Active and Passive Learning in Agent-based Financial Markets

| Article | Published: 28 December 2010

| Volume 37, pages 35–43, (2011) Cite this article

Eastern Economic Journal

Aims and scope →

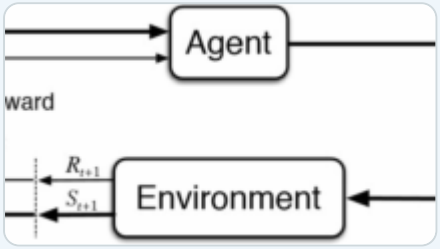
Submit manuscript →

Blake LeBaron[1]

Abstract

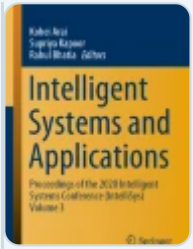
This short note compares and contrasts two forms of learning which are present in most agent-based financial markets. First, passive learning refers to a form of “as if rationality” where wealth accumulates on strategies which have done relatively well. Second active learning refers to the active switching of agents across strategies. Most heterogeneous agent markets contain some form of both these types of learning. From what we know so far the dynamics of each may be quite different, and may yield a rich and complex joint dynamic.

Similar content being viewed by others



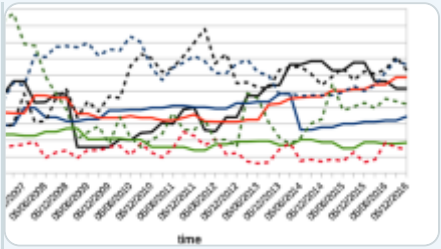
Stock Price Formation: Precepts from a Multi-Agent Reinforcement Learning Model

Article | 10 April 2022



Learning and Cognition in Financial Markets: A Paradigm Shift for Agent-Based Models

Chapter | © 2021



Modelling Stock Markets by Multi-agent Reinforcement Learning

Article | 17 August 2020

Notes

1. This is not a survey of learning, or heterogeneous agent models finance. This is well beyond the scope of this short paper. On heterogeneous agent models many excellent surveys exist including, Chiarella et al. [2009], Hommes [2006], LeBaron [2006], and Lux [2009]. On learning models finance in general a recent survey of this large literature can be found in Pastor and Veronesi [2009].

2. Another early theoretical derivation is in Breiman [1961]. A nice summary of this is in Markowitz [1976]. Blume and Easley [1990] and Blume and Easley [2006] state the problem in the context of a utility maximizing portfolio decision. The latter paper proves that in a complete market world the convergence to true beliefs will occur regardless of preference parameters. However, the authors point out that in an incomplete market world this convergence is not guaranteed. Evstigneev et al. [2006] look at an incomplete markets world with endogenous prices. In their framework, the growth optimal strategy will dominate any other competing strategy in terms of acquiring all wealth in the long run.

3. Often this can be calibrated to some actual macro series.

4. Some agent-based learning models go further in that the functional forms of the rules themselves are allowed to change over time as in Chen and Yeh [2001] or Arthur et al. [1997].

5. There is one important class of models where passive learning is inactive. Models with Constant Absolute Risk Aversion (CARA) utility and adaptive rule selection generally have no passive learning component. Two very different examples of this are Brock and Hommes [1998] and Arthur et al. [1997]. Price formation depends on the fraction of traders in a given strategy, and not on their wealth.

6. The best-known case would be log utility.

7. See Pastor and Stambaugh [2009] for a more complete treatment of systems of this form in finance.

8. See LeBaron [2007] or Campbell and Viceira [2002] for derivations and connections to intertemporal preferences. The variance term in the numerator can be thought of as an adjustment for the fact that these are log returns.

9. The consumption fraction, λ, is irrelevant for wealth races of this form where it is considered to be the same across all agents. Each period all agents consume the same fraction of wealth, so the relative performance is not affected by λ.

10. This is the risk-free return, which would generate the same utility as the return on the risky asset.

11. This point has been made by a large number of papers. For a result directly tied to Friedman's examples of firms and profit maximization; see Radner [1998] and Winter [1987].

12. The evidence in support of various forms of active learning extends beyond casual introspection. Laboratory evidence shows some support for various

forms of active learning. Some of this work in financial markets is surveyed in Hommes [2010].

