Evolution of imitation structures

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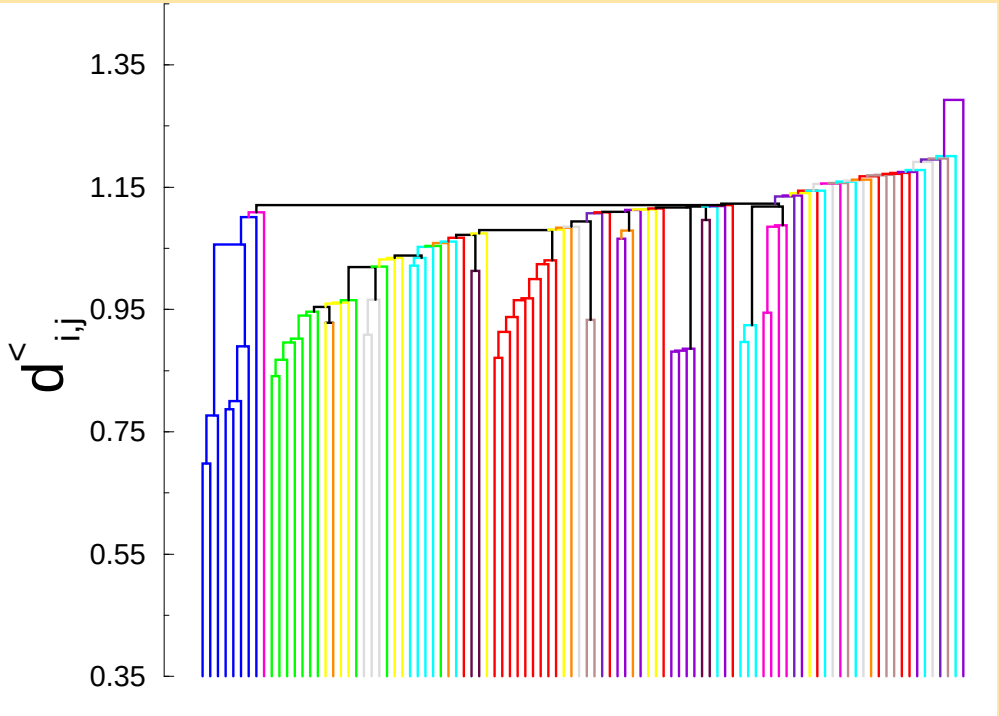
- Imitation dilemma
- Minority game with imination
- Linear chain
- Complex network
- Role of information cost

Stock correlations[G. Bonanno, F. Lillo, R. N. Mantegna, Quantitative Finance 1, 96 (2001).]



Ultrametric structure. Colors distinguish sectors, e.g. energy (blue), finance (green) etc. Time horizon 6h 30min.

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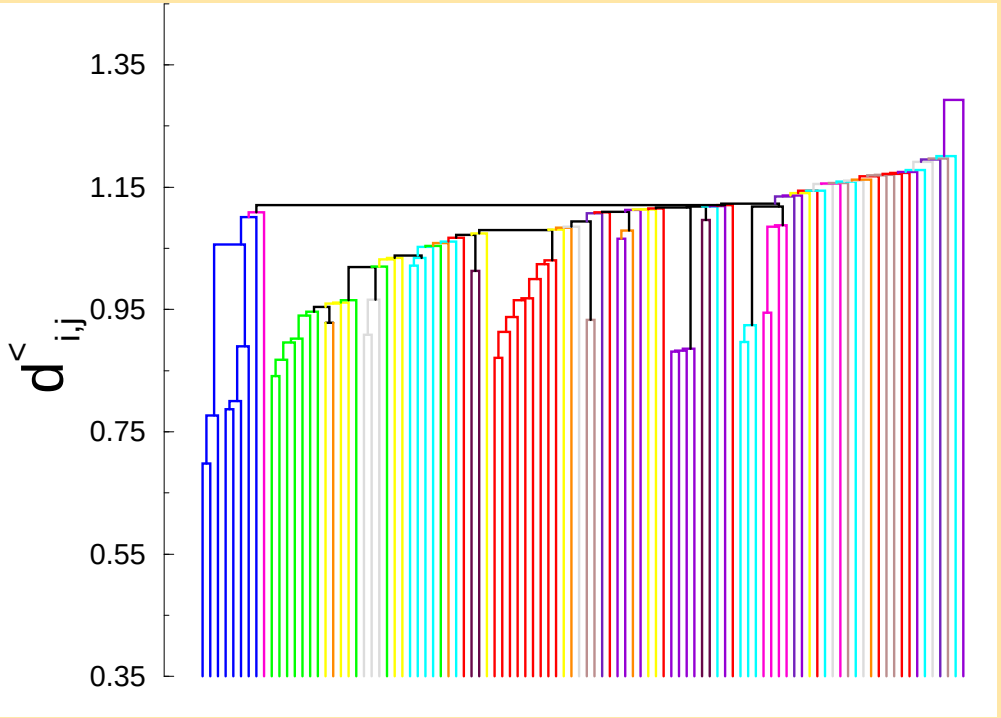

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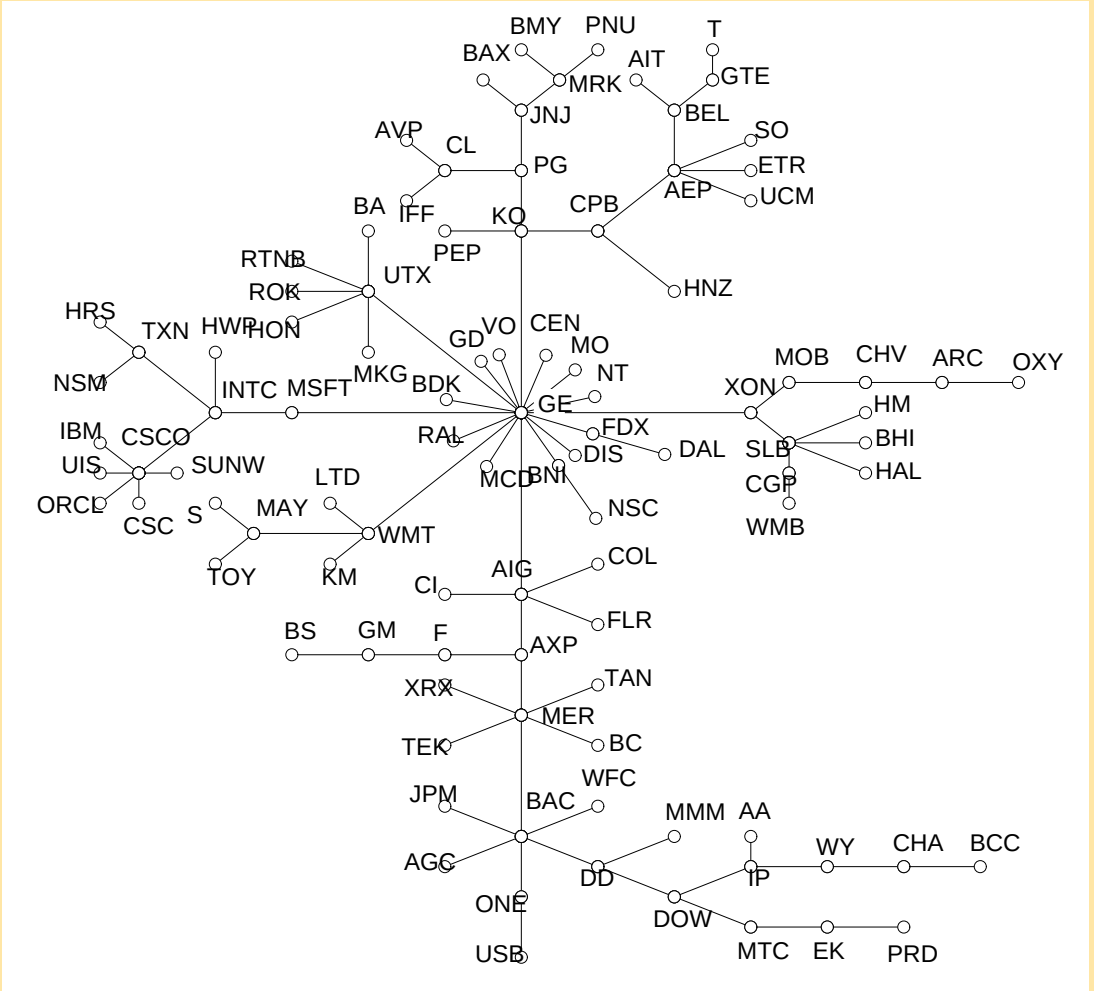
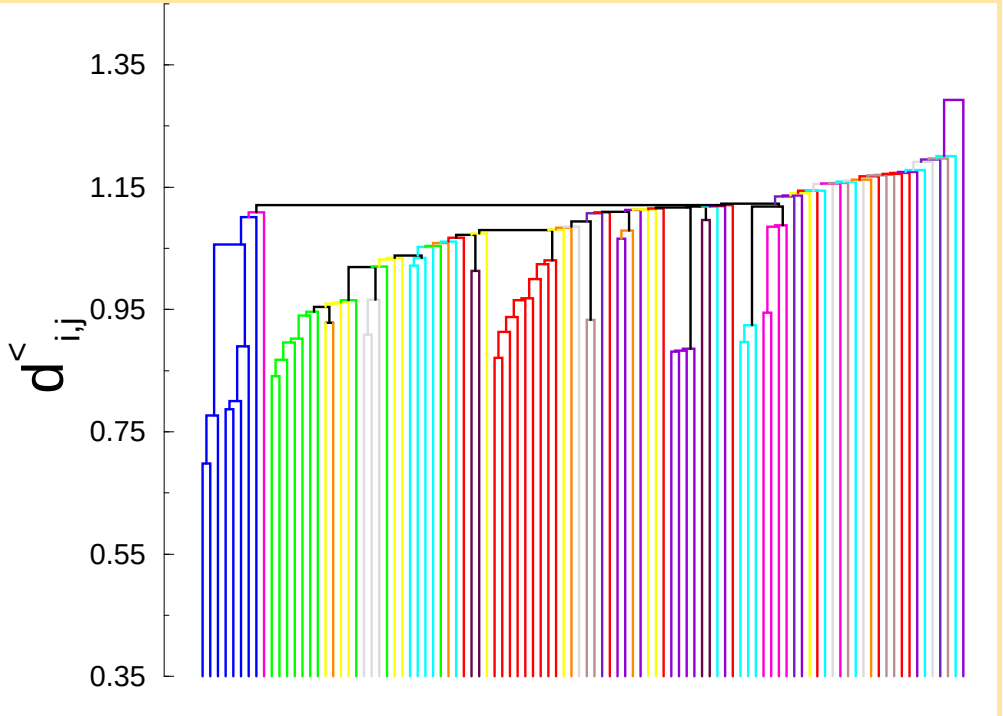


Minimum spanning tree.

Stock correlations [G. Bonanno, F. Lillo, R. N. Mantegna, Quantitative Finance 1, 96 (2001).]



