

CAA2016

Co-evolution of trade and culture

Impact of cultural network topology on economic dynamics.

Simon Carrignon, Jean-Marc Montanier, Jérôme Michaud
& Xavier Rubio-Campillo

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Barcelona Supercomputing
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Complex System Lab.

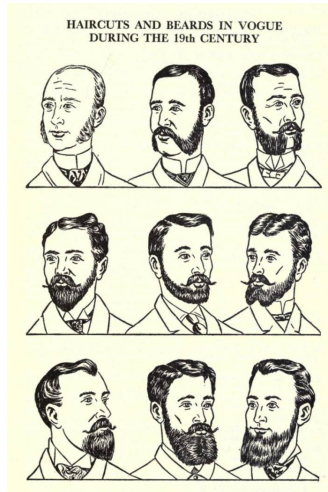


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Plan of the presentation

1. Introduction
2. Model Description
3. Experimental Setup & Results
4. Case Study: Rome

Cultural Evolution

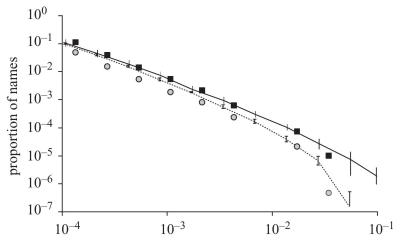


How Cultural Traits Evolve?

Cultural Evolution



Similar variants distributions

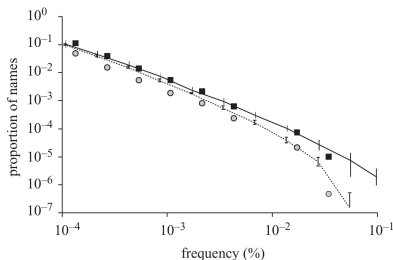


Square: male names
Circle: female names
From Bentley et al, 2004.

What Generate Those Cultural changes?

Simple mechanisms (Bentley et al, 2004):

- ▶ Random Copy
- ▶ Frequency biased (conformist/anti-conformist...)
- ▶ ...



Square: male names
Circle: female names
Dotted and plain lines: model result
with different copy probabilities.
From Bentley et al, 2004.

Trade and Cultural Network

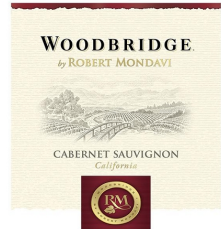
Traded Cultural Artificat :



Non-neutral value (utility):

- ▶ "Usefulness"
- ▶ popularity
- ▶ availability
- ▶ ...

What happen when such mechanisms act on traits impacting economy?



Co-evolution of Economy and Culture

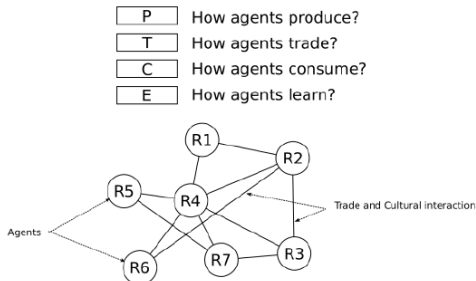
Interaction between Culture and Economy

Cultural mechanisms transform Economy



Economy influences Culture

A General Agent Based Framework



A General Agent Based Framework

Two main components:

1. Economic side: Bartering Economy (Gintis 2009),
2. Cultural side: “copy the most successful” (Bentley 2006).

The Model

1. The Economy & the Barter Mechanism

- ▶ N goods
- ▶ M Agent $\begin{cases} \text{a quantity of each Goods} \\ N \text{ values attributed to each goods} \end{cases}$
- ▶ Agents *produce* one good and *exchange* it to obtain the other goods.
- ▶ After the exchange, the agents *consume* all goods

The Model

2. Cultural Mechanisms

Every step:

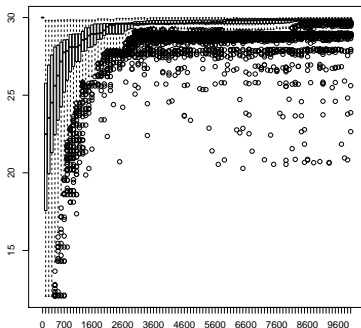
- ▶ Economic activity (cf. previous slide).
- ▶ A score is given following $f(q_n)$ a shared & fixed “utility function”.

After 10 steps:

- ▶ Less successful agents *copy* the most successful (Biased-Copy).
- ▶ Given a probability μ the value attributed to some goods is modified (Innovation/Mutation)

The Model

Figure: Example for 3 goods and 500 agents



@ Equilibrium: mean of score \rightarrow score max.

Experiments

Impact of the topologie of the cultural network

→ Average Length Path vs Density:

“What properties of the cultural network influe on the economic dynamics? ”

Experimental Setup

Set of networks with combination of properties:

- ▶ Density of the network (D)
- ▶ Average Length Path (A)

	D_1	...	D_n
A_1	Net_{11}		Net_{1n}
...		...	
A_m	Net_{m1}		Net_{mn}

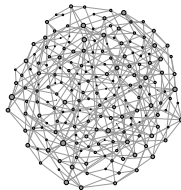
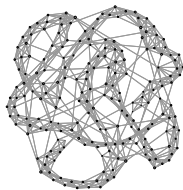
Experimental Setup

$D = 0.02$

$D = 0.04$

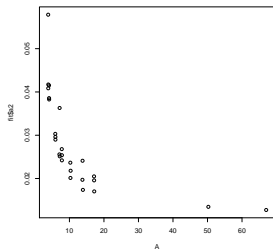
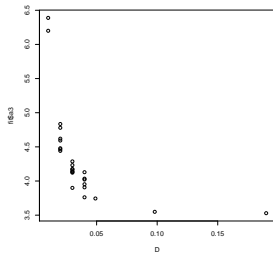


$A \approx 17$



$A \approx 4$

Results:



Summary

- ▶ A local copy mechanism alone is enough to bring the global economy to an optimal equilibrium.
- ▶ The topology of the network where this copy mechanism occurs influence the dynamics of the system

Thank for you attention!



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