Markets and networks

What it takes to make a market in a multi-agent world

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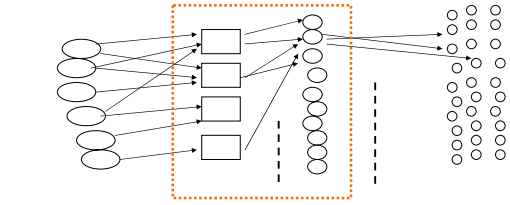
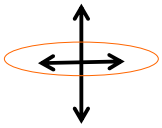
Multi-agent simulation as a social science methodology
Workshop - 2005/9/25 Tokyo University

Context: food supply chains





Study of the "market" dimension and the rationality of actors in one context

Market

"Economists": Prices as signals: limited information from the group

Hayek "The use of knowledge in Society": market is an efficient institution to organise the coordination of agents with private information

Kirman: several long term strategies for buyers and sellers to make sure to acquire the best good or make best prices

"Sociologists": Coordination through meaningful negotiations

Geertz: study of the social network that enables discriminated fixation of prices

Callon, Karpik: Which institutions are necessary to discuss about quality of goods "economics of quality"

Rationalities that cohabit on a market:
Short vs long term interest
Price vs Quality
Risk to meet shortage vs availability guaranteed

On "real" markets

Hirschman, A.O. "exit, voices and loyalty"

Behaviour of consumers is a tension between choosing best product (price, quality) or having regular relations with seller

Advantages when having regular relations

- Possibility to influence the type of products
- Complains over quality, over prices are useful mainly when relation is regular

But complain is *efficient* only when on a market (not monopolistic situation)

>>> "loyalty"

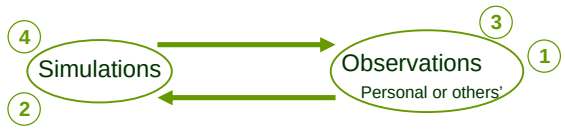
Personal main lines of research about markets

Market, trade, from a inter-individual point of view

- Definition of transactions
- Trust / fidelity / faithfulness / familiarity
- Learning dynamics (prices and relations)

Importance of network – relative role with market mechanisms

- Reputation
- Advantage for both sides (price and quality)
- Information spreading



What it takes for a closed artificial market

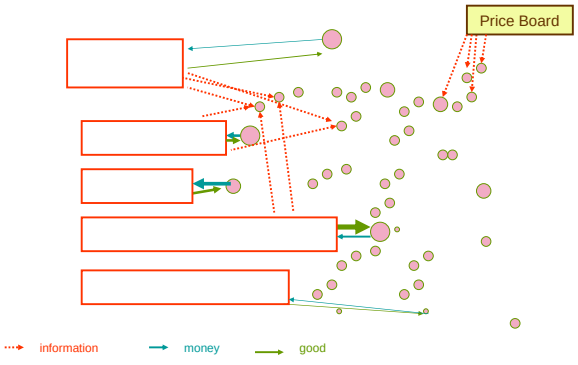
A "location" where agents interact to exchange

Type of goods exchanged
- Assets, Goods

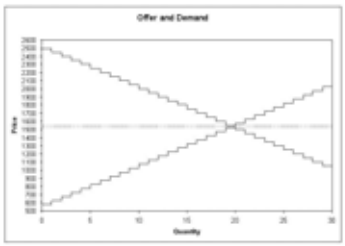
Institution
- Pair-wise, auction, double-auction

Rationality of agents
- Type of agents (sellers, buyers, both)
- Limit value
- Learning (1) Memory of past prices
- Learning (2) Negotiation ability, memory of interactions.

Sociologists' market: pair-wise interaction



Economists market: cold market



sellers

buyers

- Where nobody can communicate personally (nor associate action to who performed it)
- The main methodology is to try to fit simulation results on experimental data
  - Double-auction markets (Rouchier, Robin, 2004)
  - Apparition of speculation on good market (Rouchier, 2003)

DA institution: how do prices form?

?? Influence of information processing on global results of the market (convergence, efficiency) ??

