Discussion of *Bounded Rationality, Reinforcement Learning, and Market Efficiency*

Overview

- Excellent paper!
- Result 1: Model-free simple RL strategies→ REE
  - Contribution: A novel insight into how market efficiency can emerge from boundedly rational learning
- Result 2: Solves analytically intractable extensions (e.g., financial constraints, changing informed fraction) via RL
  - Contribution: Generate solution benchmarks for analytically unsolvable models, illustrating the practical power of AI methods in economic equilibrium analysis
- Connecting machine learning methods with classic finance theory on information and prices

Are uninformed investors genuinely behaving like RL algorithms?

- It may help readers if the authors explicitly justify RL as a model of bounded rationality
- RL-like adaptive behavior supported by recent behavioral research (Barberis & Jin, 2023)
- Empirical evidence from field studies confirming RL patterns in investor decisions (Sun, 2023)

RL vs. intractable REE (if it exists)

- No guarantee the RL strategy approximates the true theoretical optimum
- RL searches in a subset of functions – limited by the NN architecture→ approximation error likely if the REE strategies lie outside representable class
- Converged policy may be a local optimum (due to the non-convexity)

RL vs. intractable REE (if it exists)

- Robustness check 1: Vary NN architecture and RL method (e.g., actor-critic)
- Robustness check 2:

Evolution Strategies as a Scalable Alternative to Reinforcement Learning

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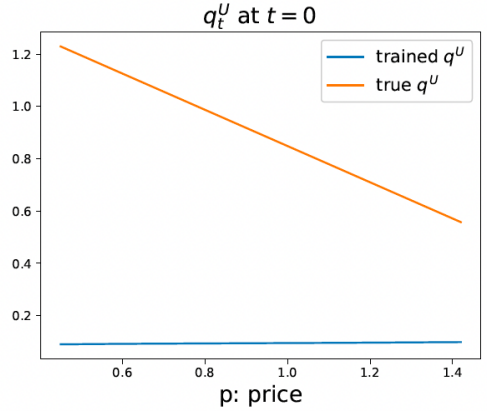
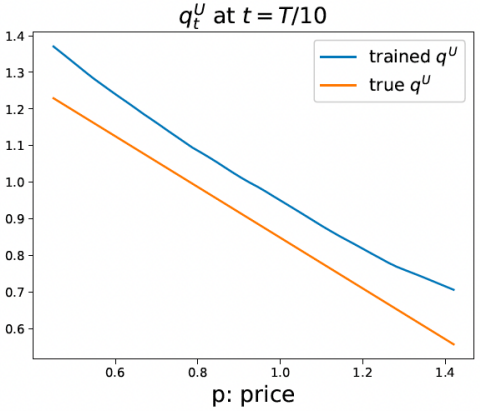
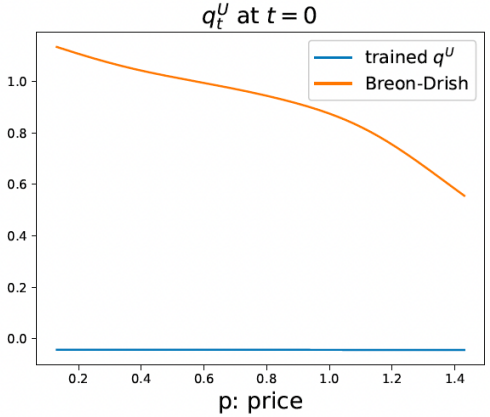
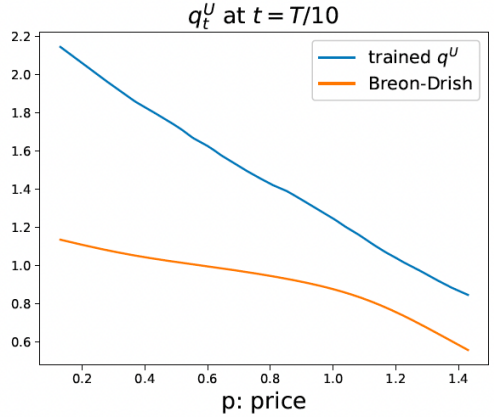
- It could be valuable to further establish theoretical bounds on the difference between RL-derived solutions and REE, if the REE exists