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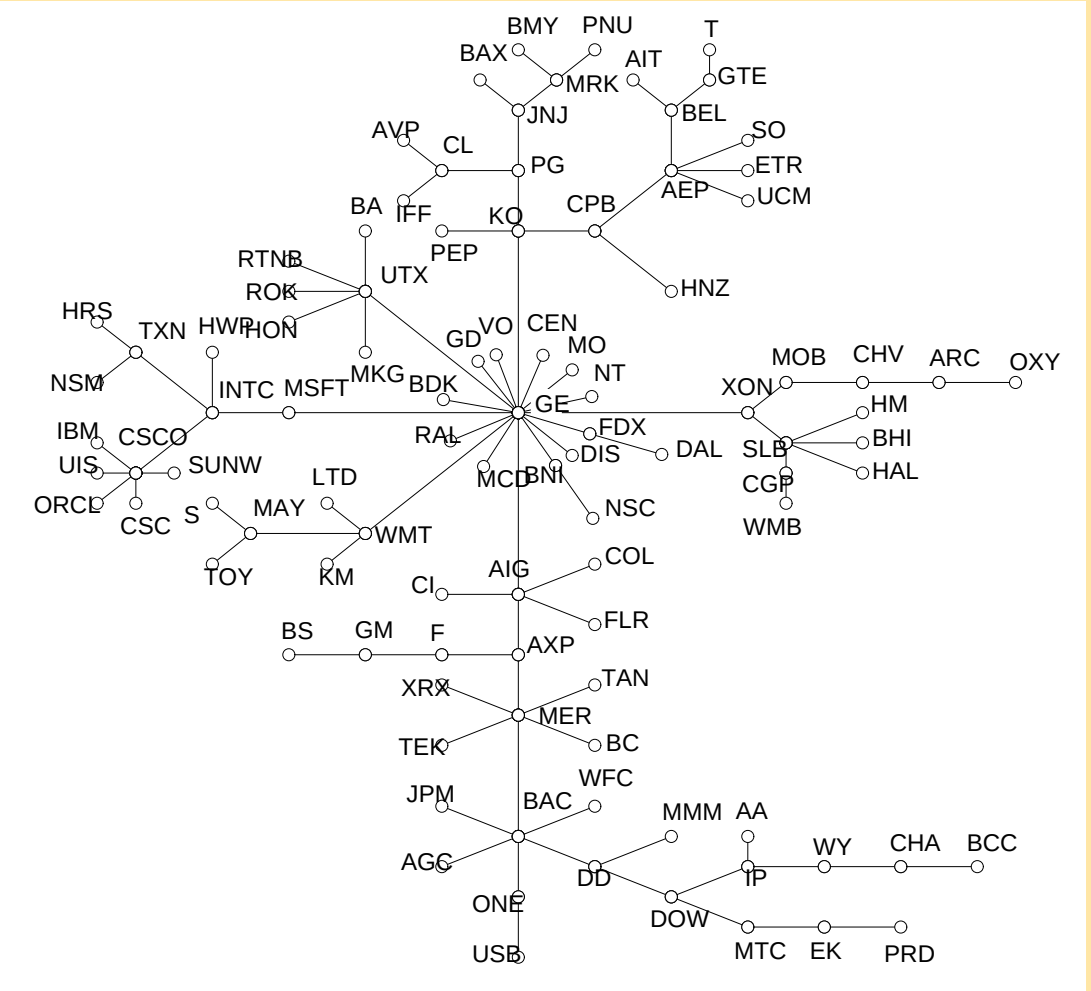
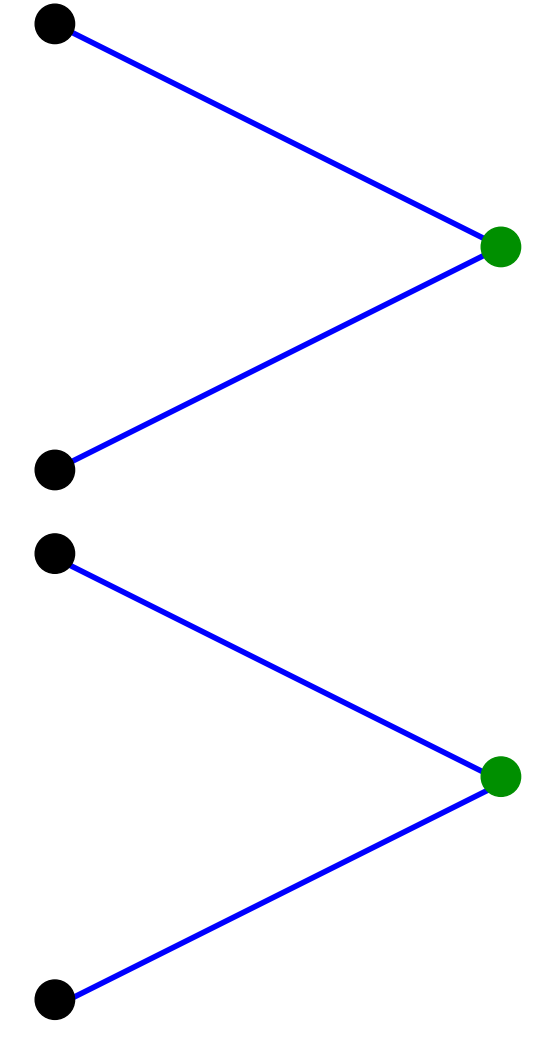


Minimum spanning tree.

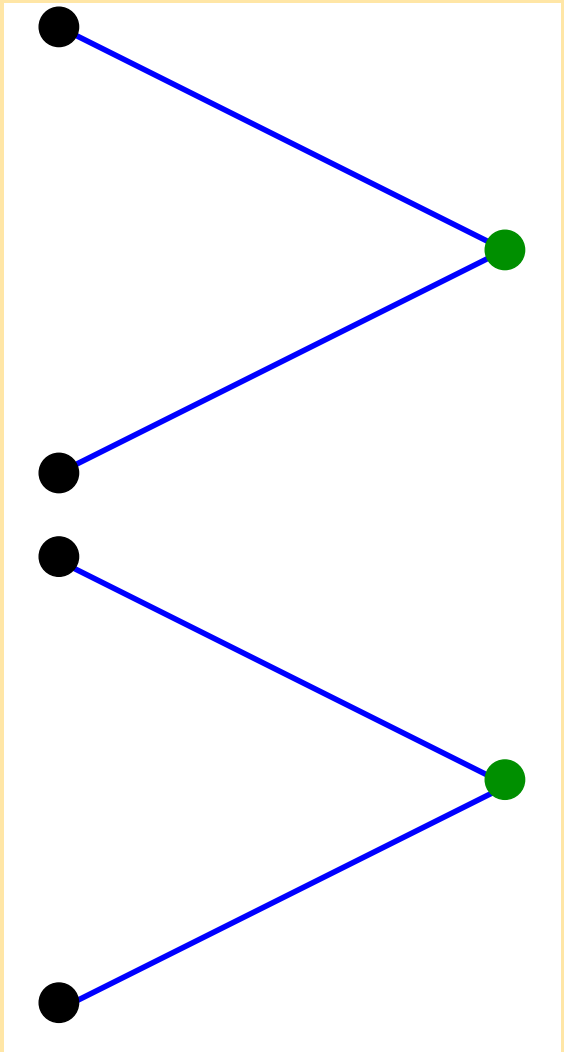
. . . Imitation (& other factors. . .)

Imitation dilemma



No imitation: fair game.

Imitation dilemma



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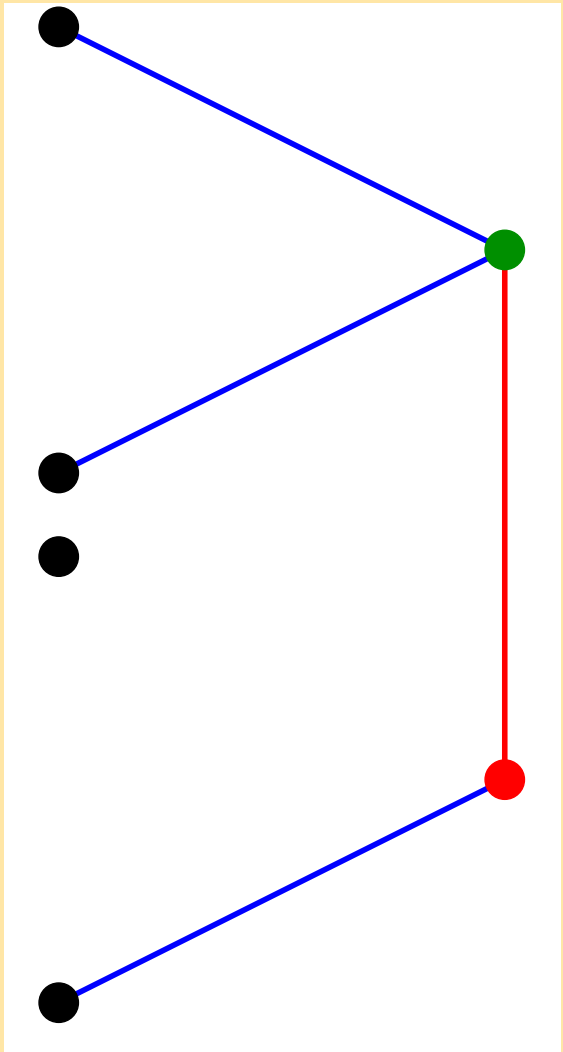
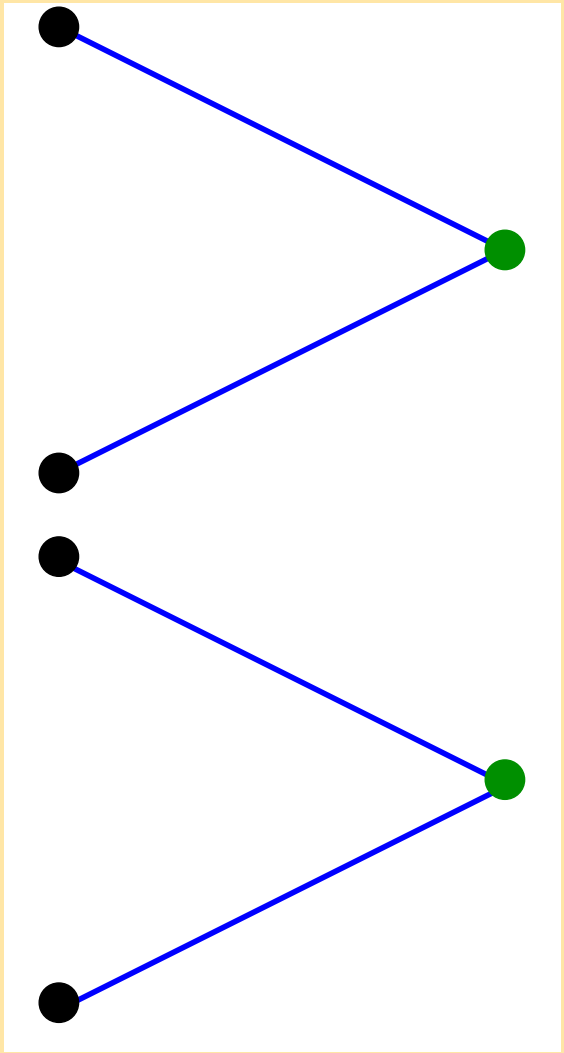


Imitation provides comparative advantage.

