

CAA2016

Co-evolution of trade and culture

Impact of cultural network topology on economic dynamics.

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31 March 2016

Barcelona Supercomputing
Center



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Complex System Lab.

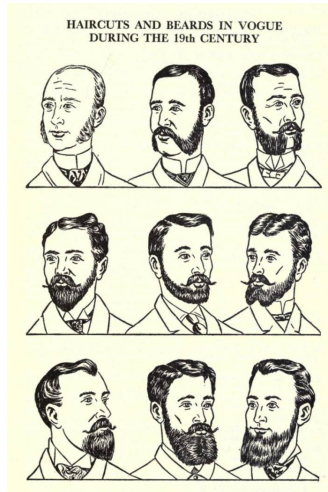


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Plan of the presentation

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

Cultural Evolution

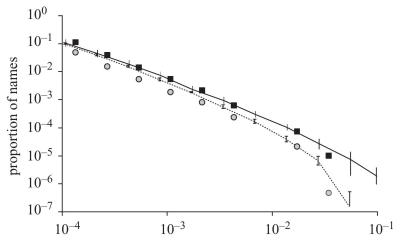


How Cultural Traits Evolve?

Cultural Evolution



Similar variants distributions

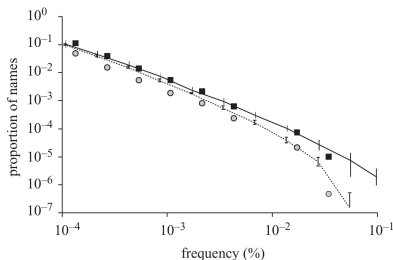


Square: male names
Circle: female names
From Bentley et al, 2004.

What Generate Those Cultural changes?

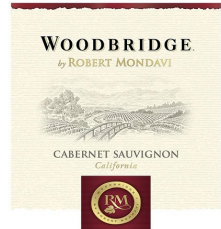
Simple mechanisms (Bentley et al, 2004):

- ▶ 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.

What happen when such mechanisms act on traits impacting economy?



Co-evolution of Economy and Culture

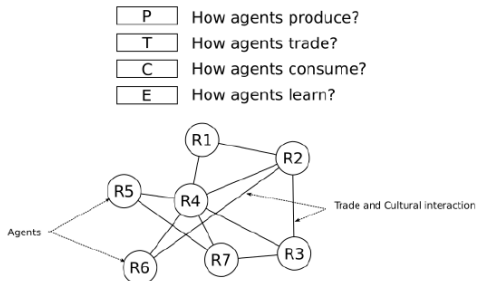
Interaction between Culture and Economy

Cultural mechanisms transom 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:

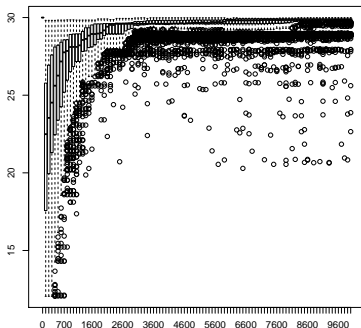
- ▶ Economic activity (cf. previous slide).
- ▶ A score is given following $f(q_n)$ a shared & fixed “utility function”.

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:

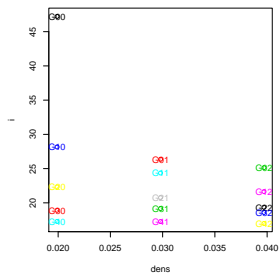
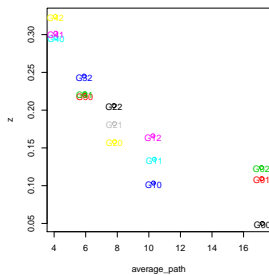
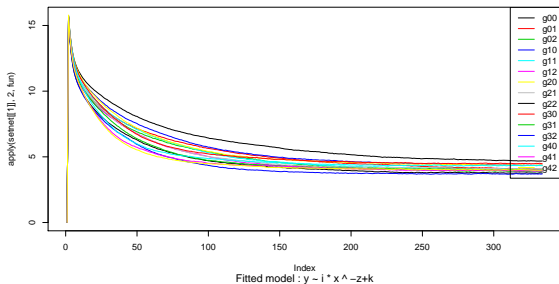
“What properties of the cultural network influe on the economic dynamics? ”

Experiments

Creation of set of network with combinaison of the properties we want to test:

AVLP:	Density:	
	D_1	D_2
A_1	Net_{11}	Net_{12}
A_2	Net_{21}	Net_{22}

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

What was the nature of Roman economy?



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Thank for you attention!