13. This is where Sims's [1980] critique of deviations from rationality is in full force.

14. Important current work has moved in the direction of estimating the intensity of choice as in Goldbaum and Mizrach [2008] or Boswijk et al. [2007].

15. It reminds one of Fisher Black's discussions in Black [1986].

References

Anufriev, M., and P. Dindo . 2010. Wealth-driven Selection in a Financial Market with Heterogeneous Agents. Journal of Economic Dynamics and Control, 73: 327–358.

Google Scholar

Arthur, W.B., J. Holland, B. LeBaron, R. Palmer, and P. Tayler . 1997. Asset Pricing under Endogenous Expectations in an Artificial Stock Market, in The Economy as an Evolving Complex System II, edited by W.B. Arthur, S. Durlauf and D. Lane. Reading, MA: Addison-Wesley, 15–44.

Google Scholar

Berrada, T. 2009. Bounded Rationality and Asset Pricing. Review of Finance, 13: 693–725.

Article Google Scholar

Black, F. 1986. Noise. Journal of Finance, 41: 529–543.

Article Google Scholar

Blume, L., and D. Easley . 1990. Evolution and Market Behavior. Journal of Economic Theory, 58: 9–40.

Article Google Scholar

Blume, L., and D. Easley . 2006. If You’re so Smart, Why aren’t you Rich? Belief Selection in Complete and Incomplete Markets. Econometrica, 74: 929–966.

Article Google Scholar

Boswijk, H.P., C.H. Hommes, and S. Manzan . 2007. Behavioral Heterogeneity in Stock Prices. Journal of Economic Dynamics and Control, 31 (6): 1938–1970.

Article Google Scholar

Breiman, L. 1961. Optimal Gambling Systems for Favorable Games, in Proceedings of the Fourth Berkeley Symposium of Math Statistics, and Probability, Vol. 1, edited by J. Newyman and E. Scott, Berkely, CA: University of California Berkely Press.

Google Scholar

Brock, W.A., and C.H. Hommes . 1997. A Rational Route to Randomness. Econometrica, 65: 1059–1097.

Article Google Scholar

Brock, W.A., and C.H. Hommes . 1998. Heterogeneous Beliefs and Routes to Chaos in a Simple Asset Pricing Model. Journal of Economic Dynamics and Control, 22 (8–9): 1235–1274.

Article Google Scholar

Campbell, J.Y., and L.M. Viceira . 2002. Strategic Asset Allocation. Oxford, UK: Oxford University Press.

Book Google Scholar

Chen, S.-H., and C.-H. Yeh . 2001. Evolving Traders and the Business School with Genetic Programming: A New Architecture of the Agent-based Artificial Stock market. Journal of Economic Dynamics and Control, 25: 363–394.

Article Google Scholar

Chiarella, C., R. Dieci, and X.-Z. He . 2009. Heterogeneity, Market Mechanisms, and Asset Price Dynamics, in Handbook of Financial Markets: Dynamics and Evolution, edited by T. Hens and K.R. Schenk-Hoppe. USA: Elsevier, 277–344.

Chapter Google Scholar

Chiarella, C., and X. -Z. He . 2001. Asset Pricing and Wealth Dynamics under Heterogeneous Expectations. Quantitative Finance, 1: 509–526.

Article Google Scholar

Chiarella, C., and X.-Z. He . 2008. An Adaptive Model on Asset Pricing and Wealth Dynamics with Heterogeneous Trading Strategies, in Handbook of Information Technology in Finance, edited by D. Seese, C. Weinhardt and F. Schlottmann. Heidelberg, Germany: Springer-Verlag.

Google Scholar

Evstigneev, I.V., T. Hens, and K.R. Schenk-Hoppe . 2006. Evolutionary Stable Stock Markets. Economic Theory, 27: 449–468.

Article Google Scholar

Evstigneev, I.V., T. Hens, and K.R. Schenk-Hoppe . 2009. Evolutionary Finance, in Handbook of Financial Markets: Dynamics and Evolution, edited by T. Hens and K.R. Schenk-Hoppe. Amsterdam, the Netherlands: Handbooks in Finance, North-Holland, 509–564.

Google Scholar

Friedman, M. 1953. Essays in Positive Economics. Chicago, IL: University of Chicago Press.