Imitation dilemma



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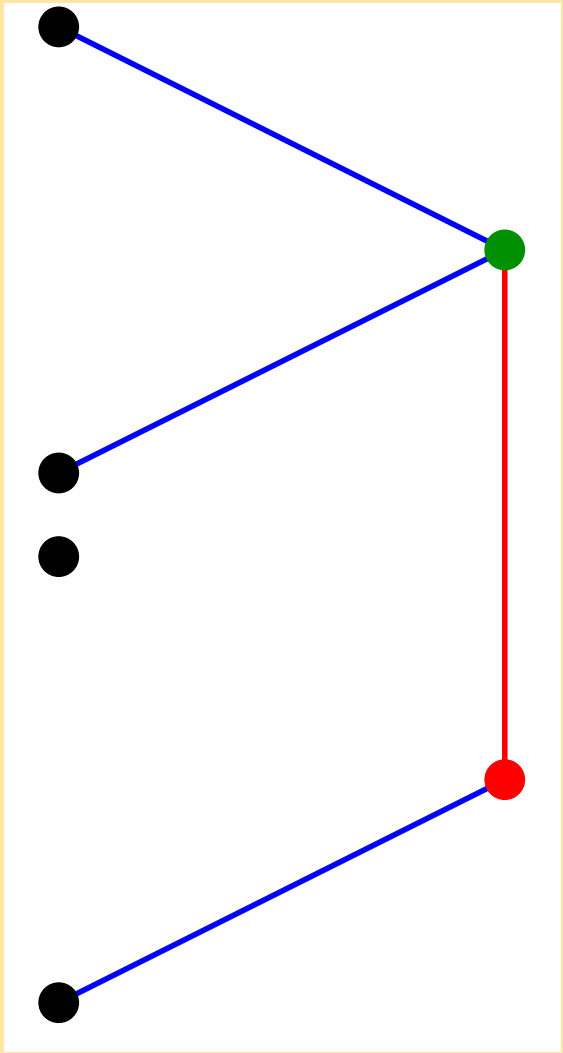

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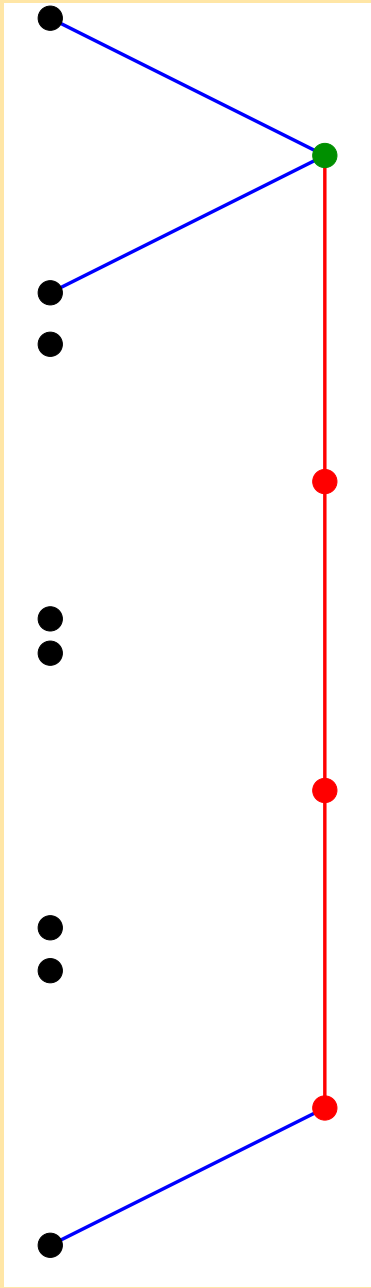
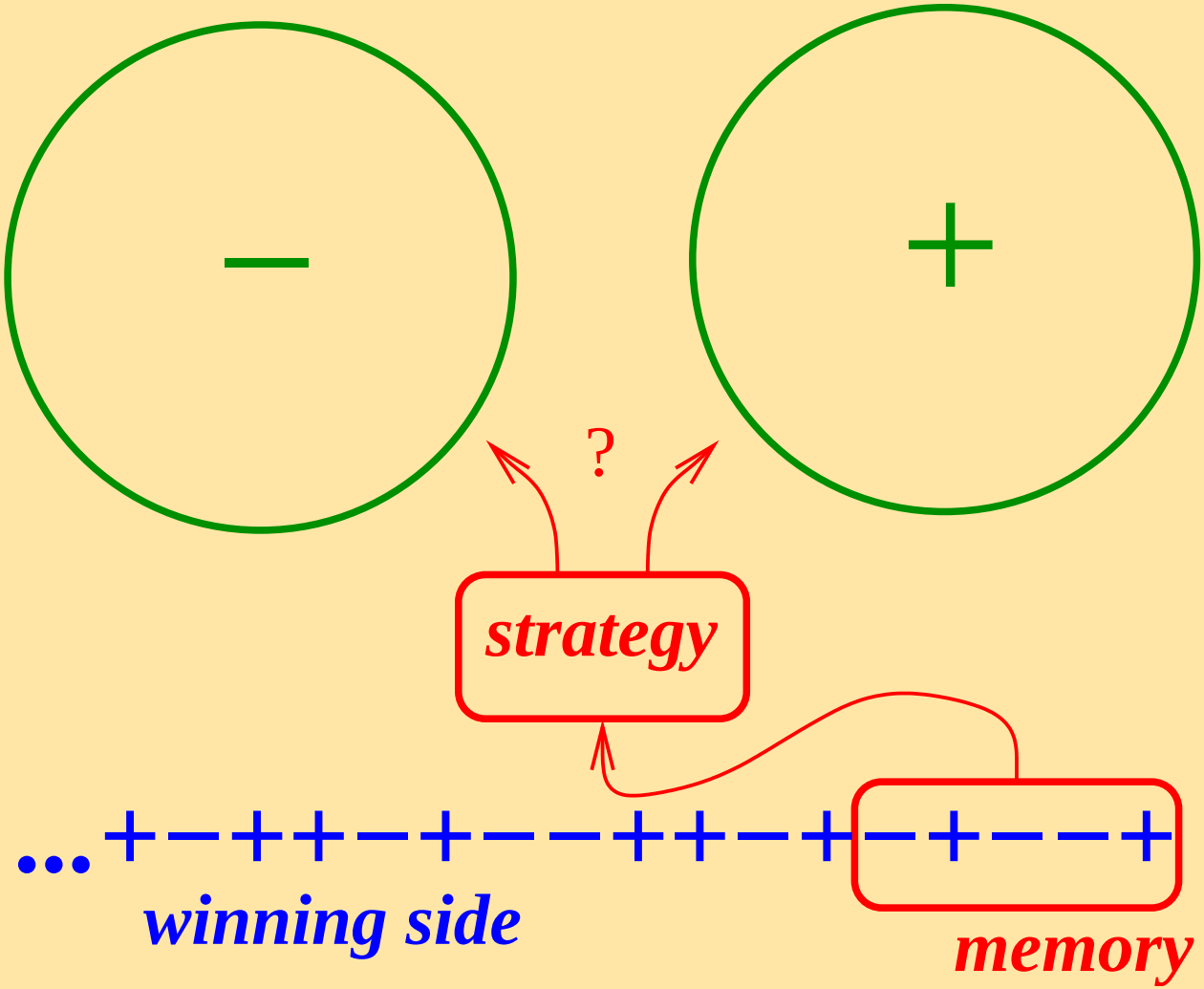
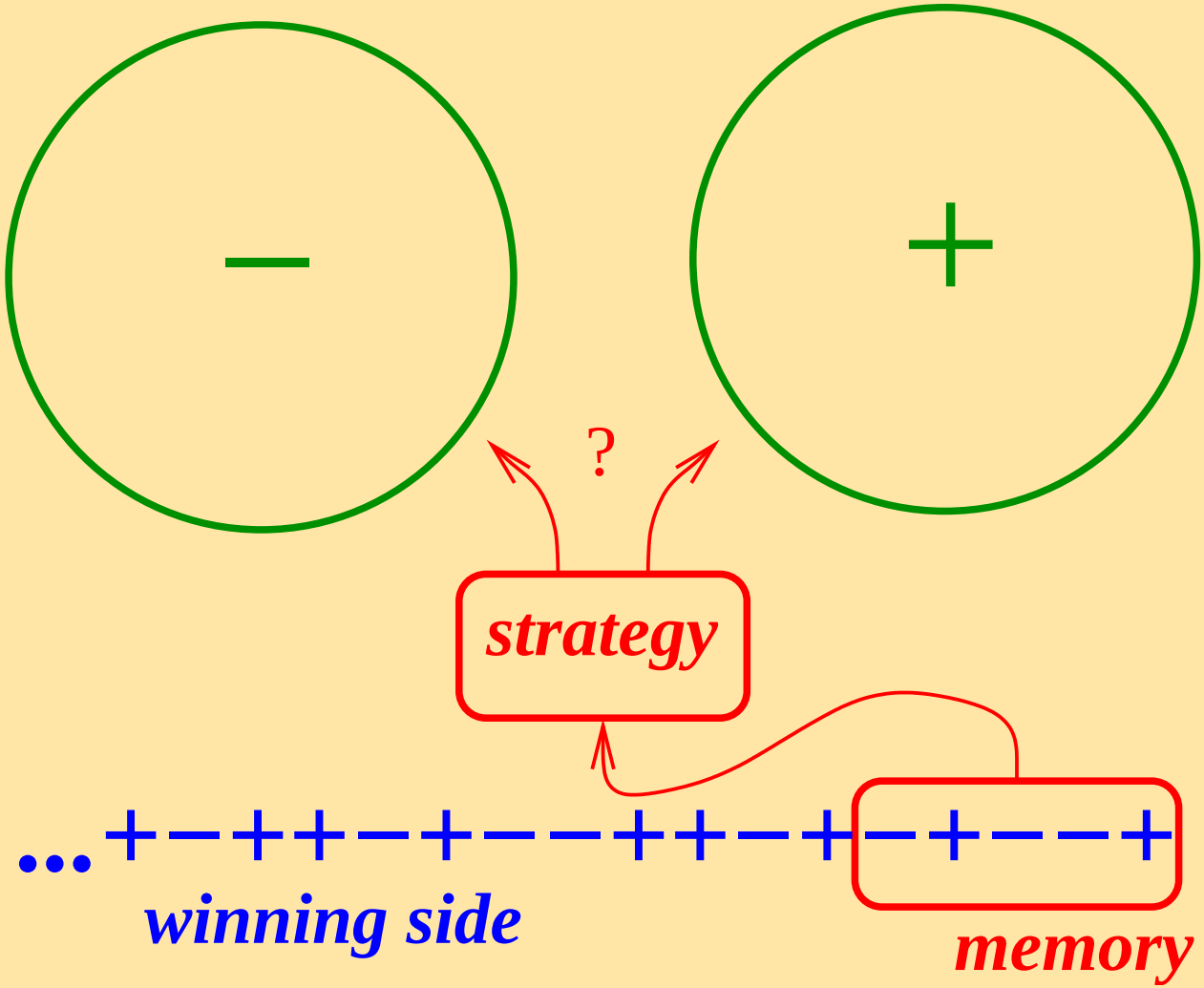


Too much imitation is harmful.

