
Emergence of Cooperative Long-lasting Loyalty in Double Auction Markets

Aleksandra Aloric
King's College London

Motivation

- Always buy from the same merchants?
 - Loyalty by design

Motivation

- Always buy from the same merchants?
 - Loyalty by design
 - CAT tournaments indicate loyalty can arise as consequence of coadaptation
-

Motivation

- Always buy from the same merchants?
 - Loyalty by design
- CAT tournaments indicate loyalty can arise as consequence of coadaptation

AIM

- Design stylized model of agents choosing among multiple markets to investigate whether loyalty can emerge spontaneously
-

Model

Aloric et al. (2015) Advances in Artificial
Economics

Aloric et al. (2016) PloS ONE

2 Double Auction markets

- Discrete time
- Globally set trading price

Agents

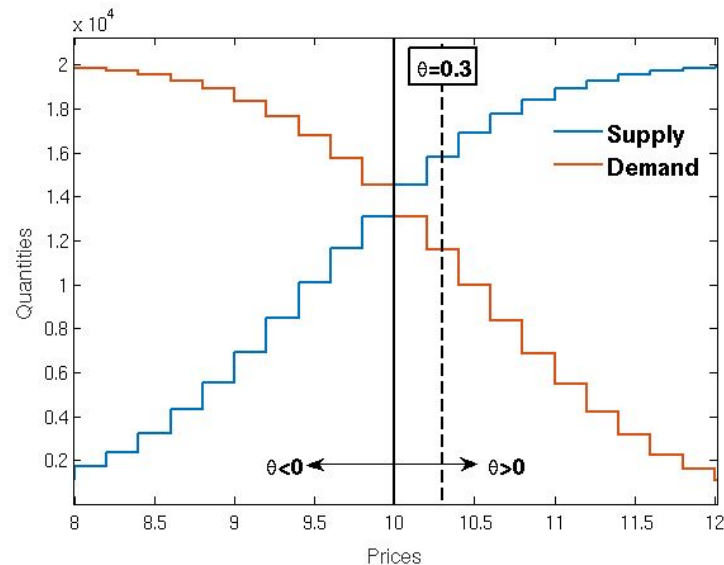
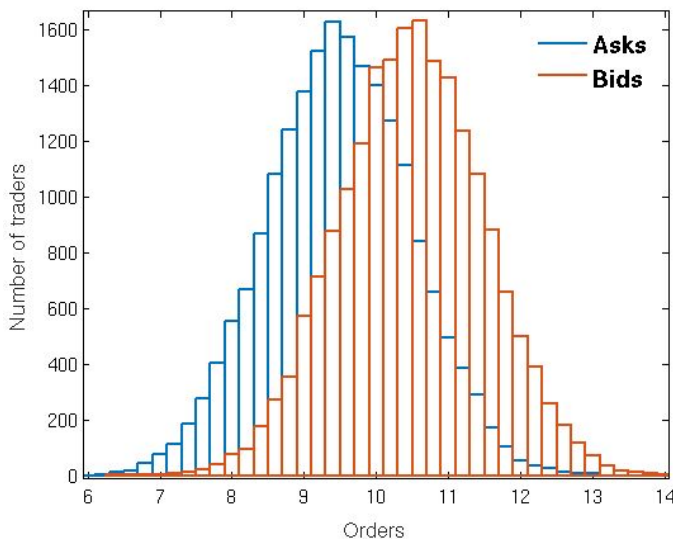
- Choosing Strategy
 - Trading Strategy
-

Markets

- Executes trades based on which traders evaluate returns
 - Sets a global trading price based on submitted bids and asks
 - $\pi = \pi^{\text{eq}} + \theta(\langle b \rangle - \langle a \rangle)$
 - Matches buyers to sellers
 - No limit order book
-