-> SIMULATIONS testing diverse assumptions on memory and perception

- Experiments (Smith, Plott)

Setting:
  - Buyers, sellers
  - Communication via computers (controlled information)
  - Limited time for transactions
  - Limit prices: *private information*

Observation:
  - Number of transactions that take place
  - Convergence
  - Efficiency (surplus)

- Models (dynamical):

  Gode and Sunder (highly constrained system)

  Easley and Ledyard (conditions for limit prices to obtain convergence)

General results

- Convergence
  - A bit quicker than with experiments
- Influence of the number of time-steps in one market
  - Bug
  - Observation of "last minute buyers" that reduces the efficiency >> coherence with data
- Counter-intuitive result on the difference between local and global information (ie: slightly higher efficiency)

Global		95	91	92	97	93	97	90	86	91	90	94	99	99	93	93
Local		94	89	88	97	96	89	90	95	96	95	86	97	100	96	100

- Memory length:
  - No real difference for memory from 5 to 20
  - Visible difference with no memory

Discussion about methodology

ABOUT THE MODEL

- Issues to solve about the memory length and time-steps: is our definition of important parameters so relevant?
- Issues about the time definition: seems to be relevant but still has to be checked because of those unable to exchange

ABOUT THE METHOD

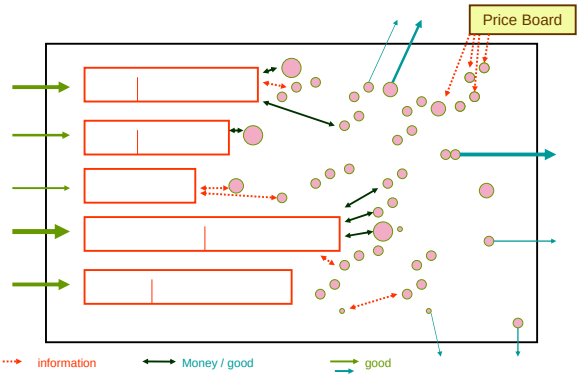
- Issues about the validation of any kind of learning, by Janssen and Ho – Rouchier in the critic of Duffy's work
  - Very difficult to assess individual behaviour AND collective behaviour at the same time
  - Is the search for the right rationality a good way to proceed?
- Next step
  - Experiments with debriefing to question about: information use, "time stress" evolution
  - Experiments with mixed agents
  - Experiments with "helping agents"

Negotiation in trade

"Exit, Voices and Loyalty"

Arnavaux market, Marseille
Fresh Fruit and vegetables
wholesale, 2003

Fruit and Vegetable Market

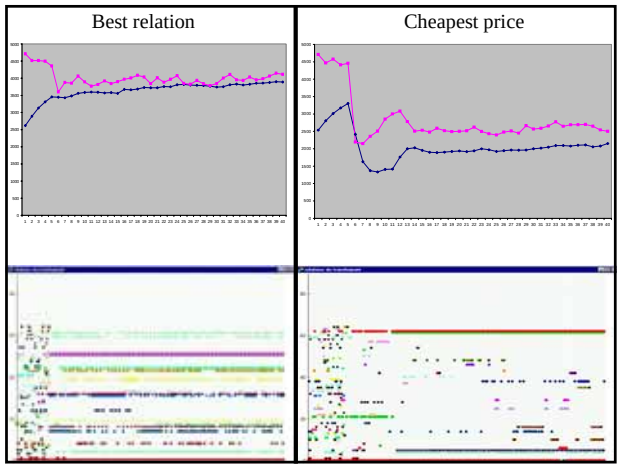


Market (1): negotiation over renewable resources
Evolution of loyalty

Goods
- Farmers offer grazing, herders ask for access for animals
- Available resource size with possibly decreasing quality if too much use >> cheap resource is limited

Interaction
- Different rationality to choose who to be loyal to
  - Just to be loyal
  - To get cheaper prices

Observations
- Destruction of resource
- Type of relations established with each learning



Arnavaux market, Marseille
Fresh Fruit and vegetables wholesale, 2003

An interaction-focused study

- Relations between wholesale sellers and retailers
  - No written information: negotiation > transaction – *individual* offers
  - Buyers don't make any prior offer, they ask for the price or declare a quantity they want (Kirman)
  - One should not interfere with others' transactions
  - Also: explicit information exchange
  - Diverse services: priority on some goods, advises to anticipate on future prices/ lacks
  - Credit
  - Friendship
- Wholesale sellers
  - The wholesale sellers have networks of sellers
  - Each have an "ecological niche" known by all – have a network of suppliers
- Retailers
  - Two main types of behaviour (schematic): regular / faithful buyers and opportunistic ones
  - (Change of behaviours is apparently linked to age)