Minority Game

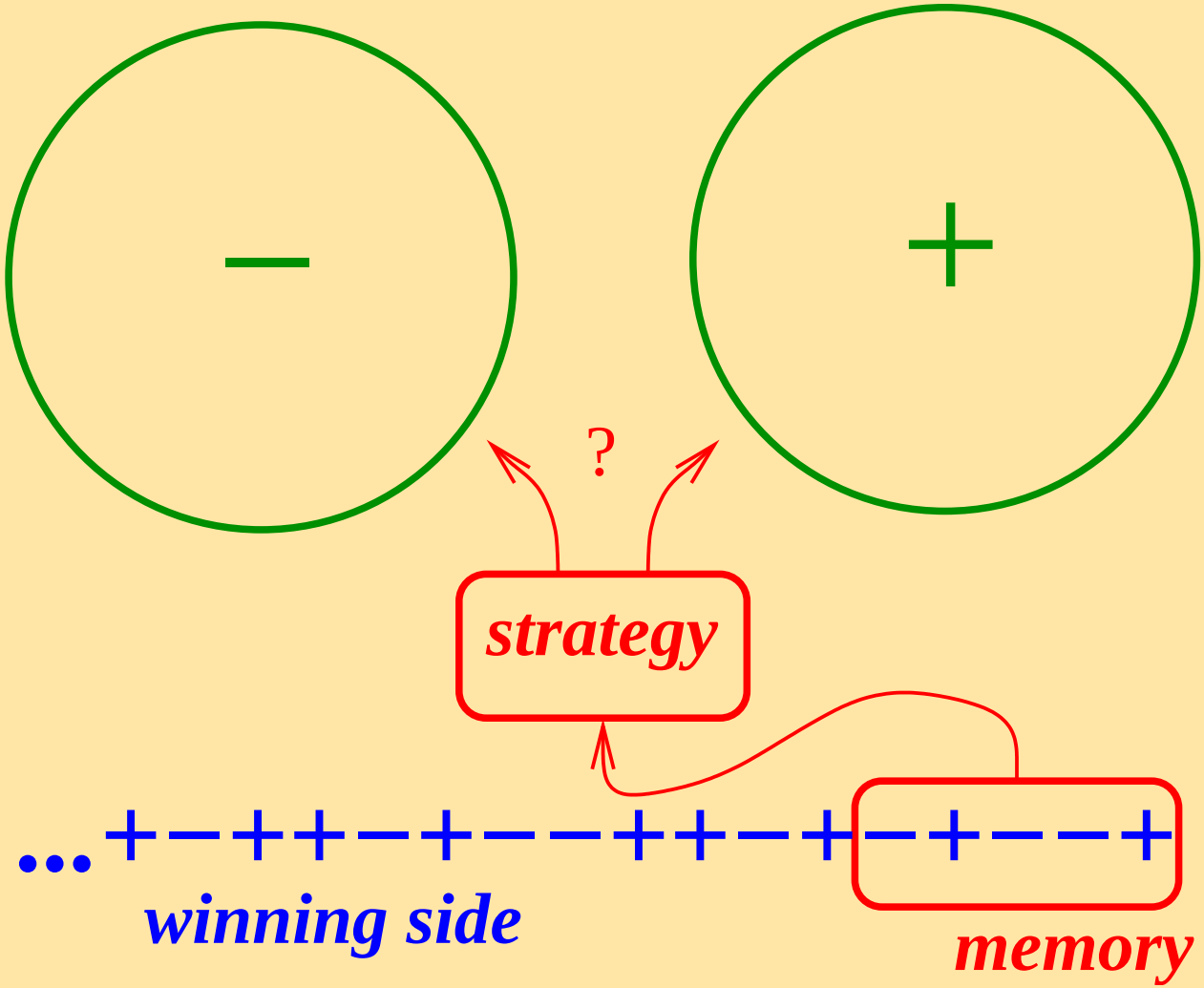


Minority Game



N agents, actions $a_i(t) \in \{-1, +1\}$

Minority Game



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Attendance $A(t) = \sum_{i=1}^{N} a_i(t)$

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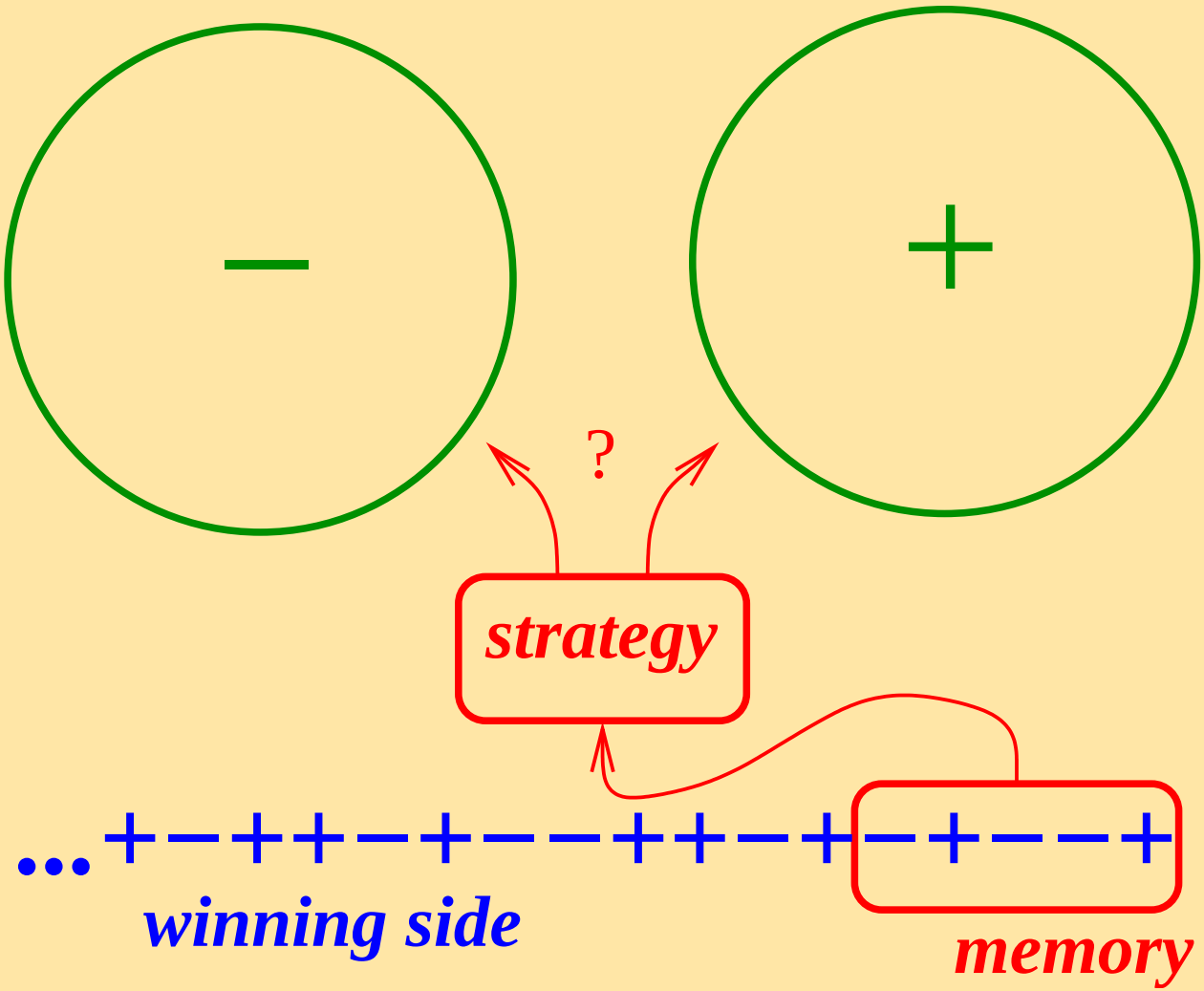

N agents, actions $a_i(t) \in \{-1, +1\}$

Attendance $A(t) = \sum_{i=1}^{N} a_i(t)$

Minority rewarded: $W_i(t) - W_i(t-1) = -a_i(t) \operatorname{sign} A(t)$

Social organization

[F. Slanina, *Physica A* **286**, 367 (2000); *Physica A* **299**, 334 (2001).]

Agents on social network imitate more successfull neighbors with probability p (and pay for it)

Leaders

Imitators

Potential imitators

Information flow

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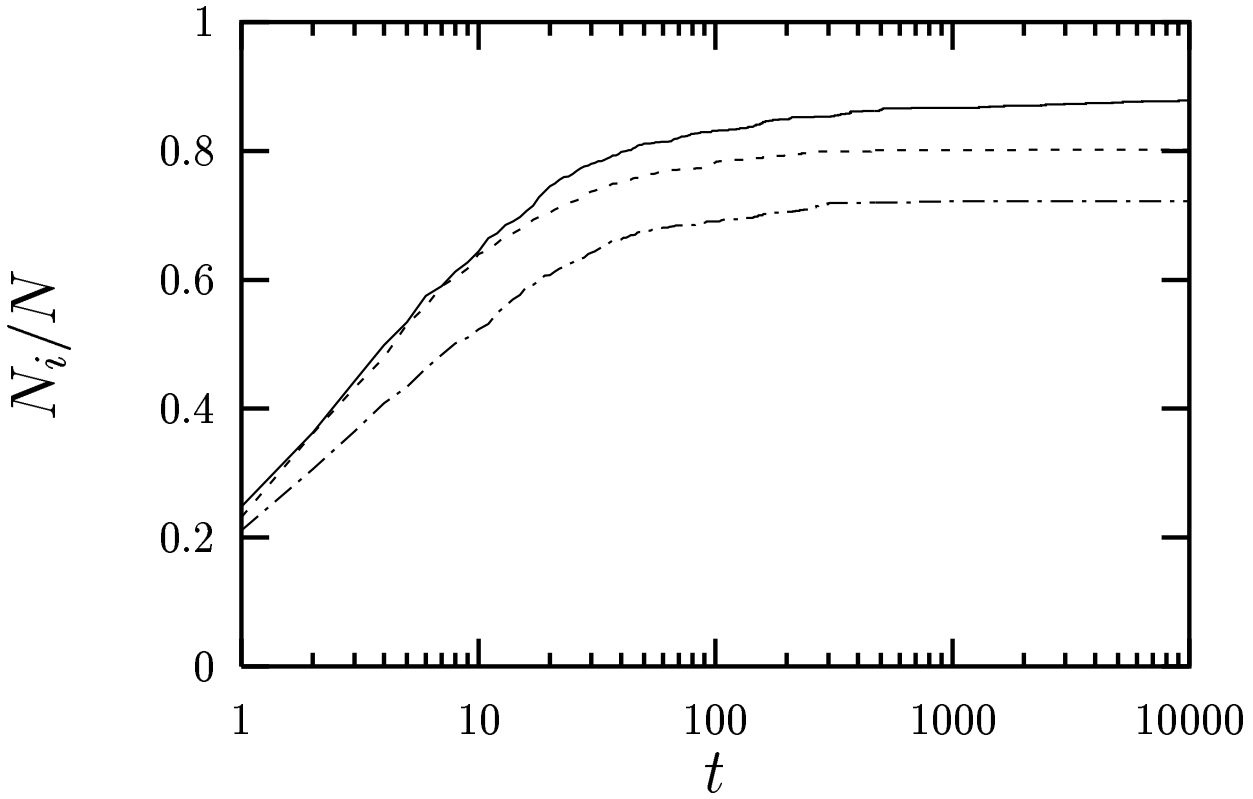


