Wind-tunnel Testing for Strategy and Market Design

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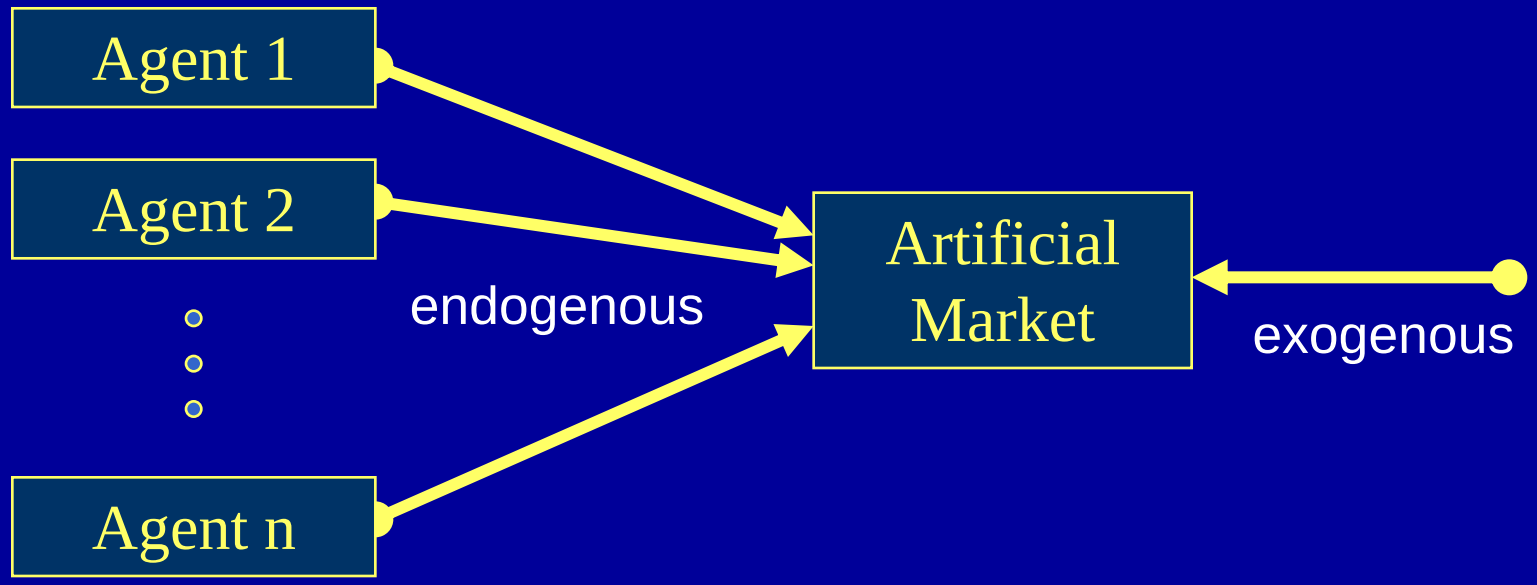
09 December 2009

Agent-based Artificial Markets

Application

Strategy Design
- How to do well in market

Wind Tunnel Market Testing
- Designing new markets



Fundamental

What happens when agents evolve?
- Nash equilibrium

Better understand the market
- What makes a market efficient?
- What is the underlying mechanism?

Summary: Agent-based Artificial Markets

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	Agents	Markets
Applications	• Strategies evolved – Payments market – Bargaining	• Wind-tunnel Testing – British Telecom • Road usage market
Fundamental	• Nash Equilibrium • Red Queens effect studied	• Reproduced stylized facts in CHASM • Rationality challenged