Markets - price setting

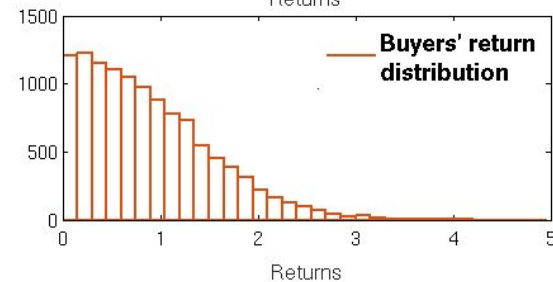
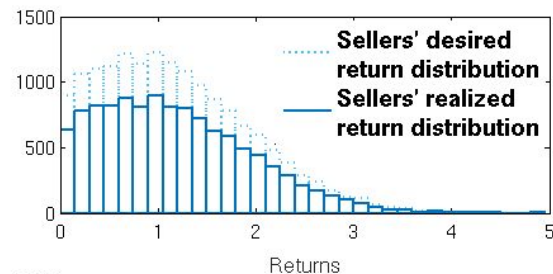
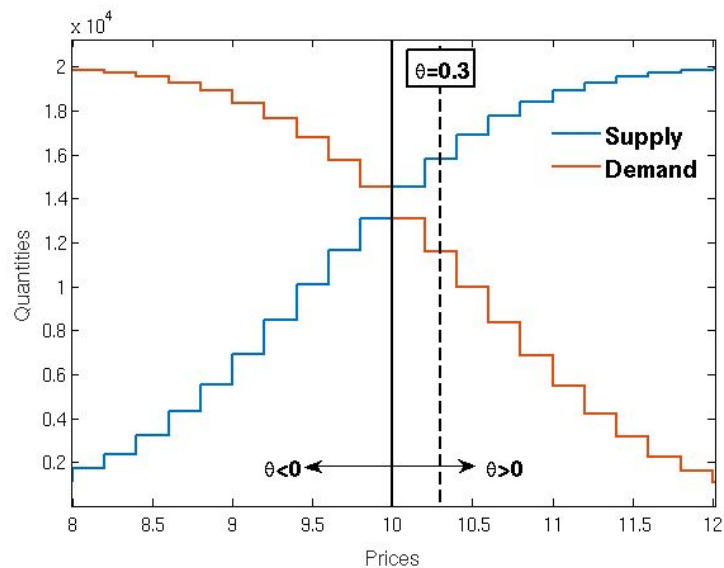
$$\pi = \pi^{\text{eq}} + \theta(\langle b \rangle - \langle a \rangle)$$



Markets - returns

$$S_{Sm}(n) = \pi_m(n) - a(n)$$

$$S_{Bm}(n) = b(n) - \pi_m(n)$$



Agents - Choosing strategy

- Where to trade? (which market)
- How to trade? (to buy or to sell)



Agents - Choosing strategy

- Where to trade? (which market)
- How to trade? (to buy or to sell)
- Decision is based on **attractions**:



$$A_{\gamma}(n+1) = \begin{cases} (1-r)A_{\gamma}(n) + rS_{\gamma}(n), & \text{if agent has chosen action } \gamma \\ (1-r)A_{\gamma}(n), & \text{otherwise} \end{cases}$$

$$\gamma \in \{B1, S1, B2, S2\}$$

r - forgetting rate

$S_{\gamma}(n)$ - score received during trading period n , when action γ is taken

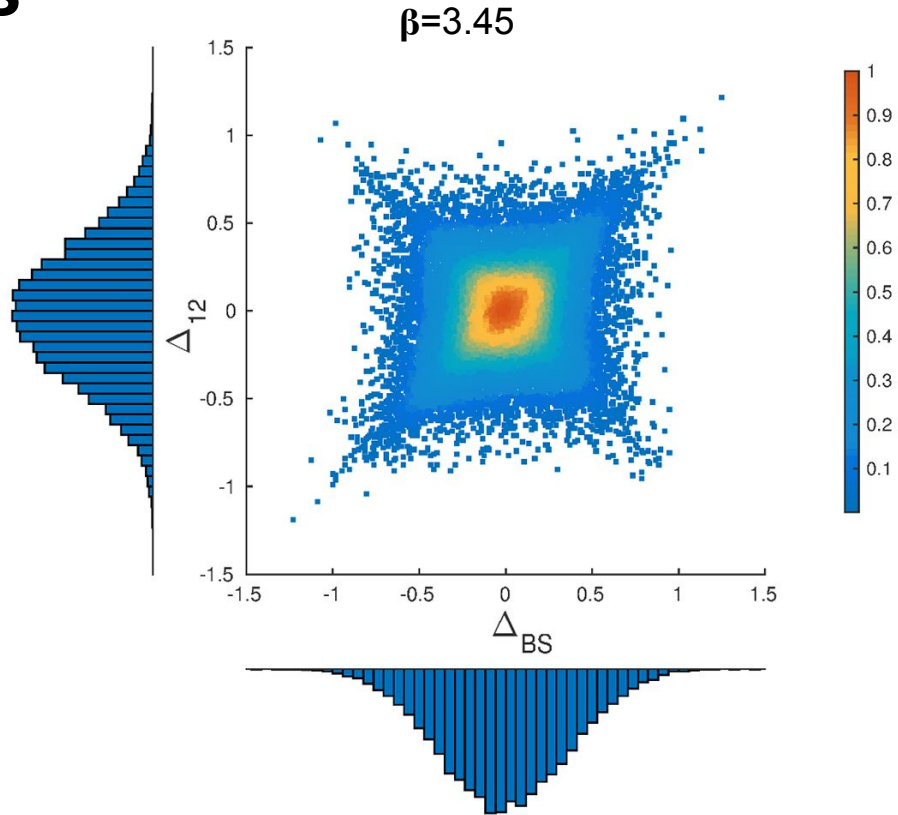
$$p_{\gamma} \propto \exp(\beta A_{\gamma}), \quad \beta \text{ intensity of choice}$$

