Animal Spirits, Heterogeneous Expectations and the Amplification and Duration of Crises

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Animal Spirits (Keynes)

much of (macro)economic activity is governed by **animal spirits**

- people have **non-economic motives**
- they are **not always rational** in pursuit of economic interests

Keynes: animal spirits are the main source of economic fluctuations

... but animal spirits **disappeared** from the neoclassical, rational model

Animal Spirits (Akerlof and Shiller, 2009)

How human psychology drives the economy, and why it matters for global capitalism

5 animal spirits: confidence, fairness, corruption, money illusion and stories

- **cornerstone** animal spirit: **confidence**
- **behavioral economics**: how the economy really works, when people are human
- animal spirits **difficult** to conceptualize, model and measure

Goal of this paper: dynamic equilibrium model of agents' confidence

Main Result: sudden collapse of confidence **accelerates** and **amplifies** downturn or crisis and **slows down** recovery

Main hypothesis: heterogeneous expectations

Brock and Hommes, 1997

main tool for modeling confidence in market for loans

- lenders' **heterogeneous expectations** about the (exogenous) **probability of succes**/failure of borrowers

Main finding:

- In the presence of a (small) **fraction of pessimistic beliefs**, an unexpected **negative shock** to credit markets triggers these pessimistic beliefs to become **self-fulfilling**, **amplifying** a "crisis" and **slowing down** recovery

Plan of the Talk

- Heterogeneous Expectations Model Heuristics Switching Model
- Learning to Forecast Experiments
- a simple heterogeneous expectations model of the crisis

Some Literature Related to this Talk

- Hommes, C.H. (2011) The Heterogeneous Expectations Hypothesis: Some Evidence from the Lab, *Journal of Economic Dynamics & Control*, 35, 1-24.
- Assenza, T., Brock, W.A. and Hommes, C.H. (2011), Animal Spirits, Heterogeneous Expectations and the Amplification and Duration of Crises

Heterogeneous Expectations Heuristics Switching Model

- agents choose from a number of simple **forecasting heuristics**
- **adaptive learning**: some parameters of the heuristics are updated over time, e.g. anchor $\equiv$ average
- **performance based reinforcement learning:**
  (extension of Brock and Hommes, *Econometrica* 1997)
  agents evaluate the **performances** of all heuristics, and tend to **switch** to more successful rules; **impacts are evolving** over time

Four forecasting heuristics

- adaptive rule

$$\text{ADA} \quad p^e_{1,t+1} = 0.65\, p_{t-1} + 0.35\, p^e_{1,t}$$

- weak trend-following rule

$$\text{WTR} \quad p^e_{2,t+1} = p_{t-1} + 0.4\,(p_{t-1} - p_{t-2})$$

- strong trend-following rule

$$\text{STR} \quad p^e_{3,t+1} = p_{t-1} + 1.3\,(p_{t-1} - p_{t-2})$$

- anchoring and adjustment heuristics with learnable anchor

$$\text{LAA} \quad p^e_{4,t+1} = 0.5\, p^{av}_{t-1} + 0.5\, p_{t-1} + (p_{t-1} - p_{t-2})$$

Evolutionary Switching

Brock and Hommes, (*Econometrica* 1997)

- performance measure of heuristic i is

$$U_{i,t-1} = -\left(p_{t-1} - p^e_{i,t-1}\right)^2 + \eta\, U_{i,t-2}$$

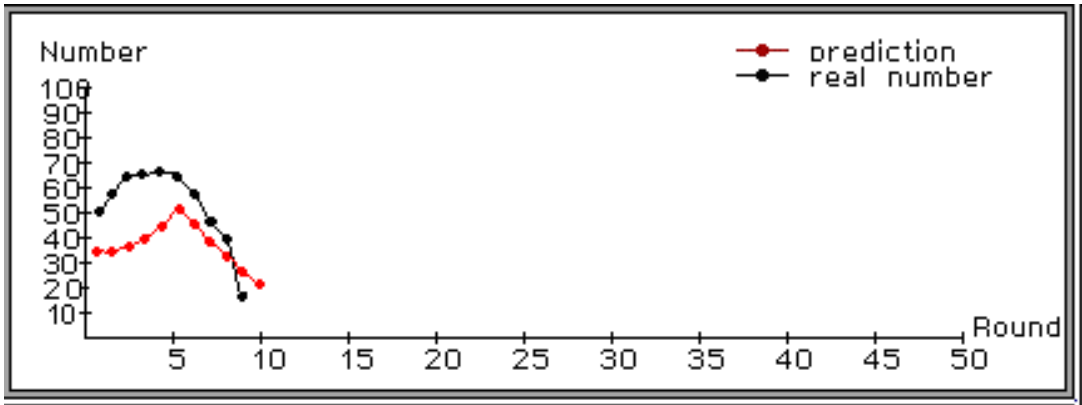
parameter $\eta \in [0,1]$ – the strength of the agents' memory

