
Contents

Part I Agent-Based Modeling in Economics

1	Introduction	3
2	The Rationale for Agent-Based Modeling	5
2.1	Introduction	5
2.2	The Representative Agent Modeling Approach	7
2.2.1	Avoiding the Lucas-Critique	8
2.2.2	Building Walrasian General Equilibrium Models	9
2.2.3	Representative Agents and the Fallacy of Composition	10
2.2.4	Expectation Formation in Markets with Heterogeneous Investors	11
2.3	Rational Expectations and Disequilibrium Dynamics	13
2.4	The Economy as an Evolving Complex Adaptive System	14
2.5	Some Methodological Aspects of Agent-Based Simulations	16
3	The Concept of Minimal Rationality	19
3.1	Introduction	19
3.2	Economic, Bounded, and Situational Rationality	21
3.3	Situational Analysis, Minimal Rationality, and the Prime Directive	24
3.4	Minimal Rationality and the Phillips-Curve	26
4	Learning in Economics	29
4.1	Introduction	29
4.2	Definitions of Learning	29
4.3	Rationality-Based Learning Models	31
4.4	Biologically Inspired Learning Models	32

4.4.1	Learning Through Replicator Dynamics	34
4.4.2	Learning Through Genetic Algorithms	36
4.4.3	Learning Through Classifier Systems	46
5	Replicating the Stylized Facts of Financial Markets ..	51
5.1	Efficient Markets and the Efficient Market Hypothesis ..	51
5.1.1	Definitions	51
5.1.2	Random Walks or Martingales?	53
5.1.3	Tests for Market Efficiency	55
5.2	Stylized Facts of Financial Markets	56
5.2.1	Non-Normal Return Distributions	56
5.2.2	Volatility Clustering of Returns	60
5.2.3	High and Persistent Trading Volume	64
5.2.4	Existence of Technical Trading	65
5.3	Alternative Market Hypotheses	70
5.3.1	The Fractal Market Hypothesis	70
5.3.2	The Coherent Market Hypothesis	71
5.3.3	The Adaptive Market Hypothesis	72
5.3.4	The Interacting-Agent Hypothesis	75
5.4	Agent-Based Computational Models of Financial Markets	75
5.4.1	Allocative Efficiency with Zero-Intelligence Traders	76
5.4.2	Models with a Random Communication Structure	79
5.4.3	Models of Chartist-Fundamentalist Interactions...	83
5.4.4	Many-Strategy Models with Learning	85

Part II The Santa Fe Institute Artificial Stock Market Model Revisited

6	The Original Santa Fe Institute Artificial Stock Market	91
6.1	Introduction	91
6.2	The Marimon-Sargent Hypothesis and the SFI-ASM	92
6.3	An Overview of SFI-ASM Versions	93
6.4	The Basic Structure of the SFI-ASM	94
6.4.1	Trading Rules and Expectation Formation	95
6.4.2	Learning and Rule Evolution	99
6.4.3	Other Programming Details and Initialization of Model Parameters	101
6.5	The Homogeneous Rational Expectations Equilibrium ..	102
6.6	The Marimon-Sargent Hypothesis Refined	103
6.7	Simulation Results of the SFI-ASM	104

6.7.1	Time Series Behavior	104
6.7.2	Forecast Properties	106
6.8	A Potential Problem: A Biased Mutation Operator	108
7	A Suggested Modification to the SFI-ASM	113
7.1	Introduction	113
7.2	An Unbiased Mutation Operator	114
7.3	Simulation Results with the Modified SFI-ASM	115
7.3.1	Trading Bit Behavior	115
7.3.2	Time Series Properties	118
7.4	Robustness of the Zero-Bit Solution	121
7.4.1	Stochastic versus Periodic Dividends and the Classifier System	121
7.4.2	Dependence on Other Parameter Values	122
7.4.3	Generalization or Consistent Trading Rules?	123
8	An Analysis of Wealth Levels	127
8.1	Introduction	127
8.2	Wealth Levels in the SFI-ASM: An Economic(al) Explanation	128
8.3	Previous Studies Based on Wealth Levels in the SFI-ASM	129
8.3.1	Financial Markets Can Be at Sub-Optimal Equilibria	129
8.3.2	Technical Trading as a Prisoner's Dilemma	131
8.4	Wealth Levels in the SFI-ASM: Alternative Explanations	133
8.4.1	Risk-Premium, Taxation, and Two Benchmark Wealth Levels	133
8.4.2	Average Stock Holdings and Wealth Levels	135
8.4.3	Activated Rules and Rule Selection	139
8.5	A Verdict on Wealth Analysis in the SFI-ASM	145
9	Selection, Genetic Drift, and Technical Trading	147
9.1	Introduction	147
9.2	Technical Trading and the Aggregate Bit Level	148
9.3	The Zero-Bit Solution: Some Disturbing Evidence	150
9.4	Random Genetic Drift in Genetic Algorithms	152
9.5	The Neutralist–Selectionist Controversy	154
9.6	Fitness Driven Selection or Genetic Drift?	157
9.6.1	Selection or Genetic Drift in the Modified SFI-ASM?	157

9.6.2	Selection or Genetic Drift in the Original SFI-ASM?	159
9.6.3	Genetic Drift, Fitness Gradient, and Population Size	161
9.7	The Effect of Mutation on Genetic Drift	162
9.7.1	Genetic Drift, Mutation, and Crossover Only in SFI Agents	162
9.7.2	Genetic Drift, Mutation, and Crossover Only in Bit-Neutral Agents	166
9.7.3	An Equilibrium Analysis of Genetic Drift and Mutation	166
9.7.4	A Final Assessment of the Two Mutation Operators	171
9.8	Detection of Emergence of Technical Trading	172
9.8.1	Predictability in the Price Series	172
9.8.2	Trading Bits and Fitness Values	173
9.8.3	Equilibrium Bit Frequencies and Bit Fixations ...	176
9.9	An Evolutionary Perspective on Technical Trading	177
10	Summary and Future Research	181
Appendix		187
11.1	Timing in the Stock Market	187
11.2	Fundamental and Technical Trading Bits	189
References		195
Index		227

<http://www.springer.com/978-3-540-73878-7>

Agent-Based Modeling

The Santa Fe Institute Artificial Stock Market Model
Revisited

Ehrentreich, N.

2008, XVI, 232 p. 39 illus., Softcover

ISBN: 978-3-540-73878-7