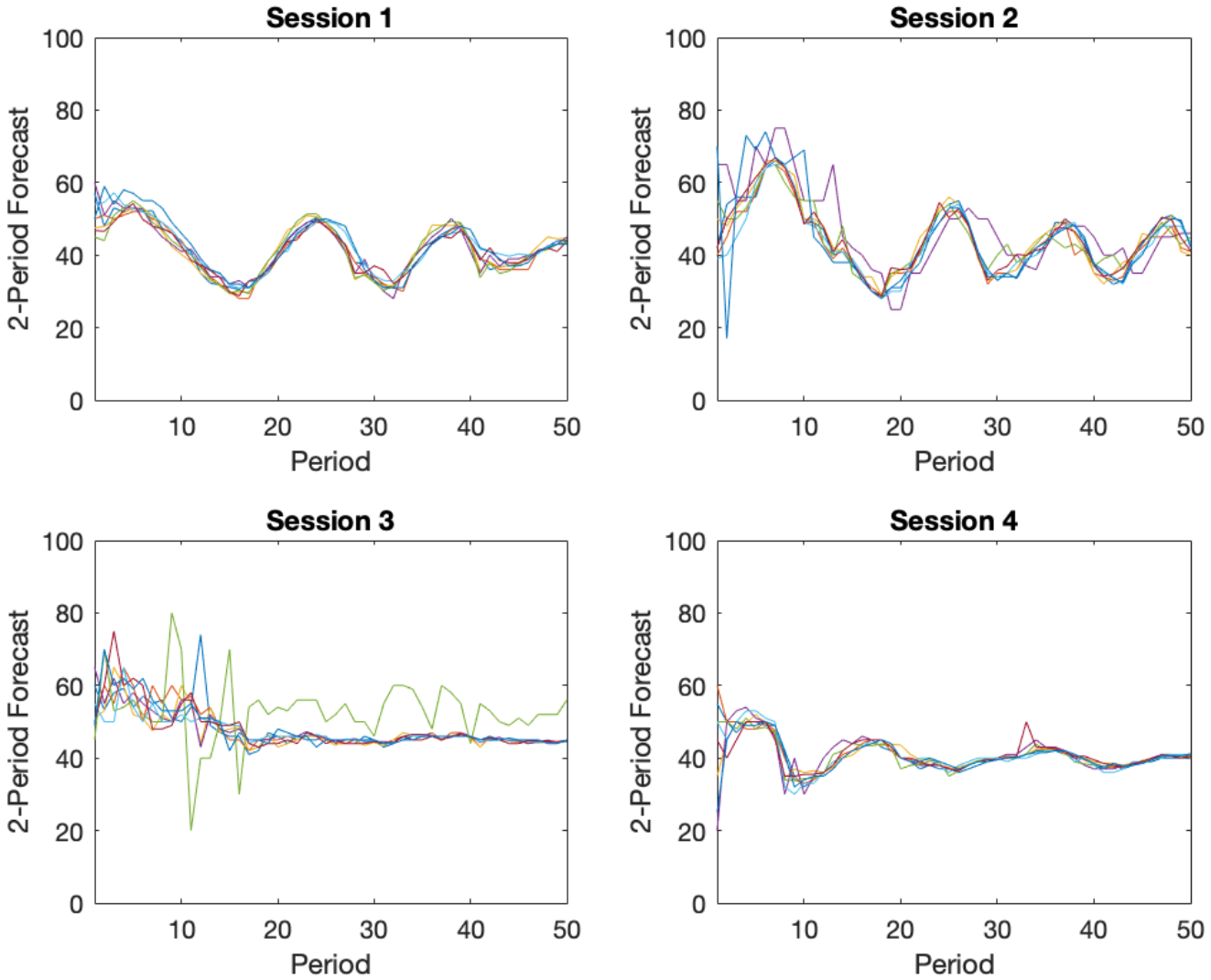


Figure 1. 2-Period Forecasts for Treatment 1 (No Cost).