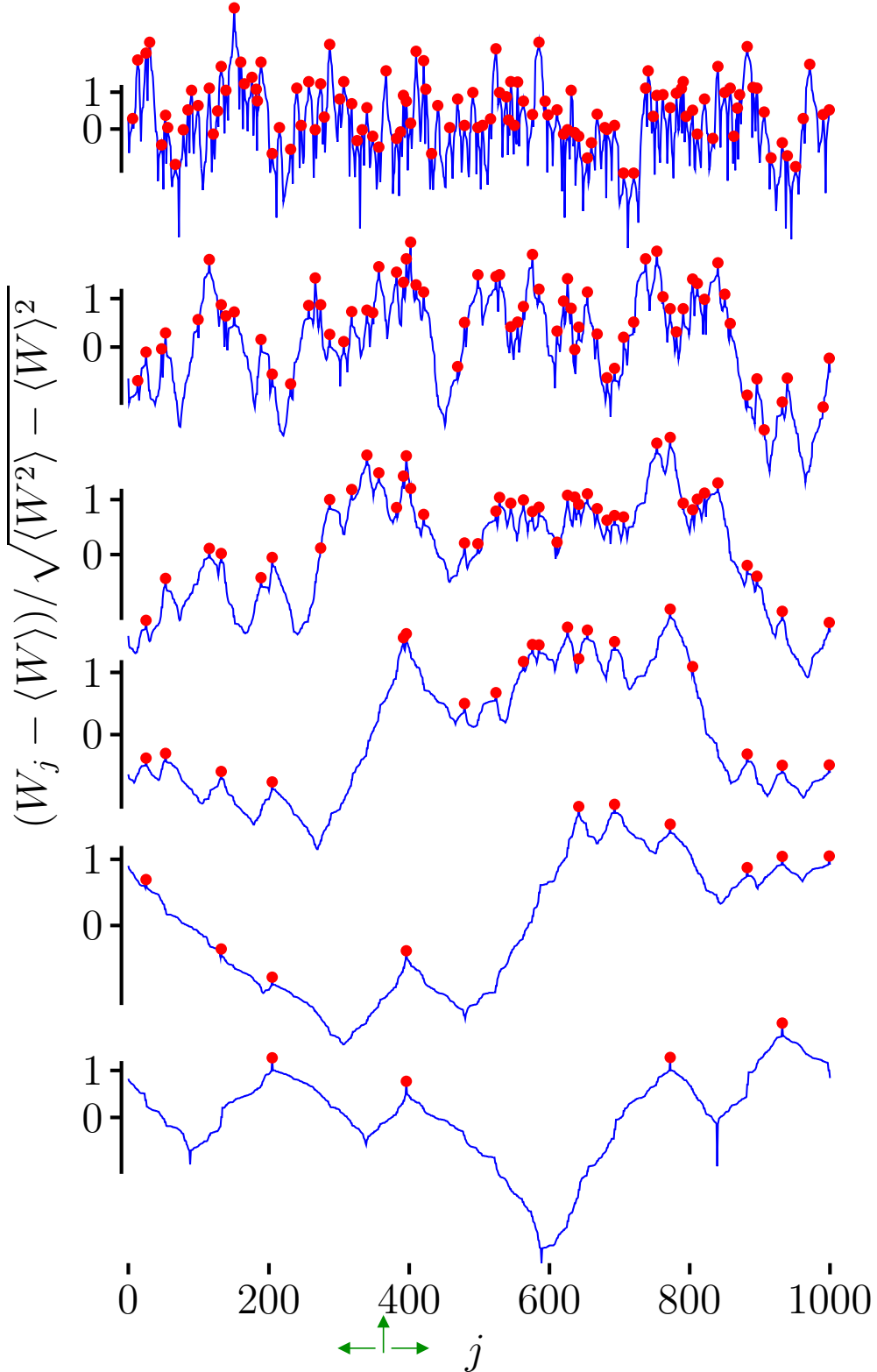
Time dependence of imitation.
$p = 0.99$ (full line) 0.95 (dashed), 0.8 (dash-dotted)

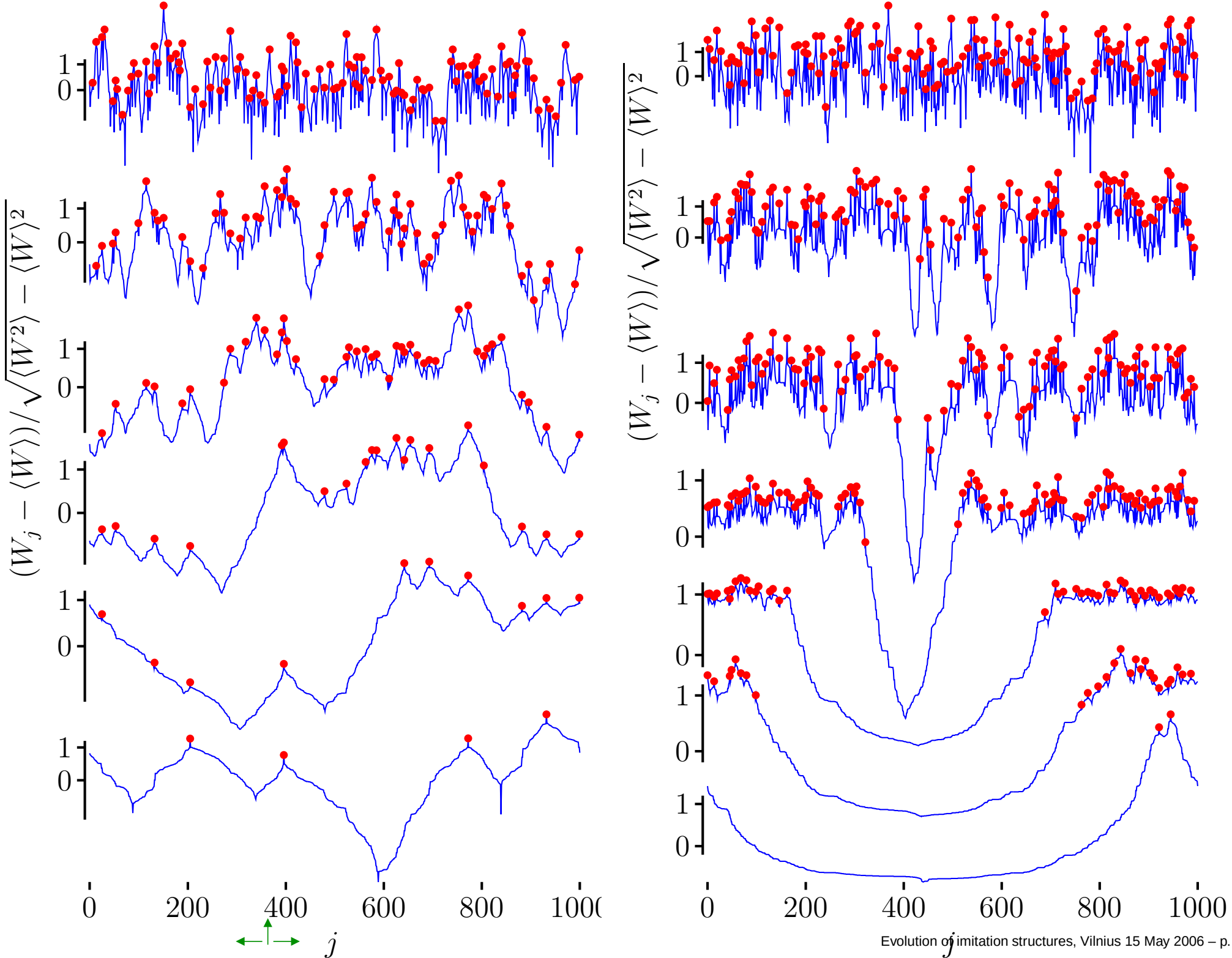
Leaders

Imitators

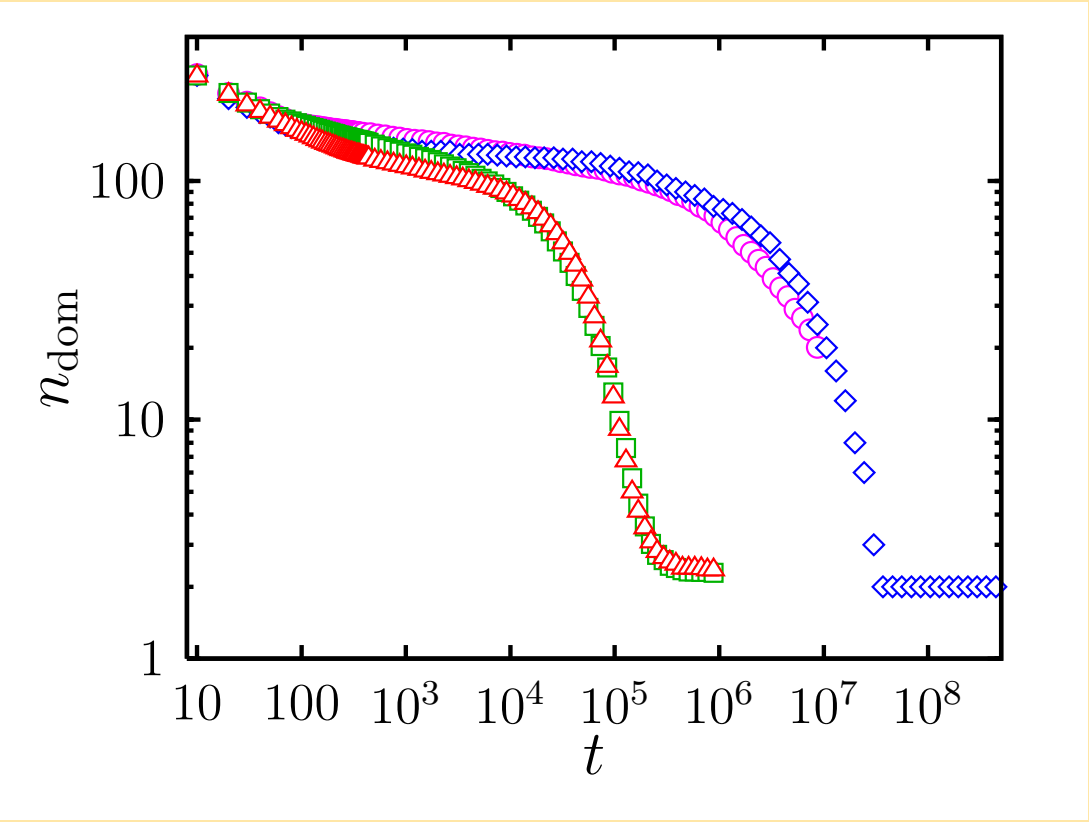
Potential imitators

Information flow


$(W_j - \langle W \rangle)/\sqrt{\langle W^2 \rangle - \langle W \rangle^2}$
1
0
1
0
1
0
1
0
1
0
1
0
0
200
400
600
800
1000
j