Agents - Trading strategy

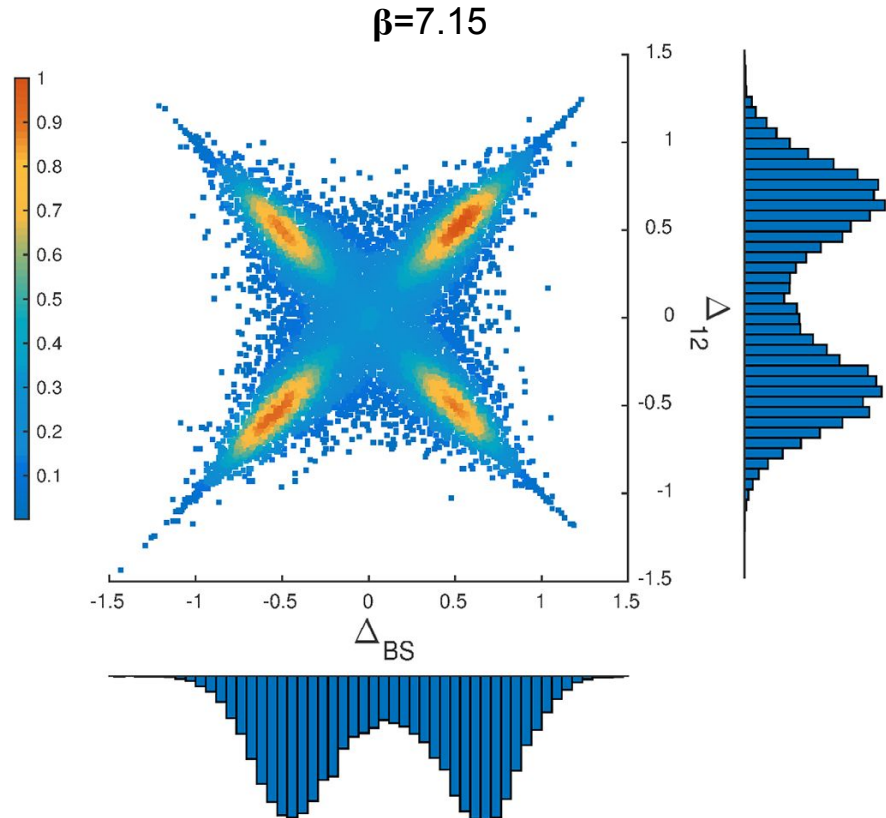
Zero Intelligence Traders

- Bids/Asks are iid Gaussian random variables
 - No dependence on previous success
 - No information about other traders
 - No wealth constraint
 - Want to trade 1 unit of stock per trading period
-