Bar Graphs

Heterogeneous Subjective Returns

Treatment 1 (No Cost)			
	Mean	Std. Dev.	N
Subjective Returns	1.13	**3.44**	1632
Subjective Returns (Participants)	1.60	0.92	51
Subjective Returns (Non-Participants)	0.13	0.69	51
Treatment 2 (Low Cost)			
	Mean	Std. Dev.	N
Subjective Returns	0.44	**3.31**	1479
Subjective Returns (Participants)	1.42	1.20	51
Subjective Returns (Non-Participants)	-0.39	0.79	51
Treatment 3 (High Cost)			
	Mean	Std. Dev.	N
Subjective Returns	0.21	**4.59**	1632
Subjective Returns (Participants)	1.06	1.12	51
Subjective Returns (Non-Participants)	-0.89	1.42	51

Table 3: Net Subjective Returns by Treatment

Results

Subjective Returns and Participation Costs

Finding 1: *While higher induced participation costs $\bar{k}$ lowers the level of net subjective returns, subjects are not ordered based on participation costs k^i.*

Subjective Returns and Participation Costs

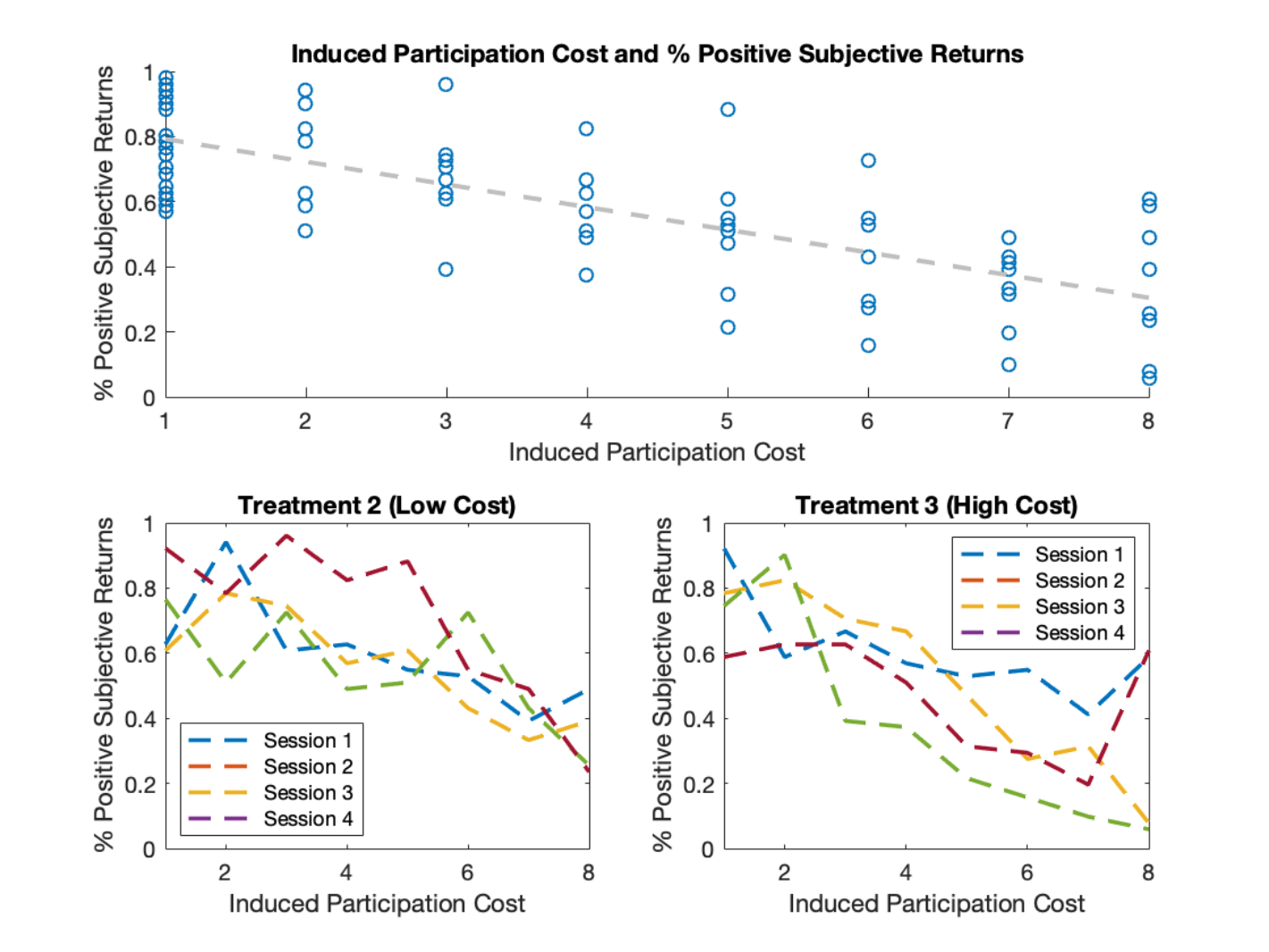


Figure 2. Participation Cost and Net Subjective Expected Returns by Treatment.