$(W_j - \langle W \rangle)/\sqrt{\langle W^2 \rangle - \langle W \rangle^2}$
1
0
0
200
400
600
800
1000
j

Time evolution

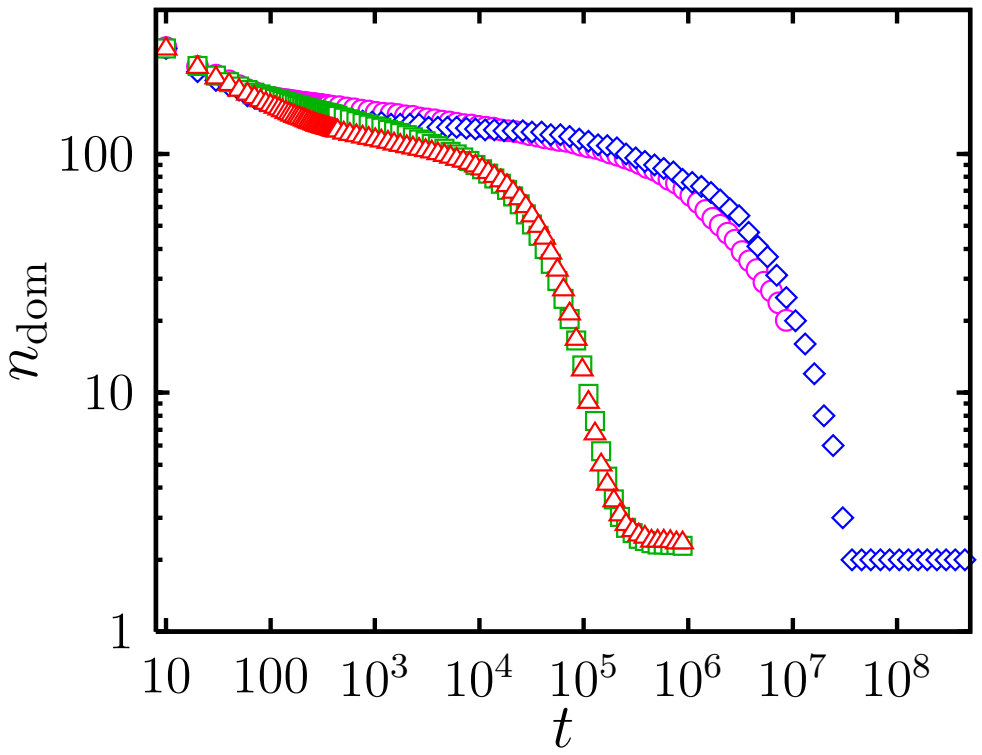


number of domains, for $N = 1001$,

$M = 6$ ($\circ$ and $\square$),$M = 10$ ($\triangle$ and $\diamond$),

$\epsilon = 0.003$ ($\square$ and $\triangle$) and $\epsilon = 0.01$ ($\circ$ and $\diamond$)

Time evolution



number of domains, for $N = 1001$,

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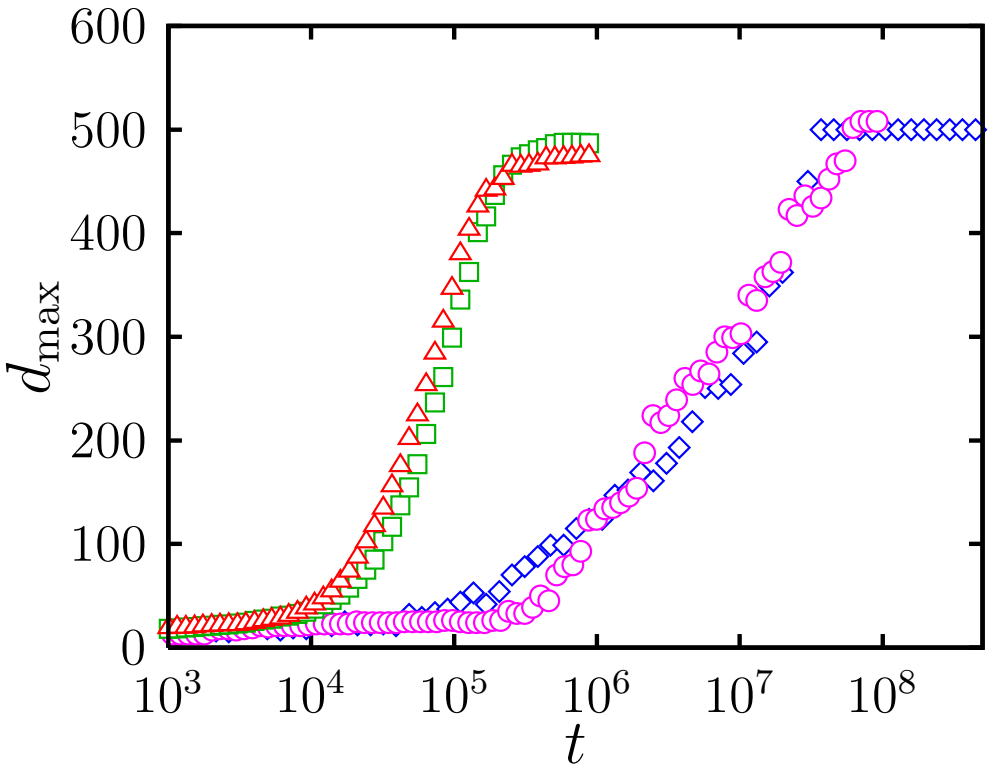
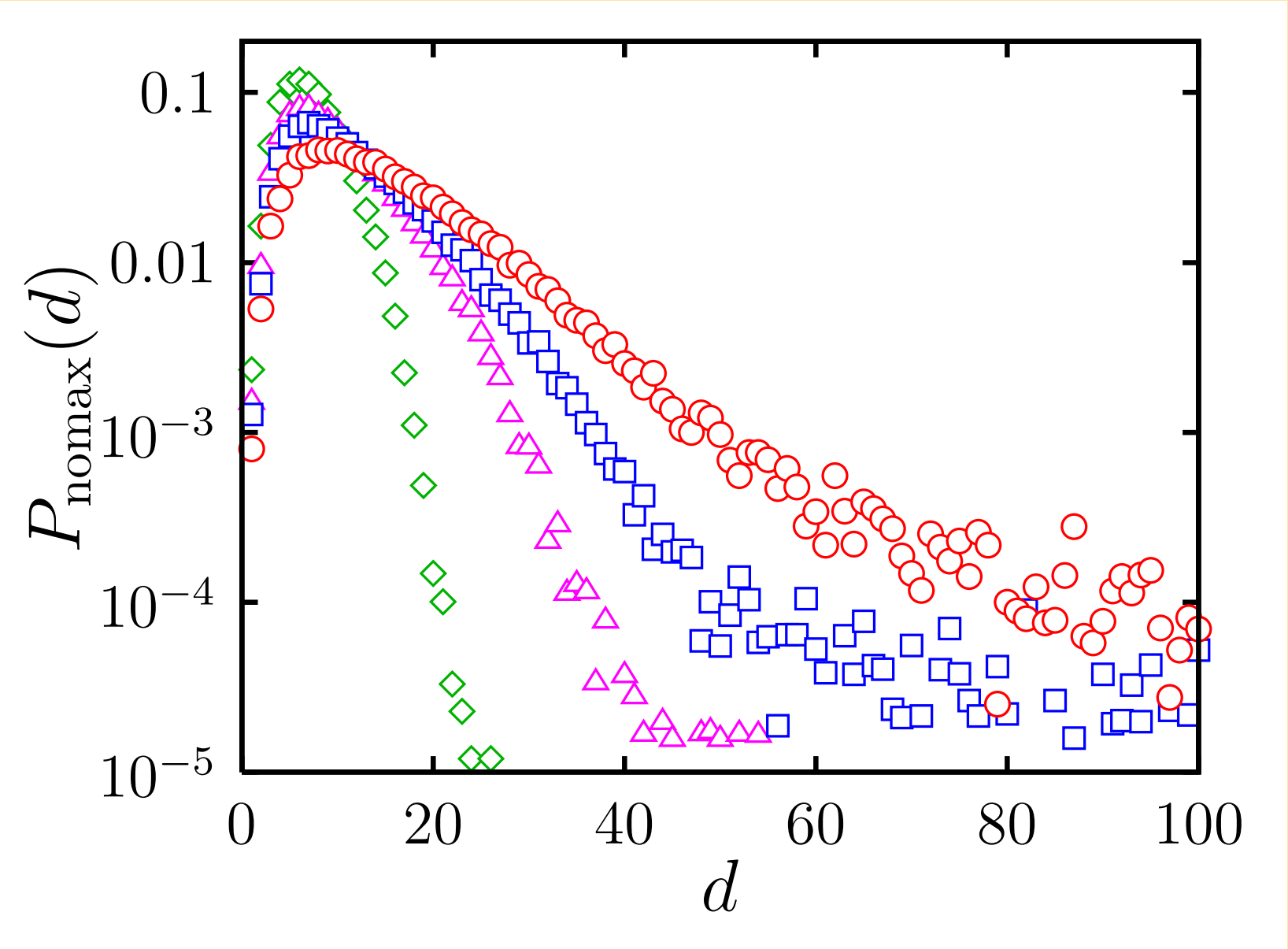


Largest domain, for $N = 1001$

$M = 6$ ($\circ$ and $\square$), $M = 10$ ($\triangle$ and $\diamond$)

$\epsilon = 0.003$ ($\square$ and $\triangle$) and $\epsilon = 0.01$ ($\circ$ and $\diamond$)

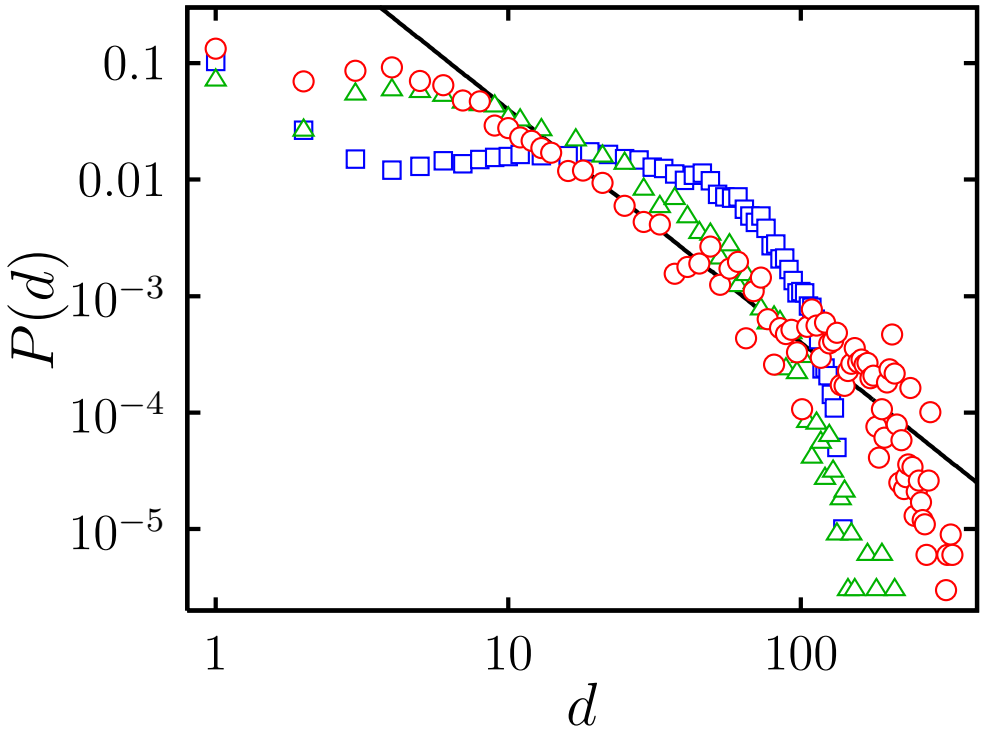
Domain distribution



At times $t = 694$ ($\diamond$), $t = 6157$ ($\triangle$), $t = 12741$ ($\square$), and $t = 26365$ ($\circ$).