Numerical Results



Numerical Results

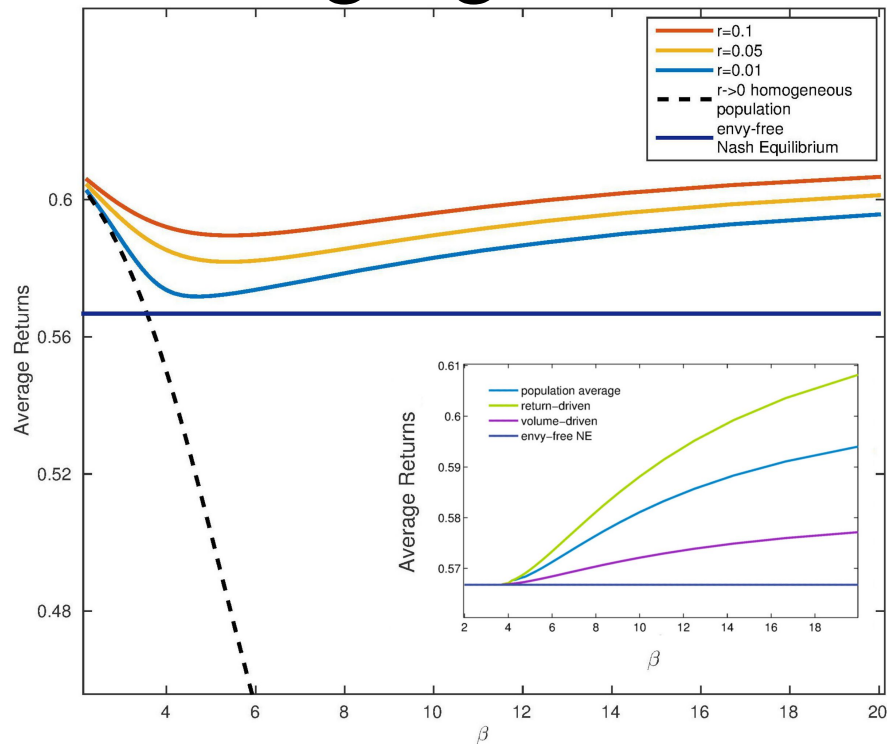


Analytical Model

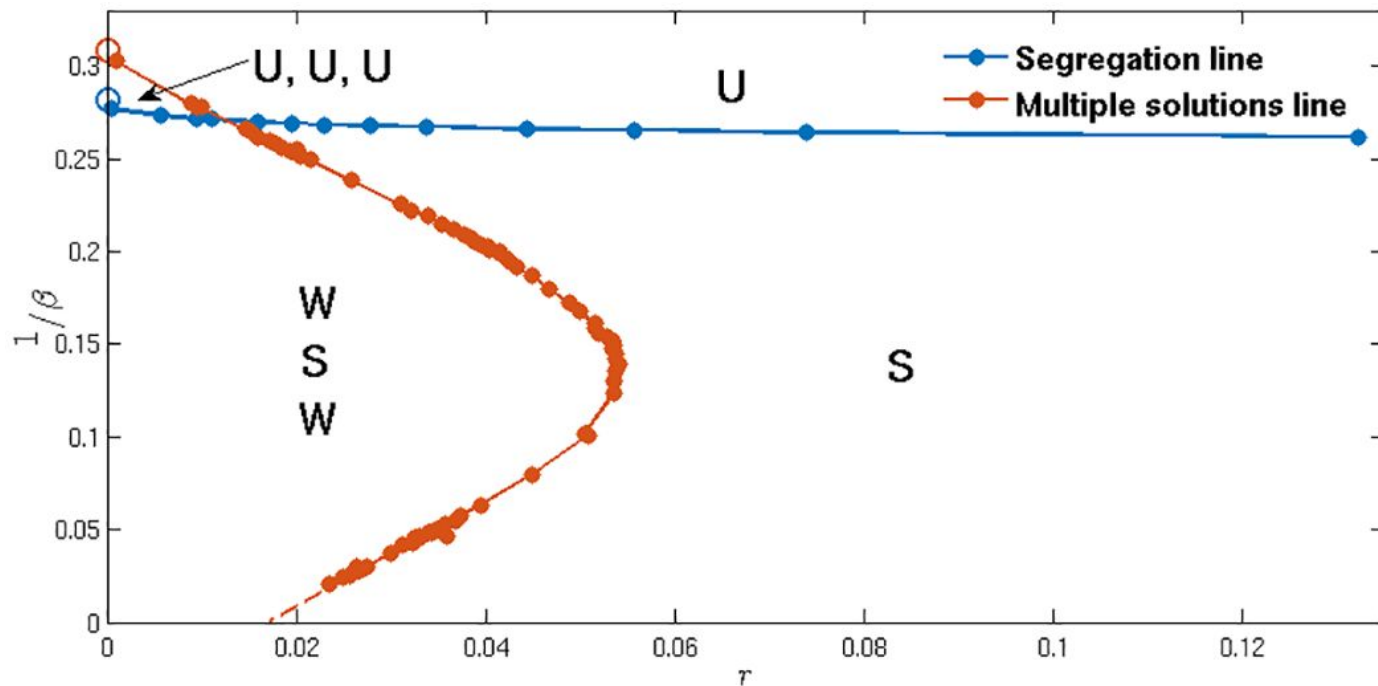
Agents with fixed Buy-Sell
preferences

- Agents' preference for Buying (Selling) non adaptive - determined on input
 - Only choice is where to trade
 - Still develop loyalty in simulations, but easier to analyse
-