Subjective Returns and Participation

Finding 2: *The probability of participating in the stock market is increasing in subjective expected returns, lagged realized returns, lagged forecasting payoffs, and a price trend.*

Determinants of Participation

Table 4: Dependent Variable: Individual Participation n_t^i

Variable	Model 1	Model 2
Subjective Returns$_t$	**0.028*** **	**0.027*** **
	(0.009)	(0.009)
Actual Returns$_{t-1}$	**0.018*** **	0.004
	(0.005)	(0.006)
Forecast Payoff$_{t-1}$	0.019***	0.01*
	(0.006)	(0.006)
Risk Aversion	0.039	0.035
	(0.026)	(0.023)
Price Trend$_{t-1}$	0.013***	0.01**
	(0.005)	(0.004)
Past Positive Payoff$_{t-1}$		**0.181*** **
		(0.023)
Past Negative Payoff$_{t-1}$		0.003
		(0.03)
N	4704	4704
Pseudo R^2	0.157	0.172

Learning from Experience

Finding 3: *Subjects who participate in the stock market in the prior period and receive a low payoff, have lower subjective expected returns.*

Learning from Experience

Table 5: Dependent Variable: 2-Period, Forecast Trend

Variable	2-Period Forecast p^e_{t+1}	Forecast Trend $p^e_{t+1} - p^e_t$
Price_{t-1}	1.323***	
	(0.063)	
Price_{t-2}	-0.374***	
	(0.0618)	
$\text{Participation}_{t-1}$	0.962***	
	(0.248)	
Price Trend_{t-1}		0.0264
		(0.219)
$\text{Past Positive Payoff}_{t-1}$	**0.428***	-0.142
	(0.217)	(0.147)
$\text{Past Negative Payoff}_{t-1}$	**-0.525***	**-0.772*****
	(0.295)	(0.2)
N	4508	4508
R^2	0.883	0.025

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Interpretation

"Although "true experiences" differ ... market returns likely have positive correlation with actual personal experiences." -Malmendier and Nagel (2011)

- "Learning from Experience" *(Malmendier and Nagel 2011)*
- Individual experiences are main determinant
- **Limited participation can result from low subjective returns due to low realized returns**
- Low experienced returns $\Longrightarrow$ low subjective returns $\Longrightarrow$ low participation rates

Main Mechanism

"We think that differences in the way people use public information must underlie much of the variation in expectations that we observe." -Dominitz and Manski (2011)

- Provides micro evidence for *Dominitz and Manski (2011)*
- Direct evidence for *Experience Hypothesis*
- Mechanism: Differences in updating the public signal "prices"
- Experience hypothesis $\Longrightarrow$ differences in updating $\Longrightarrow$ heterogeneity in expectations $\Longrightarrow$ limited participation

Conclusion

- **Limited participation can result from low subjective returns due to low realized returns**
- Write down a model of limited participation
- Bring model to the lab to elicit *expectations* and *participation*
- Takeaway:
  - Experiences (both individual and social) are an important mechanism in differences in subjective beliefs
  - Mechanism: Differences in updating the public signal "prices"

Literature Review

- **Limited Participation**:
  - *Mankiw and Zeldes (1991), Allen and Gale (1994), Haliassos and Bertaut (1995), Orosel (1998), Guiso et al (2002), Campbell (2006), Guiso and Sodini (2013), Shin (2018)*
- **Learning-to-Forecast (LtF)**:
  - *Marimon and Sunder (1993), Hommes et al (2005), Hommes (2011), Duffy (2016)*
- **Learning and Asset Pricing**:
  - *Timmermann (1993, 1994), Malmendier and Nagel (2011), Branch and Evans (2010, 2011), Adam et al (2017)*
- First paper to test limited stock market participation in the laboratory