Rich and challenging research, EC plays vital part

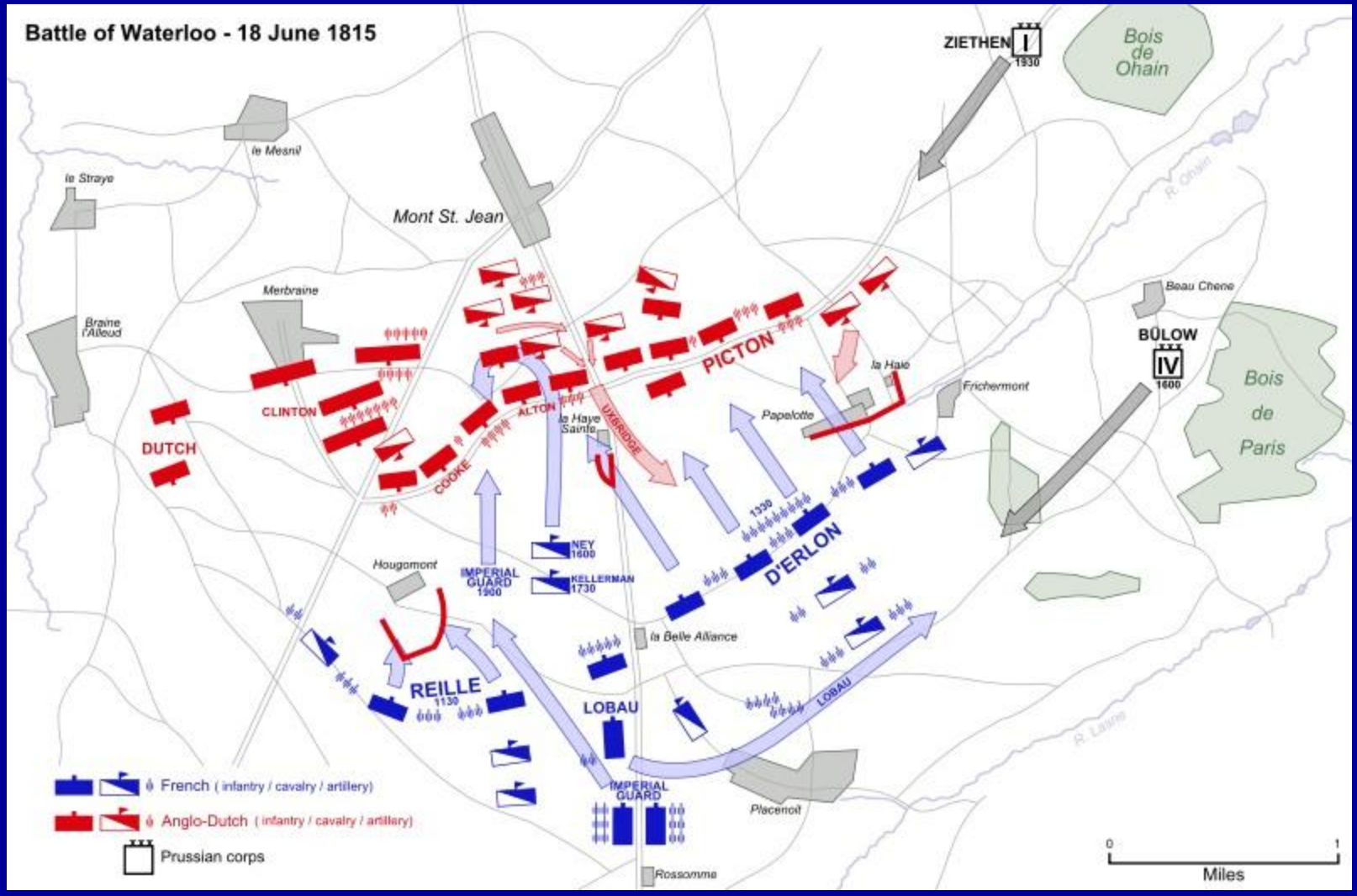
Wind Tunnel Testing

A cost-effective way to evaluate policies before implementing them

Wind-tunnel tests for new markets

- New markets are being invented
  - e-Bay, electricity, roads, polution
- Why wind-tunnel testing?
  - Answer what-if questions
  - Approximate equilibriums

Modelling is commonly used



Modelling is never perfect

"All models are wrong, but some are useful"

(Box and Draper, 1987)

"More calculation is better than less, Some calculation is better than none"

(Sun Zi, 6BC)

多算胜，少算不胜，而何况于无算乎？ 【孙子】

Market Testing Examples

- Tesfatsion & Koesrindartoto:
  - design of California's electricity market
- Markose, Allen & Blyth:
  - Market-based congestion charges
    - Presented to UK Foresight, Prime Minister's Office and Treasury
- Tsang et al:
  - BT's scheduling problem

Market for Road Usage

- Foresight, UK:
  - Car # to increase by 50% in 15 years
- What to do?