- discrete choice model with asynchronous updating

$$n_{i,t} = \delta\, n_{i,t-1} + (1-\delta)\, \frac{\exp(\beta\, U_{i,t-1})}{\sum_{i=1}^{4} \exp(\beta\, U_{i,t-1})}$$

parameter $\delta \in [0,1]$ – the inertia of the traders
parameter $\beta \geq 0$ – the intensity of choice

Computer Screen Learning to Forecast Experiment



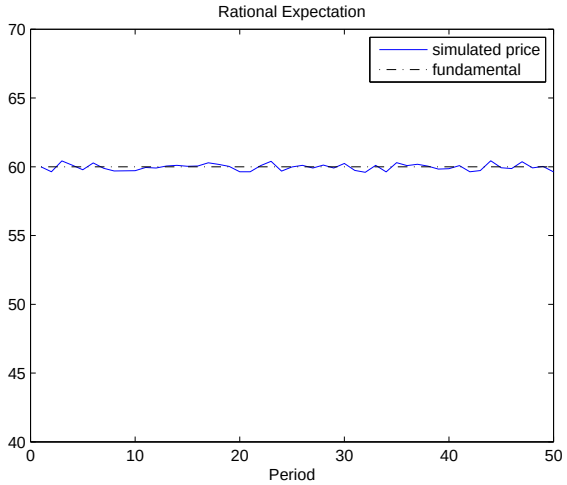
Total earnings:	earnings this period:	Remaining time:
10357	1298	00

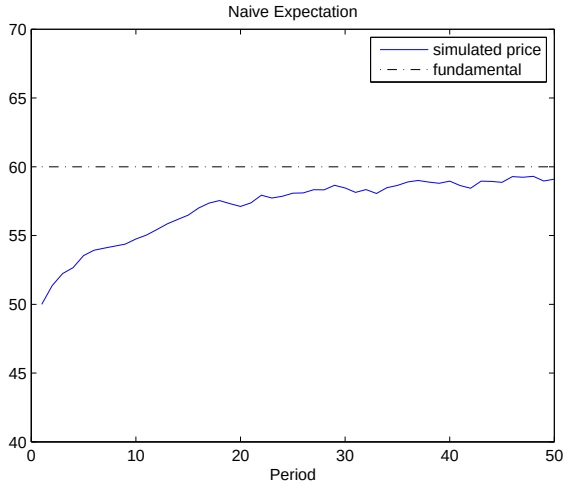
What is your prediction this period?
Your prediction must be between 0 and **100**

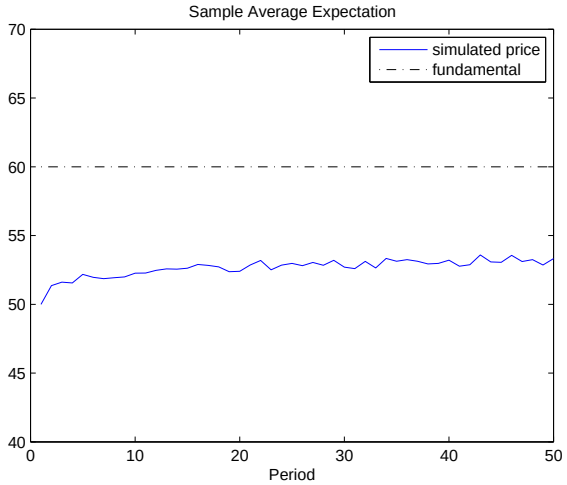
Prediction:

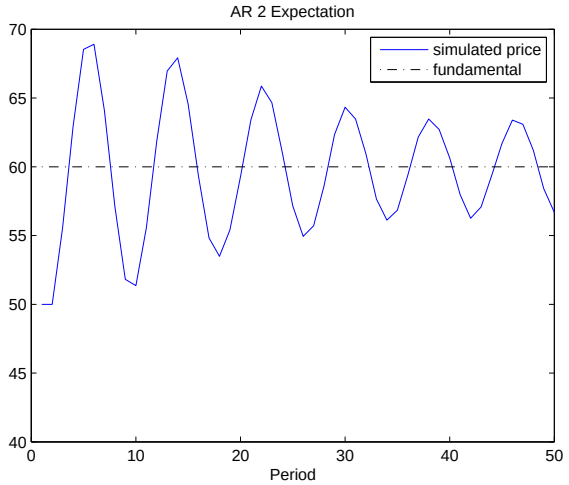
Round	Pre-diction	real value
1	33.70	50.23
2	33.70	56.63
3	37.00	65.32
4	40.10	65.00
5	43.50	66.12
6	50.00	64.53
7	48.35	58.35
8	38.70	42.35
9	30.10	40.01
10	28.25	