« Network vs market » / opportunism vs fidelity

Market (2): negotiating in a perishable supply chain

Influence of faithful and opportunistic agents

Goods
- 10 types
- Goods loose value in time (= 0 after 4 days – thrown away)

Supply

Sellers buy goods – have a probability to access products **(param.)** – choose their level of supply – served with different prices **(param.)**

Demand

Buyers need 5 randomly chosen goods

Interactions
- Sellers treat answer:
  - first arrived first served
  - 10% reduction when more than 3 products bought
  - Give cheapest products to regular OR give freshest to regular (***param.)***
- Buyers select
  - Either being loyal = their usual seller
  - Or being opportunistic = the cheapest on each product

Market (2): Rationalities

Buyers:

Time is used for: *transacting* or *information search*

Fixed attitude => a strategy to use time

Behaviour <= attitude + gathered information

Information = average price for all products for 5 wholesale seller

	Time use	Choice process
Loyal	buy – info – buy	First regular, then as few demands as possible
Opportunistic	info – buy – buy	Cheapest possible basket (up to 5 demands)

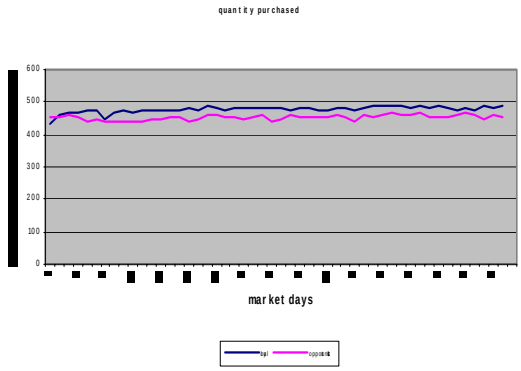
Sellers:

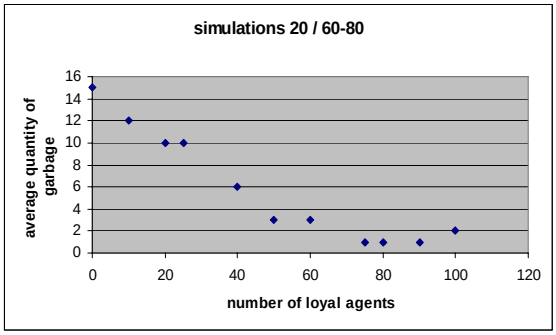
Adapt their supply to the demand and quantity thrown away (local information)

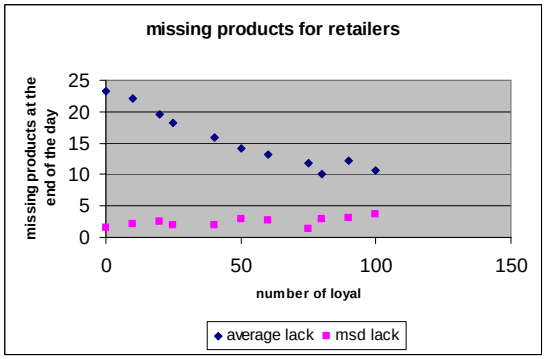
Cheapest products to regular OR give freshest to regular (***param.)***