The parameters of the model are $N = 1001$, $M = 6$, $\epsilon = 0.003$.

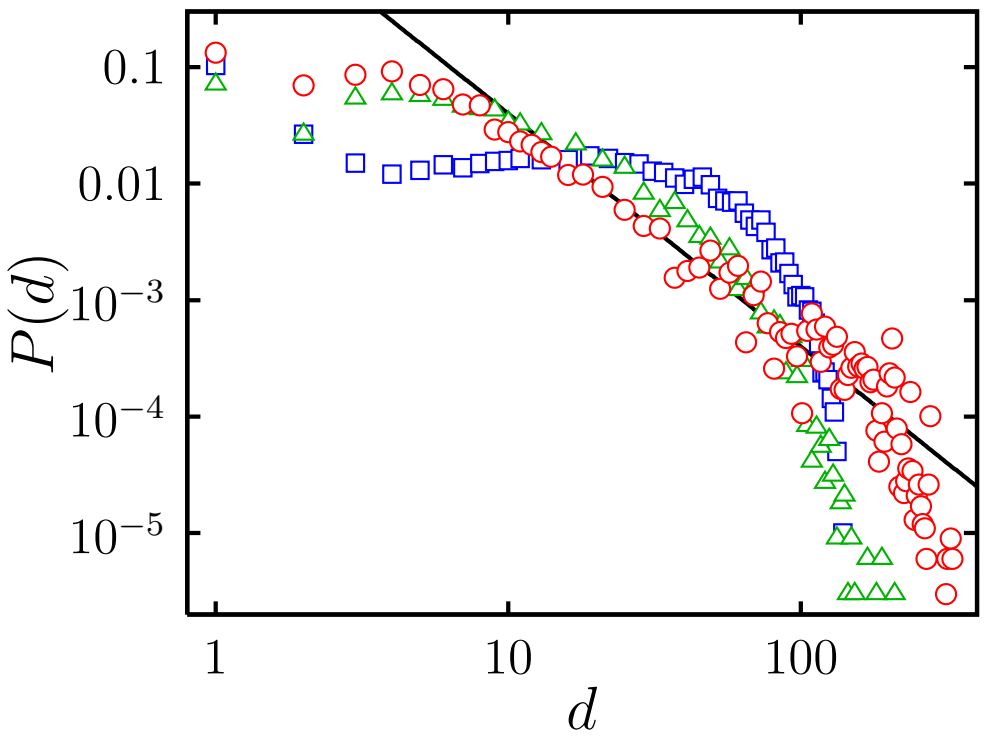
Barabási-Albert graph



Domain sizes

$\epsilon = 0.0$ (□), $\epsilon = 0.01$ (△), $\epsilon = 0.1$ (○)

Barabási-Albert graph



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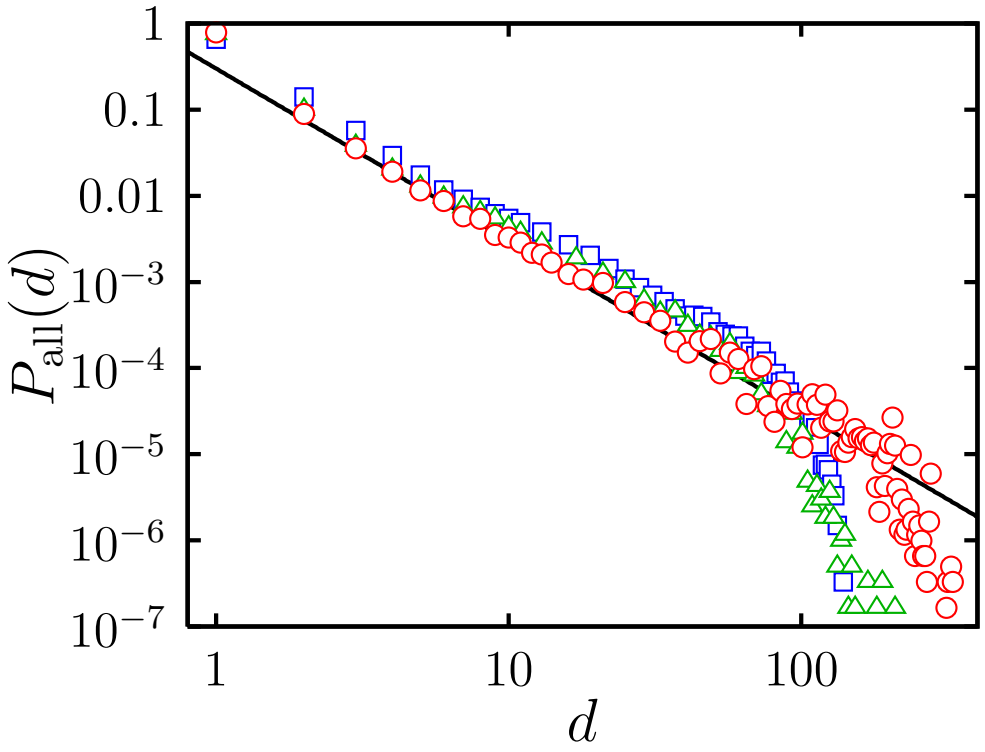
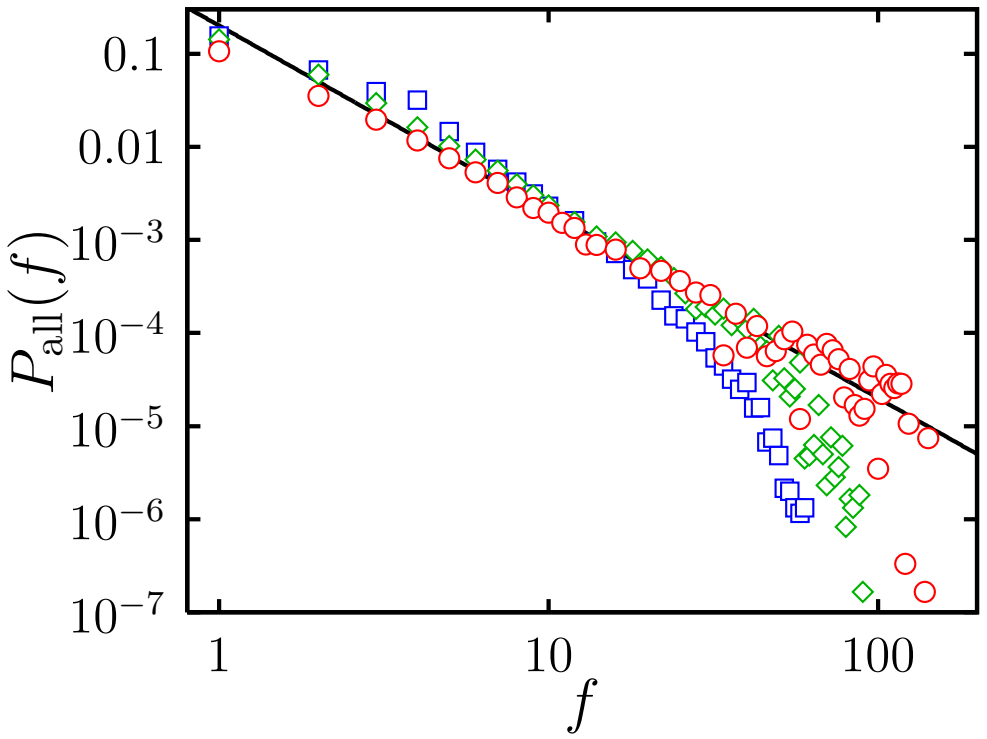


Number of followers

$\epsilon = 0.0$ (□), $\epsilon = 0.01$ (△), $\epsilon = 0.1$ (○).

Line: $\sim d^{-2}$.

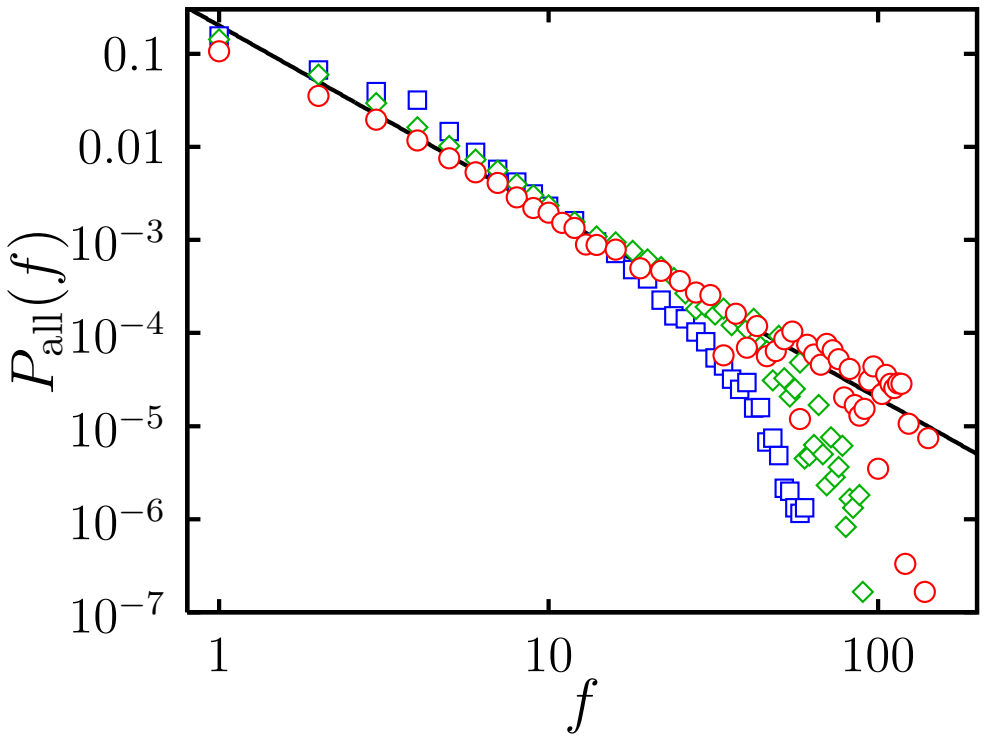
Forking



Forking distribution: all agents

$\epsilon = 0.0$ (□), $\epsilon = 0.1$ (○), $\epsilon = 0.001$ (◇)