Payoffs

- Forecasting Payoff:

$$\pi^f_{i,t} = \frac{16}{|p_t - p^e_{t,t}| + |p_t - p^e_{t,t-1}| + 2}$$

- Participation Payoff:

$$\pi^e_{i,t} = \begin{cases} \min\{5, 3 + MP_t\} & \text{if } n^i_t = 1 \text{ in t-1 and } MP_t \geq 0 \\ \max\{1, 3 + MP_t\} & \text{if } n^i_t = 1 \text{ in t-1 and } MP_t \leq 0 \\ 3 & \text{if } n^i_t = 0 \end{cases}$$

- where $MP_t = p_t + \mu - Rp_{t-1} - k^i$
- If cost is too high, lose payoff from participating Design

Individual Price Series

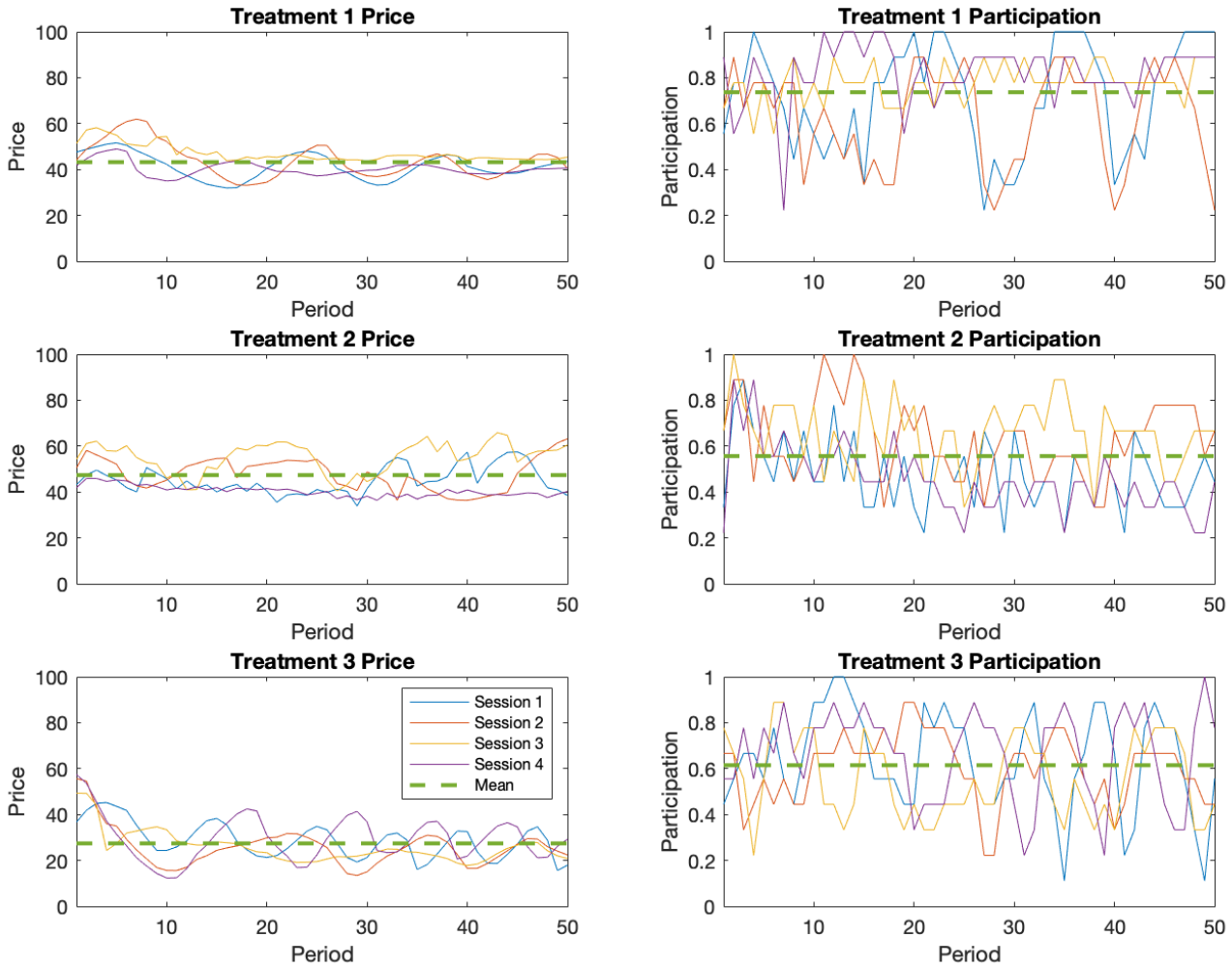
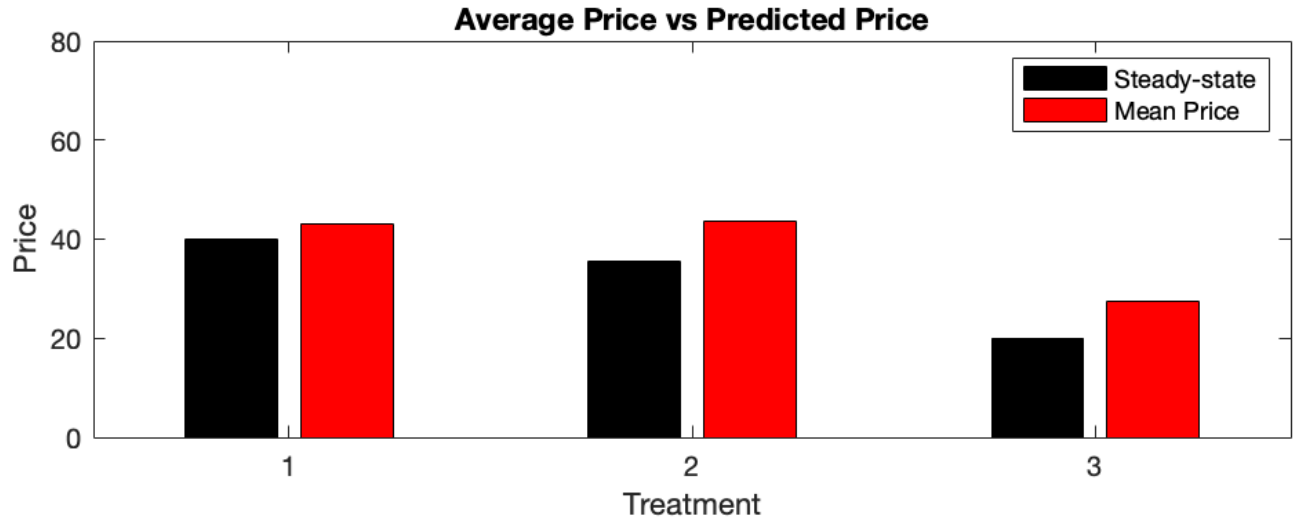