Why Wind-tunnel Testing

- Modelling is a cost-effective way of understanding a market
- It helps answering *what-if* questions
- It helps policy makers to check if intended goals are achieved; e.g.
  - London congestion charges
  - Google's IPO

  If not, how to achieve them
- It can help commercial sector to design strategies

London Congestion Charges

- 17 Feb 2003: Drew a circle, £5 per visit
- 4 Jul 2005: raised to £8 (plan: £10)
- What are the Government's objectives?
  - To reduce traffic by what %?
- Testing in real market leads to oppositions
- Why not test in a model first?
  - No model is perfect
  - But modelling enables scientific studies

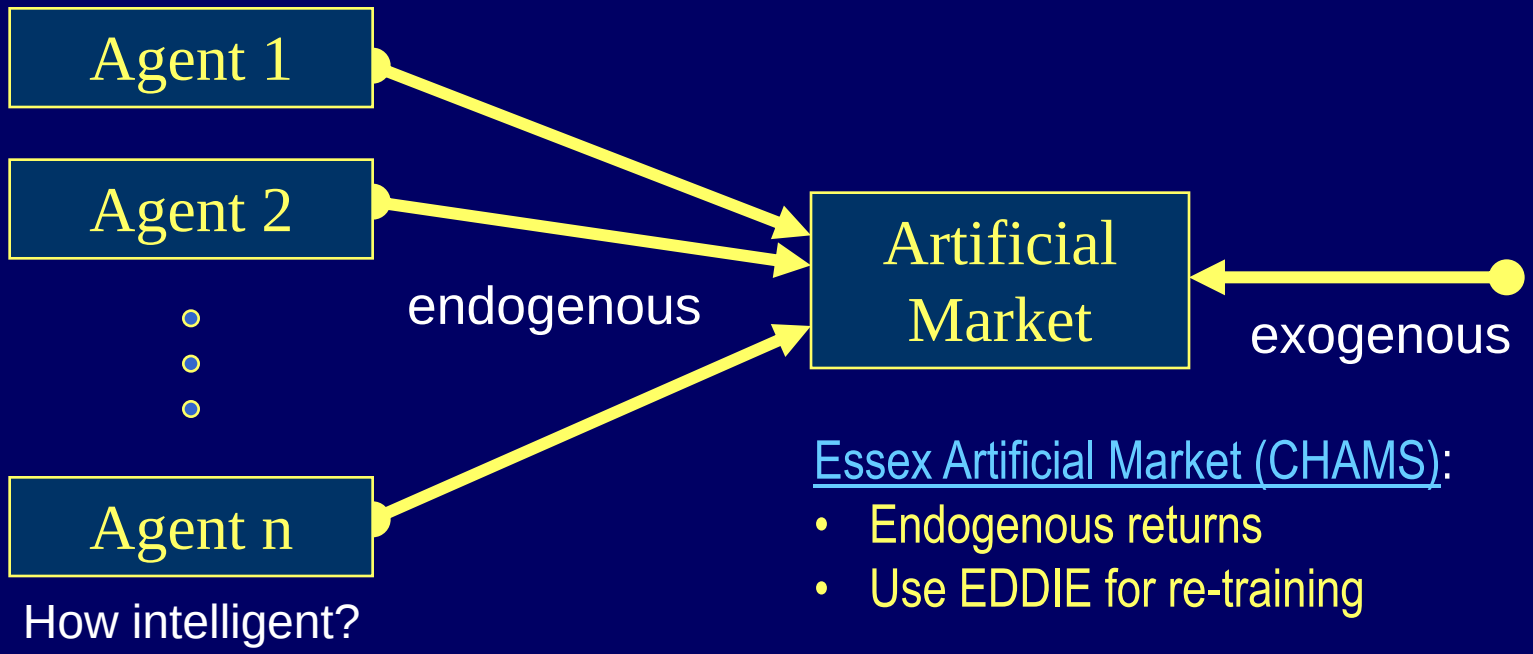
Google's Initial Public Offer (IPO)

- IPOs typically under-priced
- Google auctioned its IPOs in 2004
- Stock price up by 17% on first trading day
  - Good for investors
  - Not what Google wanted
- Could market testing help?
  - Depends on model

Strategy Design

- Bank of England & CCFEA
  - Learning “how much liquidity is required”
- Alexandrova, Tsang and Krause
  - Modelling credit card market
  - Tuning bank strategies
- Gosling & Tsang
  - Simple Supply Chain Management
  - Learning middlemen strategies
- Jin & Tsang
  - Finding reasonable bids