Asset Pricing Experiment Simulation Benchmarks

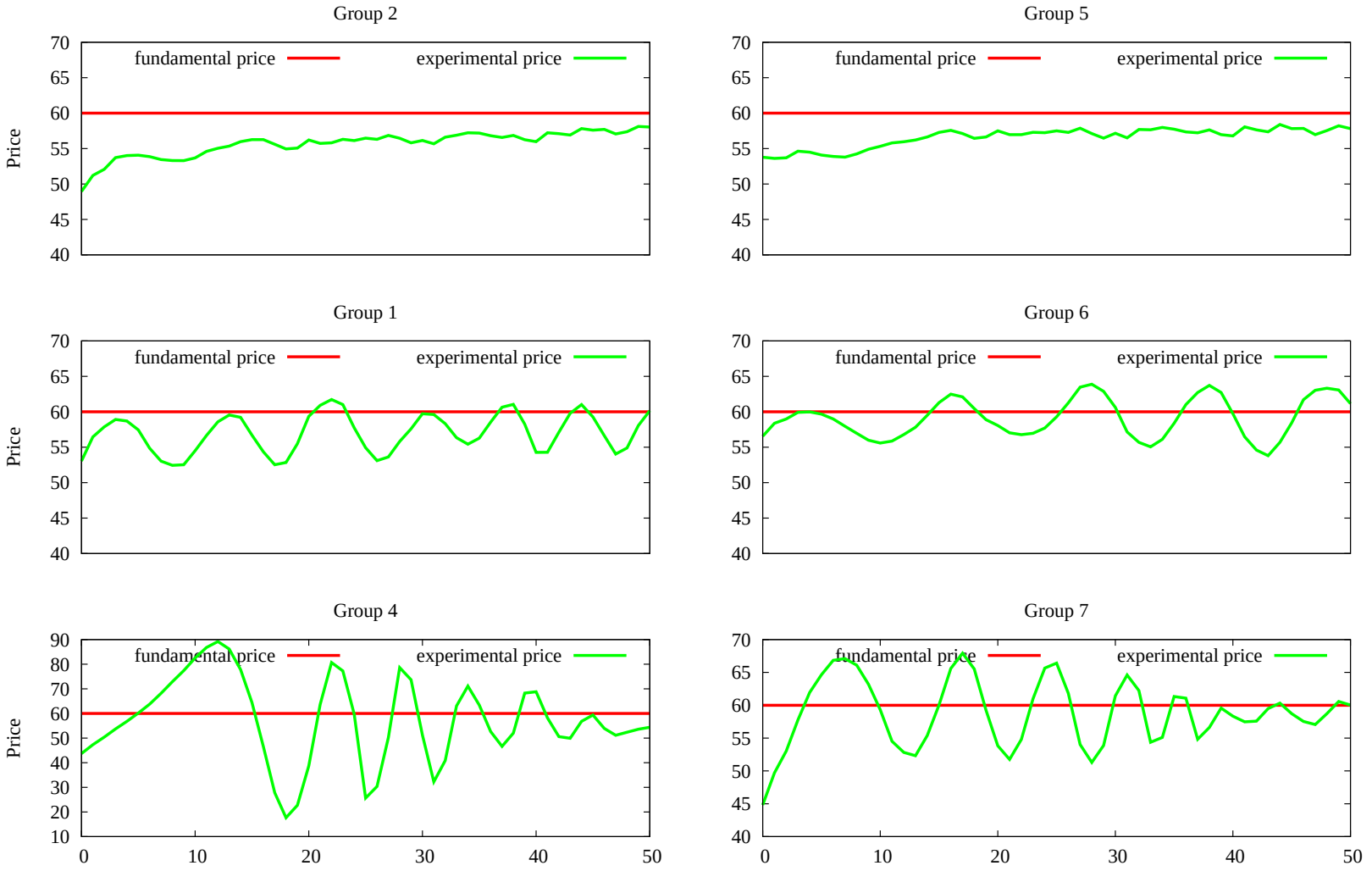








Asset Pricing Experiment (with Robot Trader)



Stochastic Simulations (one step ahead forecast)

Anufriev and Hommes (2009)

- uses **past experimental data**
- **same information** as participants in experiments

