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FINANCE, INVESTMENT & RISK MANAGEMENT CONFERENCE

15-17 JUNE 2008

HILTON DEANSGATE, MANCHESTER

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Agent-Based Modelling Working Party

Complexity Economics
Application and Relevance to Actuarial Work

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Agenda

- Andrew Slater
  - Economics & disequilibrium
- Jon Palin
  - Agent-based stock market models
- Nick Silver
  - Actuarial applications

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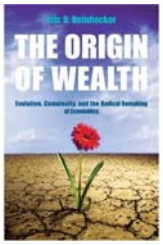
Motivation



www.mckinsey.com/ideas/books/originofwealth/pdf/Origin_of_Wealth_Ch_1.pdf

http://books.google.co.uk/books?id=xXvelSs2caQC&printsec=frontcover&dq=animation+IV-2&source=gbs_summary_r&cad=0

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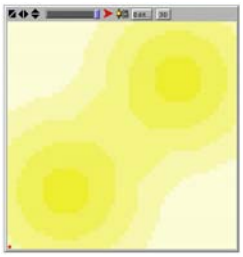
Sugarscape

Environment



Agents

- Genetic characteristics
  - Sugar metabolism (1 to 4)
  - Level of vision (1 to 6)
  - Maximum age (could be infinite)
- Variable states
  - Position (x,y)
  - Amount of sugar
- Each time period agents
  - Move, harvest, metabolise
  - Die if sugar=0 or age=max

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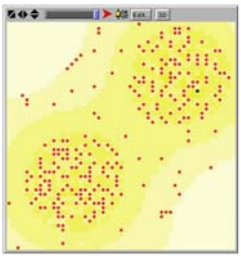
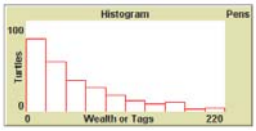
Simulation ({G_1}, {M, $R_{[60,100]}$})



NetLogo



"If you didn't grow it, you didn't explain it"

http://complexityworkshop.com/models/sugarscape.html experiment 3

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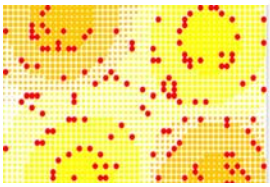
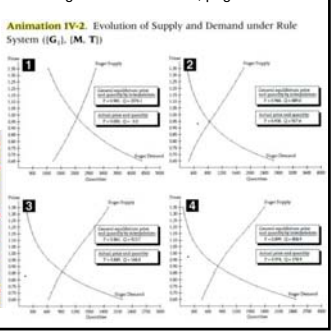
Simulation ({G_1}, {**M**, **T**})

Growing Artificial Societies, page 115

http://www.brook.edu/es/dynamics/sugarscape/animations/AnimationIV.mov





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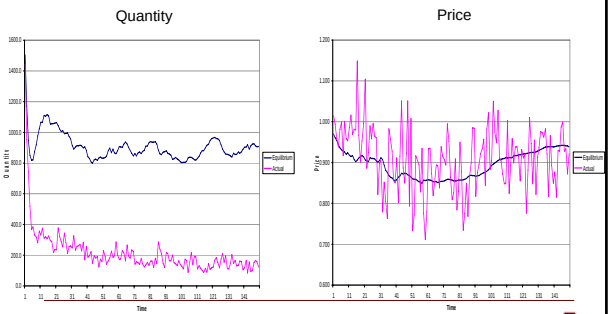
Local efficiency, global inefficiency

Disequilibrium



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Agent-based stock market models

- Stock markets have stylised features:
  - fat tails
  - persistent volatility
- Why should these features occur?
- Can we build a model that can:
  - reproduce them without hard-coding them
  - let us turn them on and off

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Le Baron's model

- Two assets:
  - cash pays guaranteed return
  - equity pays random (lognormal) dividend
- Many agents:
  - trade cash and equity to maximise lifetime utility
  - using "trading rules" which have worked in the past
  - using different periods of "memory"
- Stock price is an emergent property
- More detail: http://citeseer.ist.psu.edu/palin02agentbased.html

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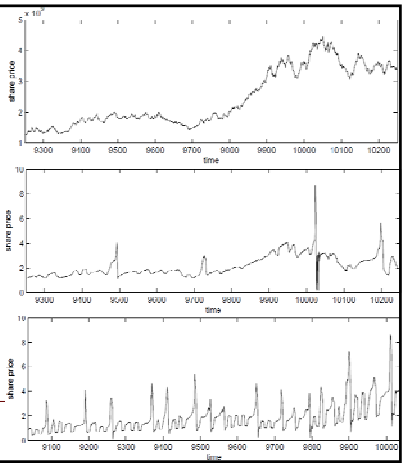
Long memory

Mixed memory

Short memory



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Successes and failures

- Successes:
  - demonstrates complexity of markets
  - emergent price is qualitatively sensible
  - changing a parameter (memory) changes dynamics
- Failures:
  - emergent price is quantitatively extreme
  - cannot calibrate using smooth changes
  - different models suggest different causes of fat tails

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Agent-based modelling

Background

- World as complex adaptive system
- Emergence – complex phenomena from simple rules
- Dynamically interacting rule based agents
- Commonality between different systems
- Increase in computer power

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Agent-based modelling

Features of ABMs

- Heterogeneous agents
- Adaptation
- Feedback loops
- Local interactions
- Externalities

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Agent-based modelling

Possible future applications

- Market prediction
- Risk management
- Aid regulatory design
- Model cyclicality of insurance market
- Test investment policy

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Agent-based modelling

Current drawbacks

- Lack of calibration
- Lack of predictive power
- Often arbitrary choice of assumptions
- Parsimony vs realism

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