Figure A. Prices and Participation Rates by Treatment. Finding 1

Price and Participation Rates



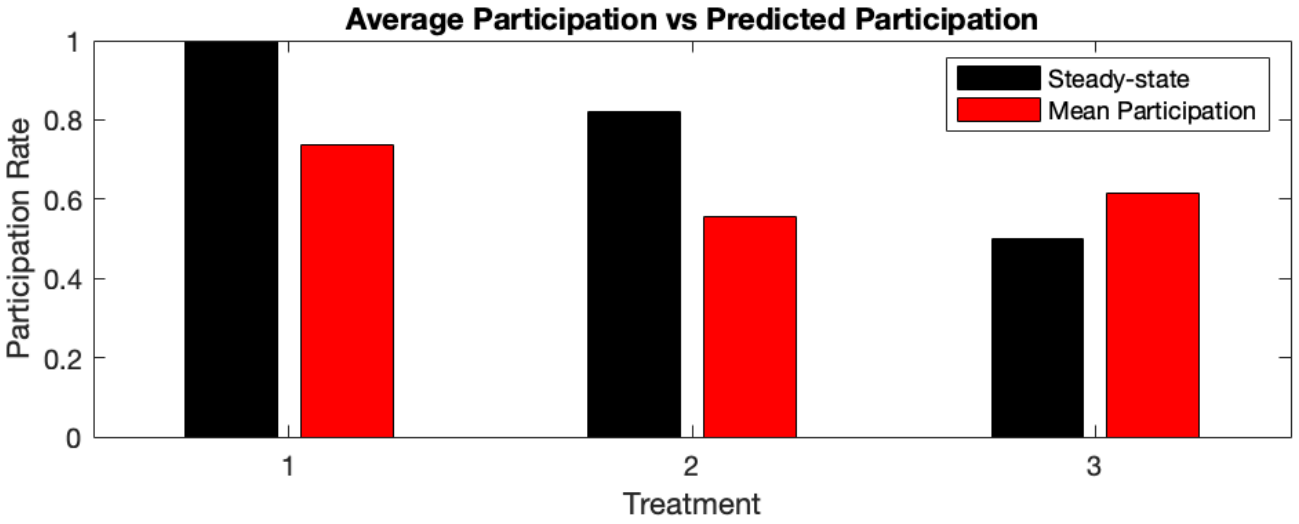


Figure B. Prices and Participation Rates by Treatment.

Explanation for Treatment 2

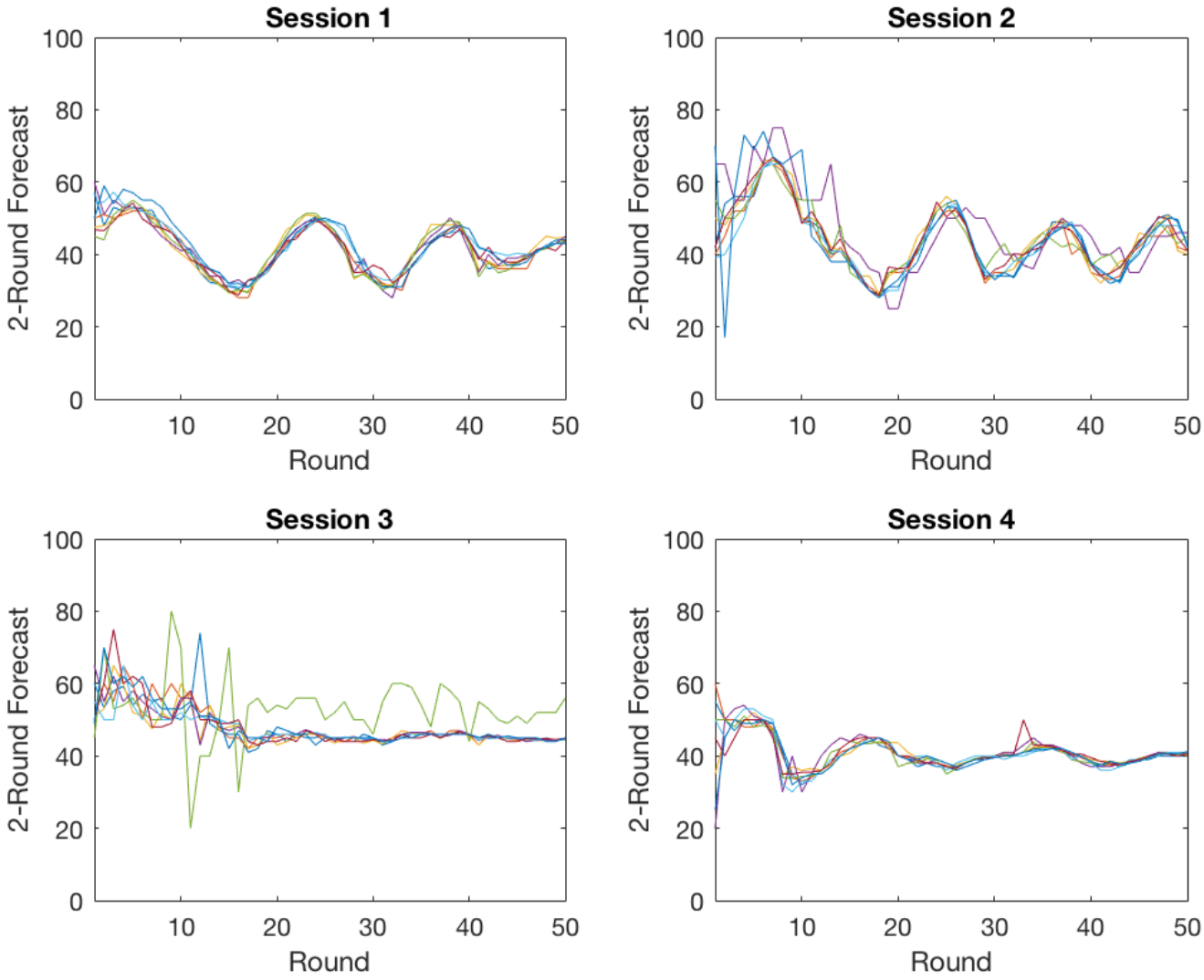


Figure C. 2-Period Forecasts for Treatment 1 (No Cost).