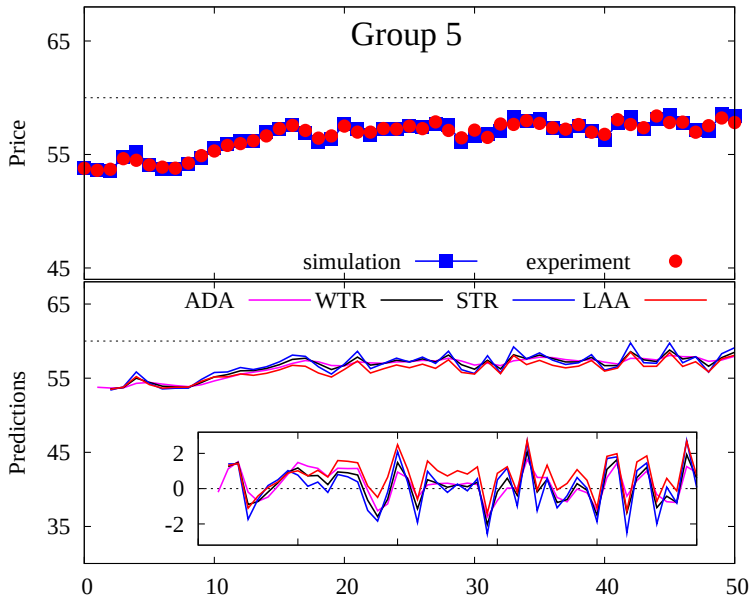
Parameters fixed at: $\beta = 0.4, \eta = 0.7, \delta = 0.9$

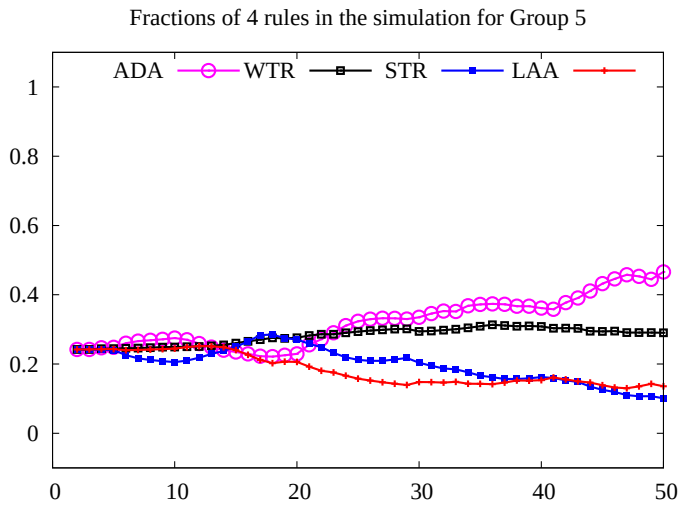
- initial fractions **equal**, i.e. $n_{ht} = 0.25$
- initial prices **as in experiments**

Group 5 (Convergence)