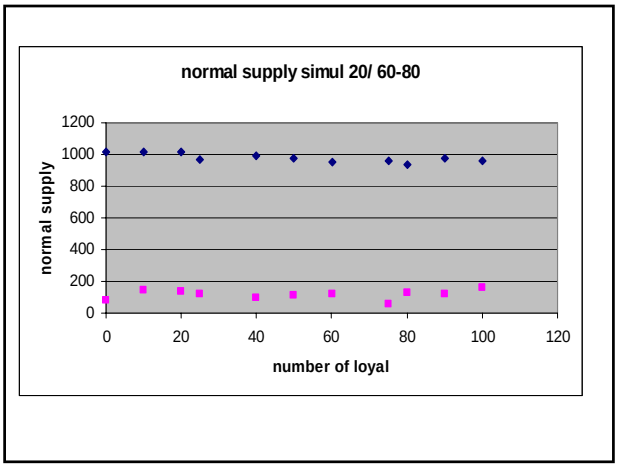
Simulations - Observation

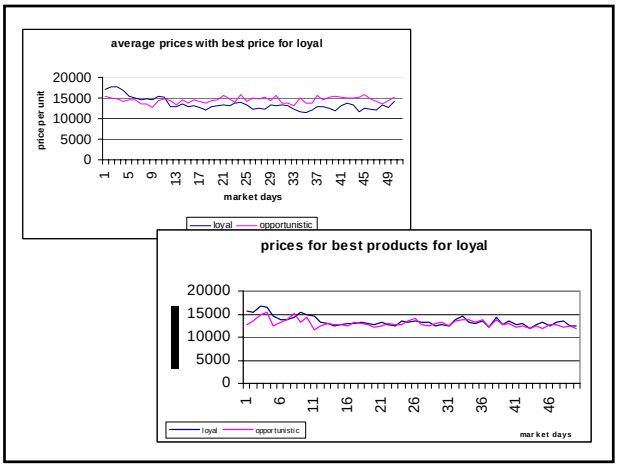
- Simulations defined by:
  - Repartition of retailers attitude: from 100-0 to 0-100
  - "Answer simulation"
    - The wholesale seller gives cheaper price to regular
    - The wholesale seller gives freshest products to regular
  - "Price" and "Supply" simulations
    - Supply probabilities = [40;60], [70-90], [80-100]
    - Price variation: 5- 20 or 40 %
- Observation (global – average)
  - Number of thrown units
  - Quantity of missing products
  - Evolution of normal supply – average and msd
  - Average age for bought products
  - Average price depending on the type of retailer

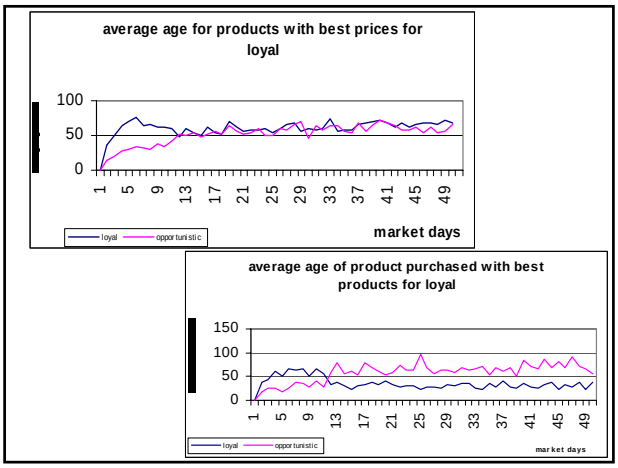












Results

- Supply and waste: retailers get more goods and wholesale sellers throw less when there are more loyal
- This increase in waste is mainly due to wholesale agents overstocking to attempt to satisfy sales that are subsequently not made – since in previous days selfish agents ask several wholesale agents to supplier various products >> Importance of loyal in the supply-regulation of market
- If wholesale sellers give “best products” to regular, loyal pay more and get fresher products and otherwise pay equivalent
- Better to use the “freshest products” logic because it is closer to other researchers’ results

Conclusion of previous work on markets

Loyalty can be created from purely local point of view

Loyalty is better quality when agents are conscious of it

Loyal agents and non loyal agents both have a role on the market

>> new questions:

is there an optimal number of loyal agents

is it possible to have agents choose loyalty for their interest only – or do I need to impose a loyalty tendency in their rationality?

How can sellers be more clever ?

Need to create a new model with a notion of quality

New model in progress

Again: Context of perishable supply chain BUT

Supply is “closer to reality”

- More specialisation for buyers in terms of quality
- More knowledge by sellers about the precise needs of their clients: niches apparition and more formal representation of the market

Buyers are not able to change from loyal to selfish but can change wholesaler when unsatisfied too long

Observation:

Again: global prices and global garbage

But also: observe the number of regular relations

>> is there an optimal number of loyal agents ?

Further evolutions

- is it possible to have agents choose loyalty for their interest only – or do I need to impose a loyalty tendency in their rationality?
- Agents can discuss and infer about price AND relation

Buyers :	Arguments about their knowledge of the market Arguments about their faithfulness / regularity
Sellers:	Accept or reject the argument, reduce prices or not