Explanation for Treatment 2

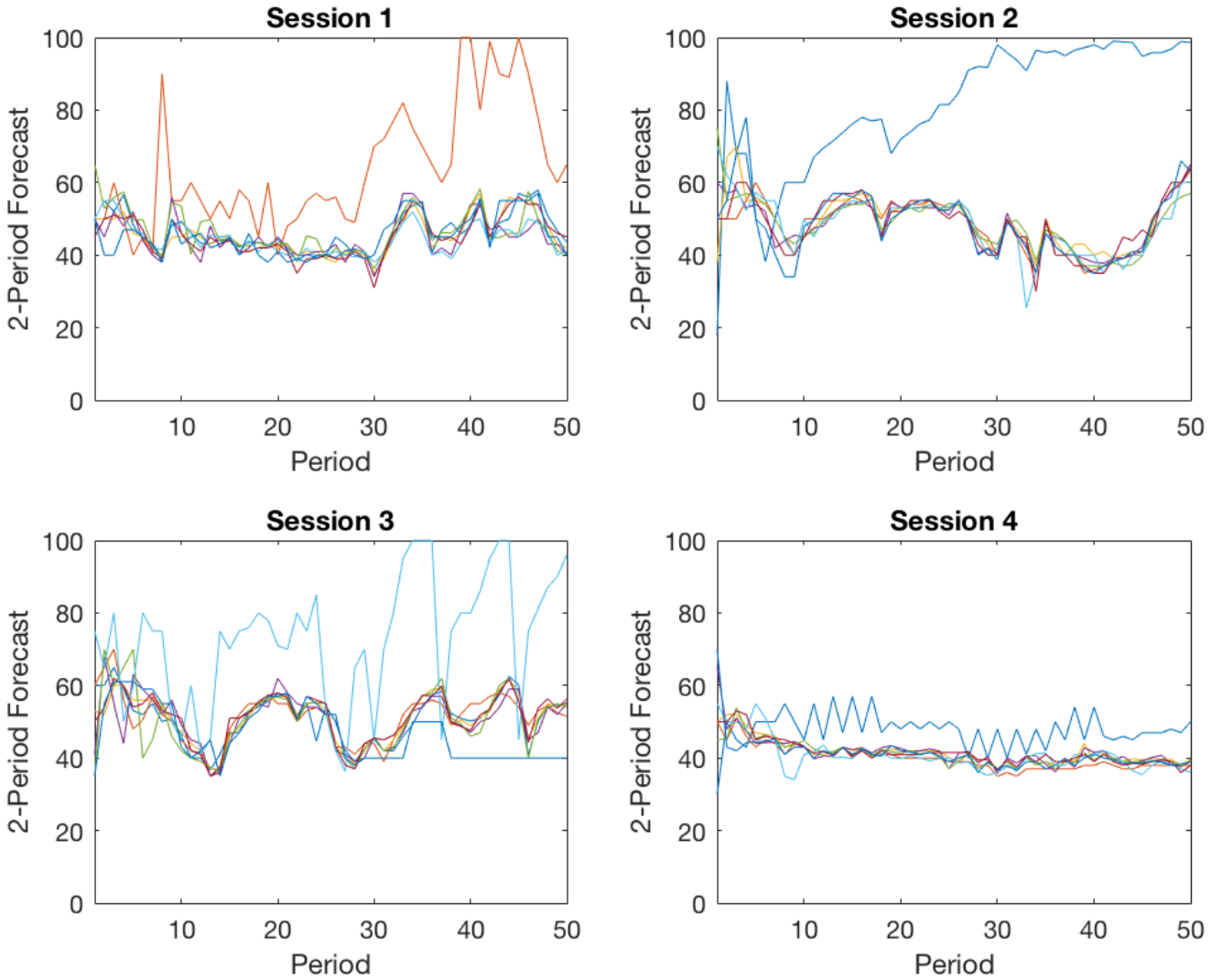


Figure D. 2-Period Forecasts for Treatment 2 (Low Cost).