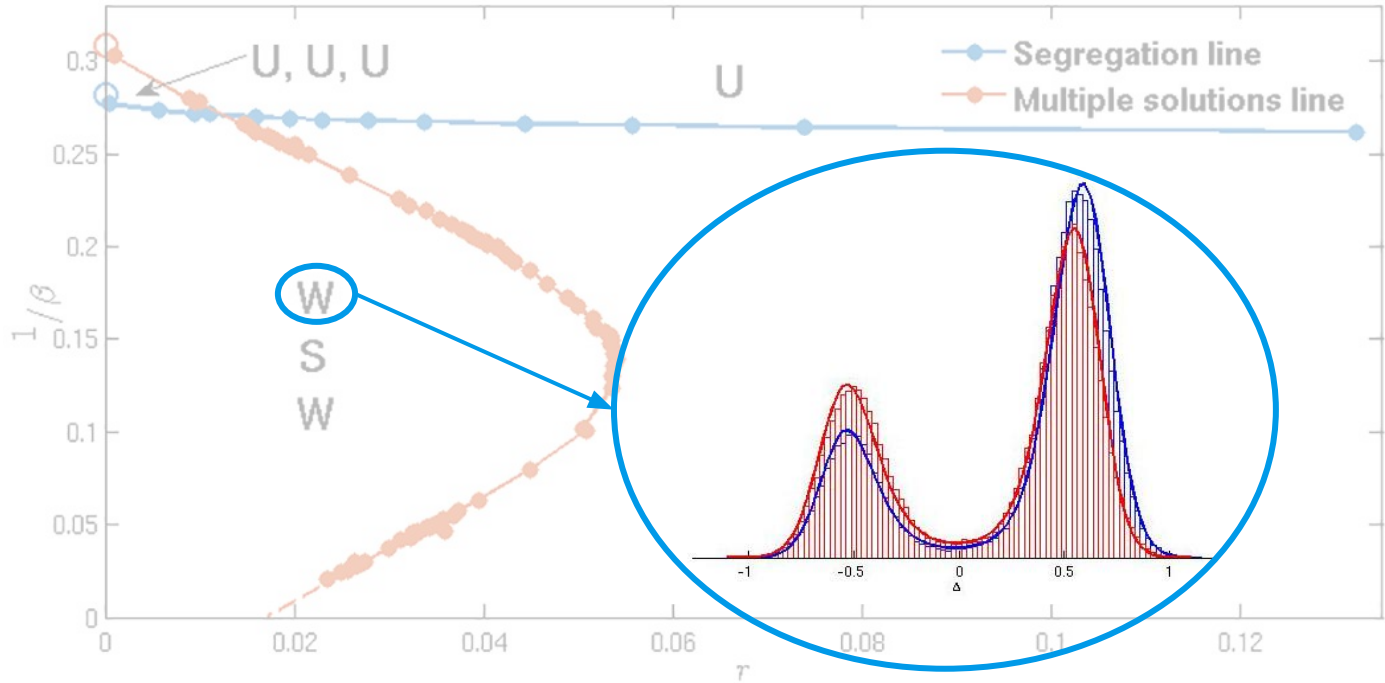
Benefits of Segregation



Phase Diagram



Phase Diagram



Robustness

- Assumptions on Bid/Ask distributions
 - Reinforcement learning
 - Wealth constraints
 - More sophisticated trading strategies
 - Continuous Double Auction Market
-

Summary

- Simple numerical model of double auction markets
 - Observed long lasting loyalty for certain range of parameters
 - Above critical intensity of choice β : the system is stabilized by traders who persistently chose to trade at suboptimal market - **cooperative trade-enabling action**
 - Even the volume driven agents benefit from segregated state
 - Adaptation/Learning is the key driver of segregation
-

Thank you for the attention!

aleksandra.aloric@gmail.com
