The Impact of Imitation on Long Memory in an Order-Driven Market

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Abstract

Recent research has documented that learning and evolution are capable of generating many well-known features in financial times series. We extend the results of LeBaron and Yamamoto (2007) to explore the impact of varying amounts of imitation and agent learning in a simple order-driven market. We show that in our framework, imitation is critical to the generation of long memory persistence in many financial time series. This shows that imitation across trader behavior is probably crucial for understanding the dynamics of prices and trading volume.

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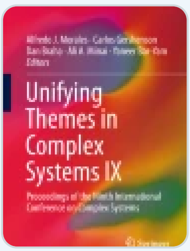

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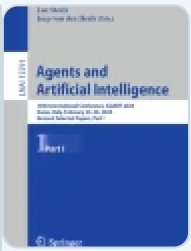

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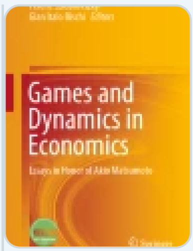

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Notes

1. We are grateful to four anonymous referees who provided useful suggestions and feedback. Barkley Rosser provided useful comments on the authors' earlier work that inspired the research questions addressed in this paper.

2. See LeBaron [2001b] for an example of how endogenously changing heterogeneity in investor strategies can impact observed market behavior.

3. See Khandani and Lo [2007] for information on how this situation might occur with quantitative hedge funds.

4. The use of k here represents a crude form of heterogeneous risk aversion in our population. Both buyers and sellers demand some premium beyond their risk neutral price. In this sense we are assuming that the actual risk of placing the order dominates any impact on the agents' portfolio. As a practical matter this also keeps traders from churning their portfolios at the same buy and sell prices. We model k as symmetric since we are not modeling any specific differences between buying and selling behavior. Also, there is some empirical evidence on the symmetry of order placement in Mike and Farmer [2008].

5. We have performed robustness checks on our mutation rate. For values of $p_m = 0, 0.08, 0.12, 0.16$ our results are unchanged. As the mutation rate gets very high, the selective impact of the GA is driven to zero, and the results will disappear for relatively large values of p_m. We have performed further robustness checks on other parameters used in our simulations. Specifically, we have varied σ_1, the standard deviation of the fundamental forecasts from

0.5 to 1.5 from our original value of 1. We have also varied σ_2 the chartist forecasting component from 1 to 2 from the original value of 1.5, and the noise standard deviation, σ_n, from 0.3 to 0.7 from our original value of 0.5. Finally, we have adjusted k_{max}, the spread parameter length from 0.3 to 0.7. In all these cases we find that our results do no change significantly.

6. See Vriend [2000] for a general discussion.

7. It is beyond the scope of this paper to discuss long-memory processes. Interested readers should consult some recent surveys which include Baillie [1996], Robinson [2003], and Doukhan et al. [2003]. See also Parke [1999] for examples, intuition and discussion. Recent work in finance shows that volatility is a likely candidate for long memory even at longer horizons than intraday. For examples see Ding et al. [1993], Baillie et al. [1996], and Andersen et al. [2003].

8. The Lo test is one of many long memory tests, and is based on earlier R/S analysis. The test has been criticized in Teverosvsky et al. [1999] and Willinger et al. [1999]. Their Monte-Carlo experiments show that the test can accept the null of no long-range dependence as the bandwidth parameter is increased. We are concerned about this, but in most of our runs this low power problem is not an issue since we are rejecting the null hypothesis. We are also exploring the use of some other long-range diagnostics such as Giraitis et al. [2003a, 2003b].

9. We have also experimented with smaller order blocks, specifically 10 units. These blocks were not able to generate long memory in any of our time series. Obviously, there are many ways to implement order splitting, and we are continuing to explore the differences between these mechanisms, and our imitative framework.

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