Forking



Forking distribution: all agents

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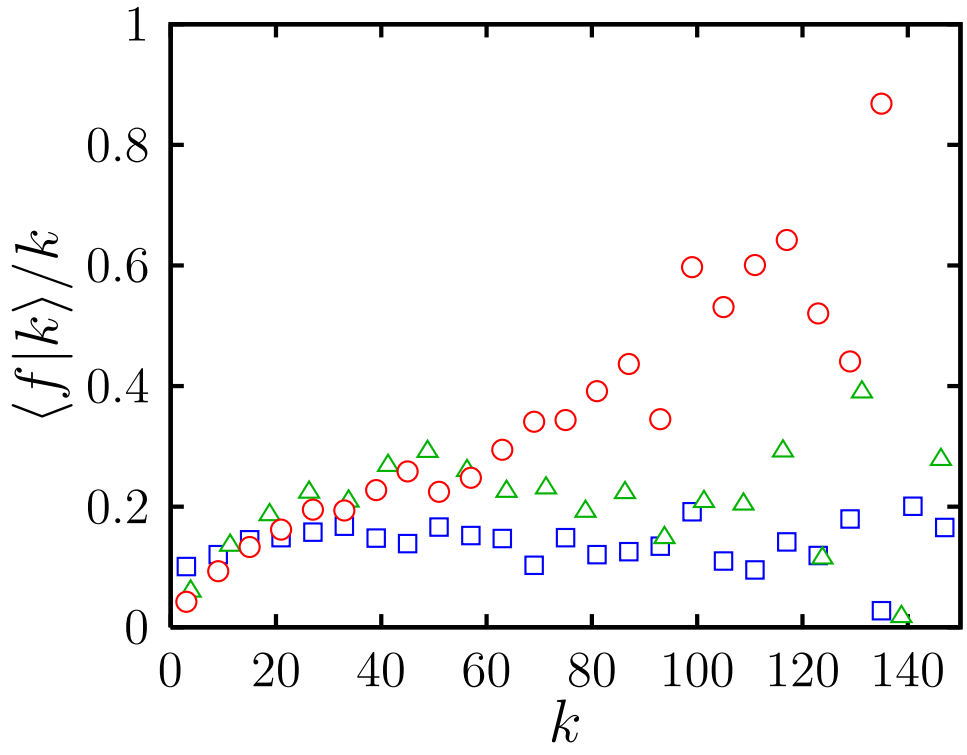
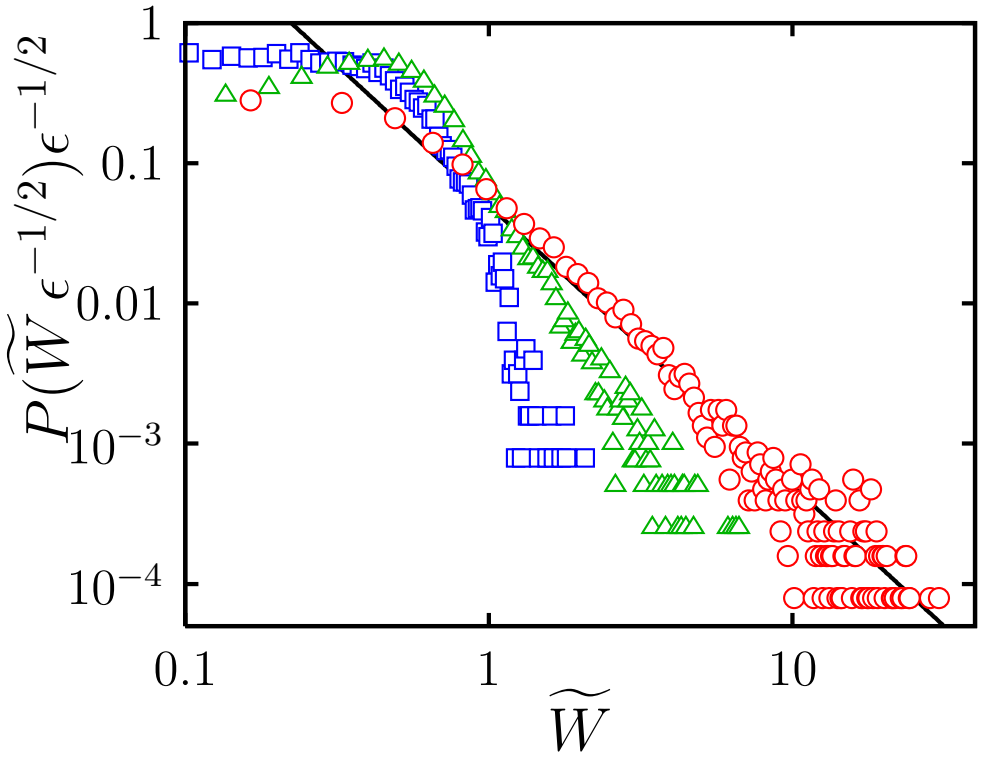


Average forking vs. degree

$\epsilon = 0.0$ (□), $\epsilon = 0.01$ (△), $\epsilon = 0.1$ (○)

Wealth

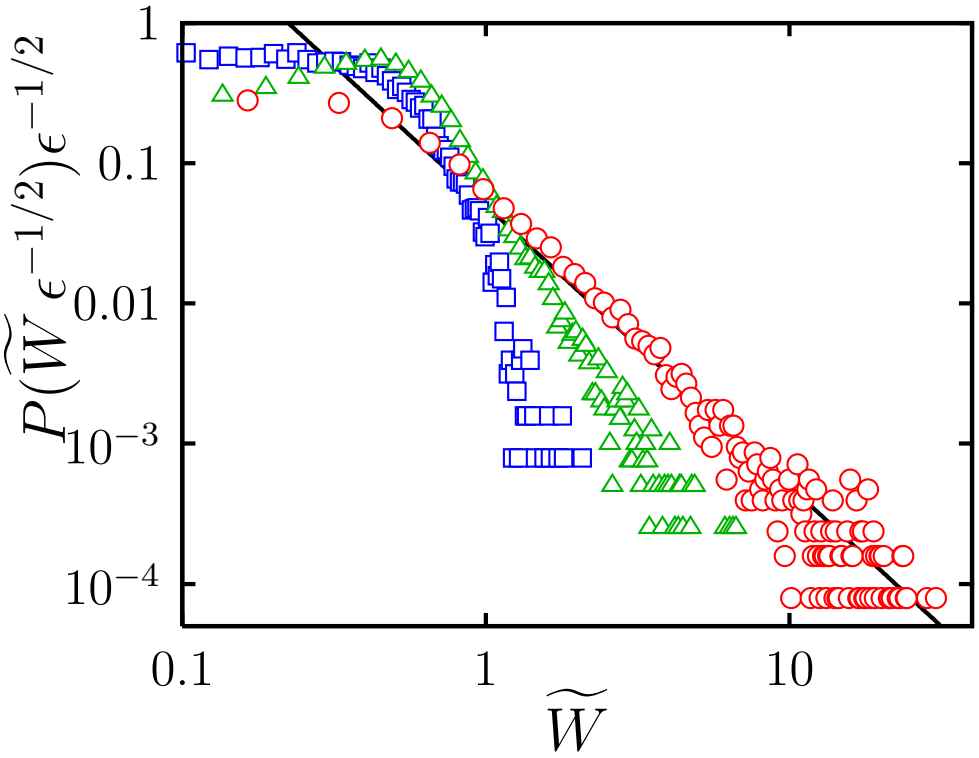


Wealth distribution.

$\epsilon = 0.1$ ($\circ$), $\epsilon = 0.01$ ($\square$), $\epsilon = 0.001$ ($\triangle$).

Line: $\sim \widetilde{W}^{-2}$

Wealth



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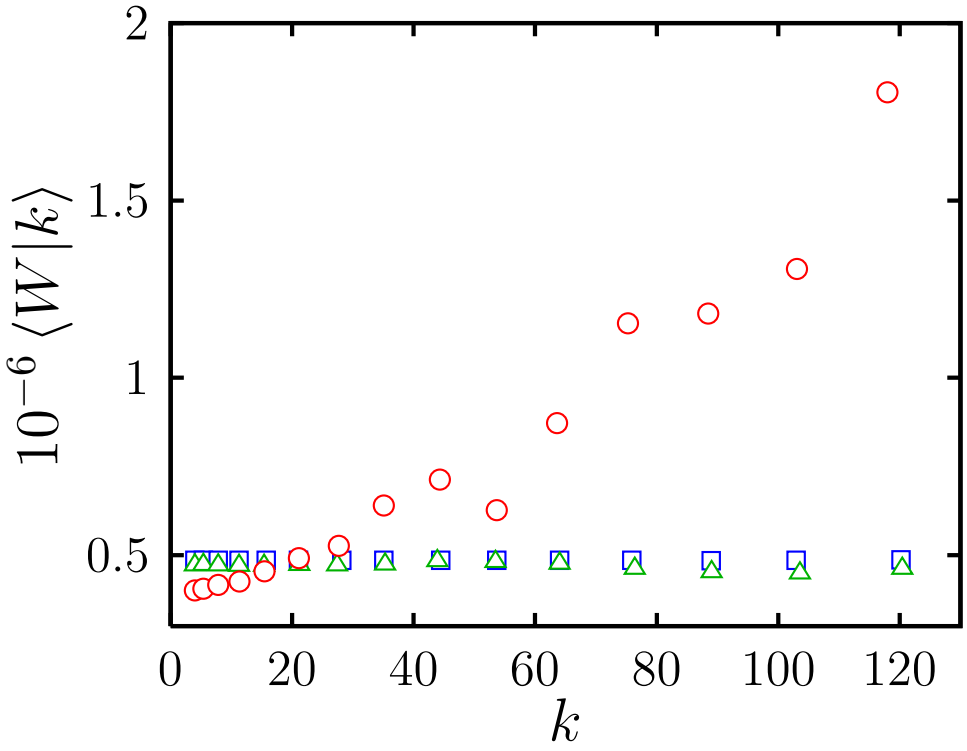

Wealth vs. degree

$\epsilon = 0.0$ ($\square$), $\epsilon = 0.1$ ($\circ$), $\epsilon = 0.01$ ($\triangle$).

Role of information cost

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1. linear chain

- wealth profile

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2. complex network (e. g. BA)

- power-law in distribution of domains

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- wealth profile

2. complex network (e. g. BA)

- power-law in distribution of domains
- detto in forking distribution
- detto in wealth distribution
- “supersaturation” in forking

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- “supersaturation” in forking
- wealth proportional to degree

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- detto in forking distribution
- detto in wealth distribution
- “supersaturation” in forking
- wealth proportional to degree

$\Rightarrow$ combined with imitation creates “rich gets richer”