Understanding Market Behaviour



Essex Artificial Market (CHAMS):

- Endogenous returns
- Use EDDIE for re-training

Understanding the underlying mechanism

- Many interesting results reported

Agent-based Equilibrium

- Bees maintain constant hive temperatures
- How?
- By varying their wing-frequencies?
- No, much simpler
- By switching on/off at different thresholds

Building Artificial Markets

- Goal: to understand the underlying mechanism of real markets
- Means: to build artificial markets and observe their behaviour
- Rationale:
  - If the artificial market exhibits stylized facts
  - Then the built in mechanism might reflect the underlying mechanism

Red Queen

… Now, *here*, you see, it takes all the running *you* can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that! …

Red Queen in Economics

Red Queen principle

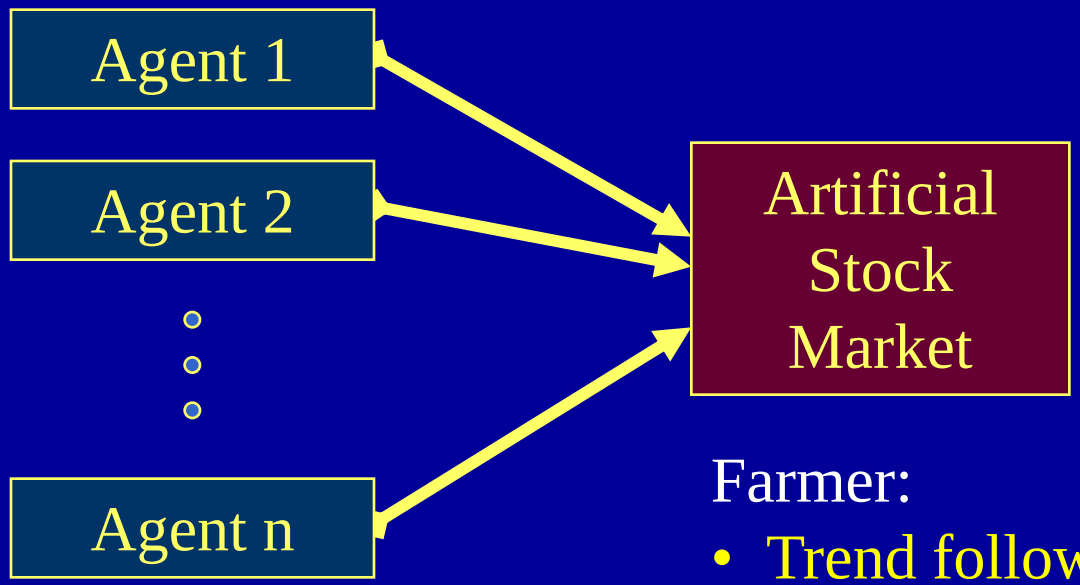
- The Red Queen principle was proposed by the evolutionary biologist Leigh Van Valen (1973).
- For an evolutionary system, continuing development is needed just in order to maintain its fitness relative to the systems it is coevolving with.

Agent-based Artificial Market

- Built to understand market behaviour better

Santa Fe Institute:

- Exogenous returns (set by experimenter)
- (Evolutionary) Classifier Systems



Herding behaviour?

LeBaron:

- Endogenous returns
- Does market exhibit empirical features ("Stylized facts")?
- Effects of the traders' memory

Farmer:

- Trend following agents +
- (Fundamental) value investors

Daniel Kahneman

- Nobel Prize in Economics, 2002
- Psychology in Economics, uncertainty

  "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty"
- Princeton, USA

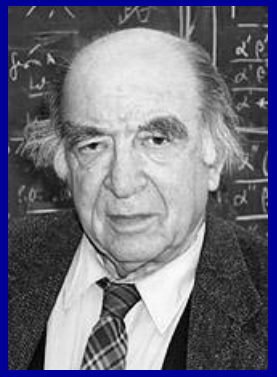
Vernon Smith

- Nobel Prize in Economics 2002
- Experimental Economics

  "for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms"
- George Mason University, USA

Mechanism Design

- Nobel Prize in Economics 2007
- *For having laid the foundations of mechanism design theory*



Leonid Hurwicz
Minnesota
b.1917

Eric S Maskin
Princeton
b.1950

Roger B Myerson
Chicago
b.1951