Google Scholar

Goldbaum, D., and B. Mizrach . 2008. Estimating the Intensity of Choice in a Dynamic Mutual Fund Allocation Decision. Journal of Economic Dynamics and Control, 32: 3866–3876.

Article Google Scholar

Hakansson, N.H. 1971. Multi-period Mean-variance Analysis: Toward a General Theory of Portfolio Choice. Journal of Finance, 26: 857–884.

Google Scholar

Hommes, C.H. 2006. Heterogeneous Agent Models in Economics and Finance, in Handbook of Computational Economics, edited by K.L. Judd and L. Tesfatsion. Amsterdam, the Netherlands: Elsevier.

Google Scholar

Hommes, C.H . 2010. The Heterogeneous Expectations Hypothesis: Some Evidence from the Lab, Technical Report, CeNDEF, University of Amsterdam.

Kelley, J.L. 1956. A New Interpretation of Information Rate. Bell Systems Technical Journal, 35: 917–926.

Article Google Scholar

LeBaron, B. 2001. Evolution and Time Horizons in an Agent-based Stock Market. Macroeconomic Dynamics, 5 (2): 225–254.

Article Google Scholar

LeBaron, B. . 2006. Agent-based Computational Finance, in Handbook of Computational Economics, edited by K.L. Judd and L. Tesfatsion. Amsterdam, the Netherlands: Elsevier, 1187–1233.

Google Scholar

LeBaron, B. . 2007. Wealth Evolution and Distorted Financial Forecasts, Technical Report, International Business School, Brandeis University.

LeBaron, B. . 2010. Heterogenous Gain Learning and the Dynamics of Asset Prices, Technical Report, International Business School, Brandeis University, Waltham, MA.

Levy, M., H. Levy, and S. Solomon . 1994. A Microscopic Model of the Stock Market: Cycles, Booms, and Crashes. Economics Letters, 45: 103–111.

Article Google Scholar

Lux, T. 2009. Stochastic Behavioral Asset Pricing Stochastic Behavioral Asset Pricing Models and the Stylized Facts, in Handbook of Financial Markets: Dynamics and Evolution, edited by T. Hens and K.R. Schenk-Hoppe. North-Holland.

Google Scholar

Markowitz, H. 1976. Investment for the Long Run: New Evidence for an Old Rule. Journal of Finance, 31: 1273–1286.

Article Google Scholar

Pastor, L., and P. Veronesi . 2009. Learning in Financial Markets. Annual Review of Financial Economics, 1: 361–381.

Article Google Scholar

Pastor, L., and R.F. Stambaugh . 2009. Predictive Systems: Living with Imperfect Predictors. Journal of Finance, 64: 1583–1628.

Article Google Scholar

Radner, R. 1998. Economic Survival, in Frontiers of Research in Economic Theory, edited by D.P. Jacobs, E. Kalai and M.I. Kamien. Econometric Society Monographs, Cambridge, UK: Cambridge University Press, 183–209.

Chapter Google Scholar

Samuelson, P. 1971. The “fallacy” of Maximizing the Geometric Mean in Long Sequences of Investing or Gambling. Proceedings of the National Academy of Science, 68: 2493–2496.

Article Google Scholar

Sims, C.A. 1980. Macroeconomics and Reality. Econometrica, 48: 1–48.

Article Google Scholar

Winter, S.G . 1987. Competition and Selection, in The New Palgrave: A Dictionary of Economic, edited by J. Eatwell, M. Milgate and P. Newman. Basingstoke: Palgrave Macmillan, 545–548.

Google Scholar

Yan, H. 2008. Natural Selection in Financial Markets: Does It Work? Management

Science, 54 (11): 1935–1950.

Article Google Scholar

Author information

Authors and Affiliations

International Business School, Brandeis University, 415 South Street, Mailstop 32, Waltham, 02453 – 2728, MA, USA

Blake LeBaron

Rights and permissions

About this article

Cite this article

LeBaron, B. Active and Passive Learning in Agent-based Financial Markets. *Eastern Econ J* **37**, 35–43 (2011). https://doi.org/10.1057/eej.2010.53

Published
28 December 2010

Issue date
01 January 2011

DOI
https://doi.org/10.1057/eej.2010.53

Keywords

agent-based financial markets | evolutionary finance | learning

JEL Classifications

G11 | G14 | G17 | D84

Search

Search by keyword or author

Navigation

Find a journal

Publish with us

Track your research