experimental prices
simulated prices, predictions and errors

Parameters: $\beta = 0.4, \eta = 0.7, \delta = 0.9$

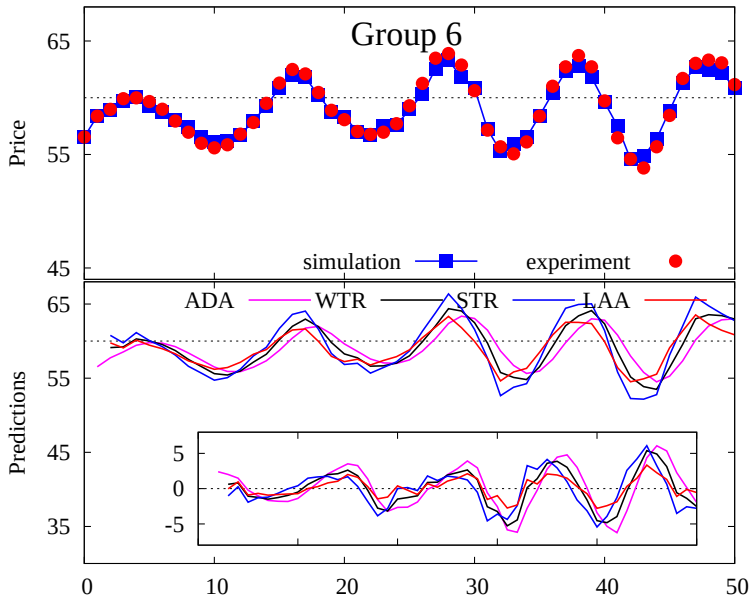


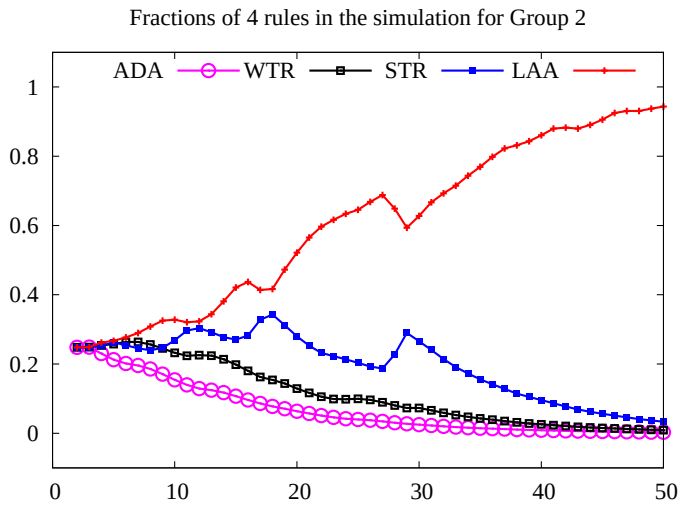


Group 6 (Constant Oscillations)

experimental prices
simulated prices, predictions and errors

Parameters: $\beta = 0.4, \eta = 0.7, \delta = 0.9$

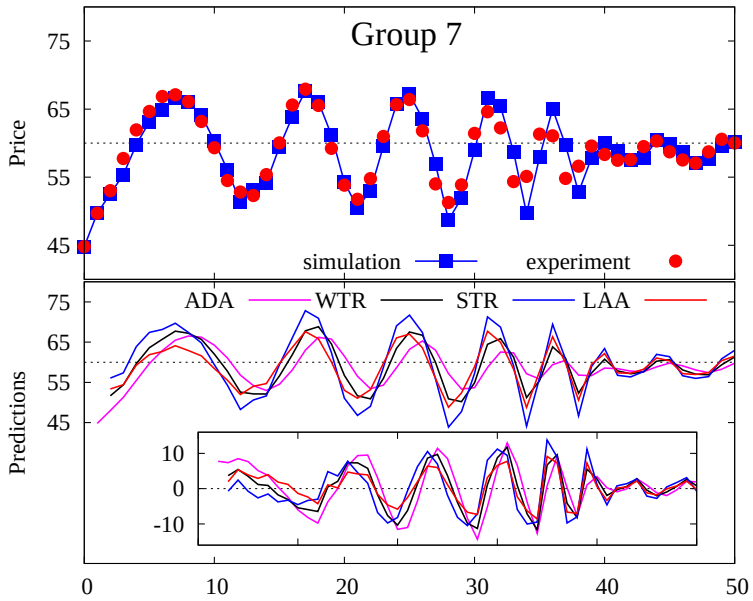


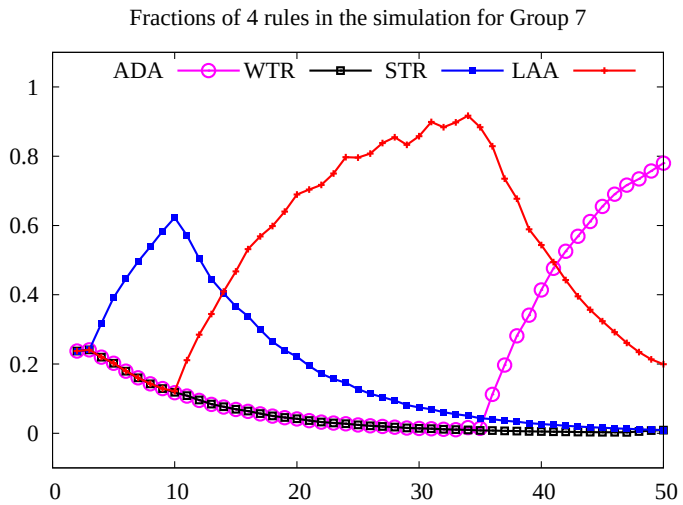


Group 7 (Damping Oscillations)

experimental prices
simulated prices, predictions and errors

Parameters: $\beta = 0.4, \eta = 0.7, \delta = 0.9$





Conclusion based on Experiments

- simple **heterogeneous expectations heuristics switching model** fits experimental data quite nicely
- **performance based reinforcement learning:** (extension of Brock and Hommes, *Econometrica* 1997) agents evaluate the **performances** of all heuristics, and tend to **switch** to more successful rules; **impacts are evolving** over time
- agents use simple heuristics such as
  - **adaptive expectations**
  - **trend following rules**
  - **anchor and adjustment rules**