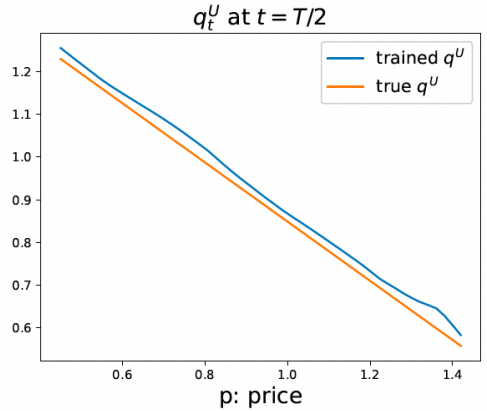
Interesting Learning Pattern

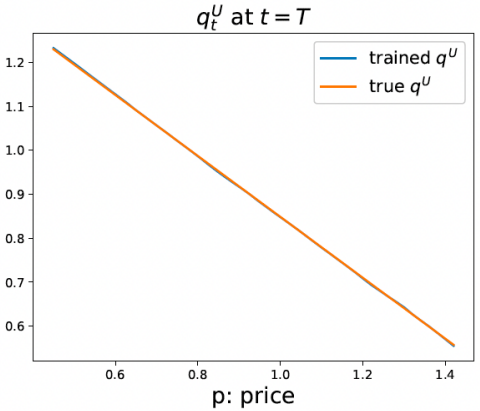


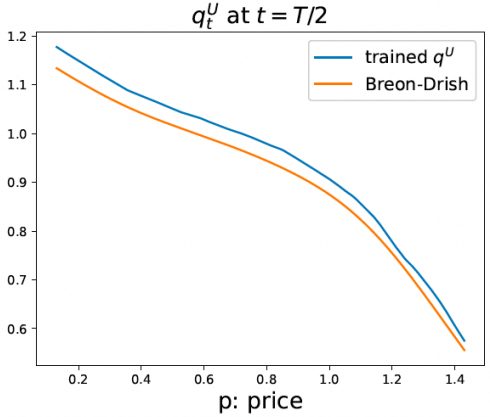


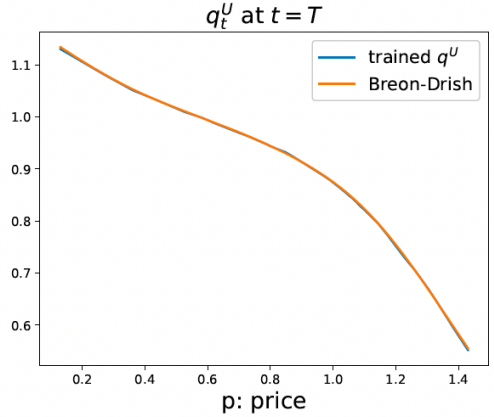












Interesting Learning Pattern

- Learned RL demand consistently overshoots theoretical demand despite zero initialization
- Is this learning bias potentially model-specific or more general?
  - Vary NN architectures, and hyper parameters
  - Use alternative RL methods (e.g., Q-learning or actor-critic) to examine if similar overshooting patterns emerge
- Could laboratory experiments or field data confirm similar patterns in real investor behavior?

Conclusion

- Excellent paper!
- Remarkably clear, well-executed
- Best wishes to the paper!

References

- Barberis, N.C. and Jin, L.J., 2023. *Model-free and model-based learning as joint drivers of investor behavior* (No. w31081). National Bureau of Economic Research.
- Salimans, T., Ho, J., Chen, X., Sidor, S. and Sutskever, I., 2017. Evolution strategies as a scalable alternative to reinforcement learning. *arXiv preprint arXiv:1703.03864*.
- Sun, C., 2023. Personal experience effects across markets: Evidence from NFT and cryptocurrency investing. *Available at SSRN 4589481*.