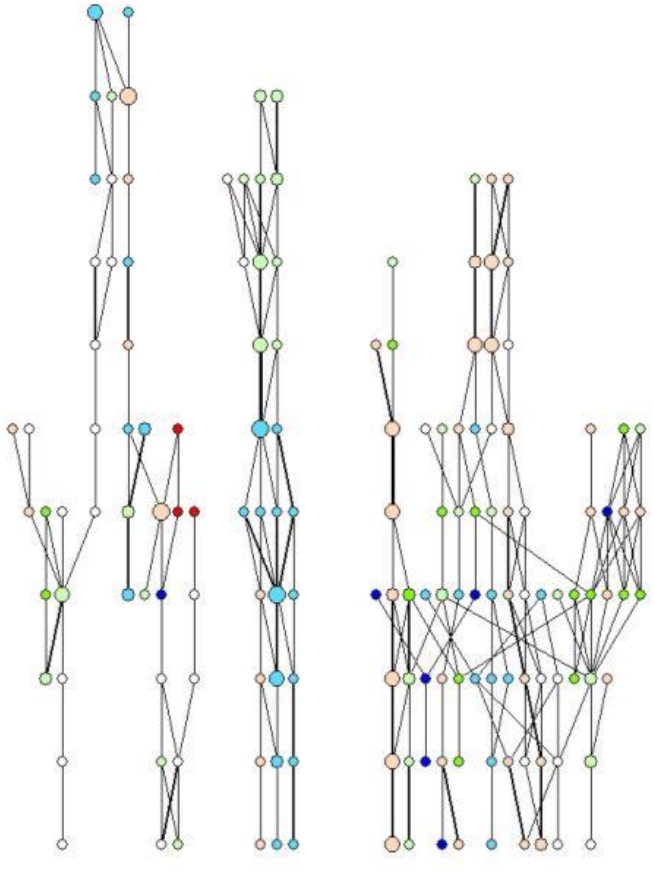
FAS from networks to strategy research

Structural Folds:
Generative Disruption in Overlapping Groups



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AJS, January 2010:

Vedres, Balázs, and David Stark. 2010.
"Structural Folds: Generative Disruption
in Overlapping Groups."
American Journal of Sociology, 115(4)

Group cohesion as a sociological concept

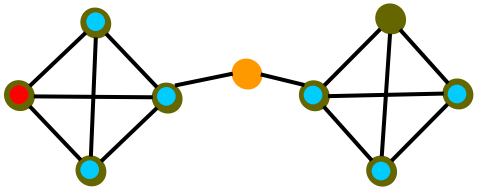
- Founding moments
  - Persistence
    - "The persistence of social groups."
      (Simmel 1898)
    - "The forces holding the individual within the groupings in which they are."
      (Moreno and Jennings 1937:371)
  - Overlapping
    - "The web of group affiliations."
      (Simmel 1922)

- Contemporary
  - A-temporal, cross sectional
    - "Cohesive subgroups are subsets of actors among which there are relatively strong ties."
      (Wasserman and Faust 1994)
  - Exclusive
    - "Groups…overlap very little if at all."
      (Freeman 1992)

Entrepreneurship and cohesive groups

By current thinking:

- Entrepreneurs are brokers taxing flows (Burt)

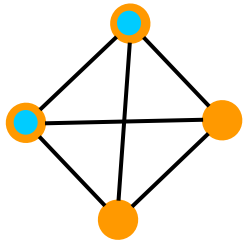


Our rethinking:

- Networks of flow – networks of alliances
  - Why would business networks be maintained for things that flow easily?
  - Embedded ties of alliances
    (Granovetter 2005; Uzzi 1997; Lincoln and Gerlach 2004)

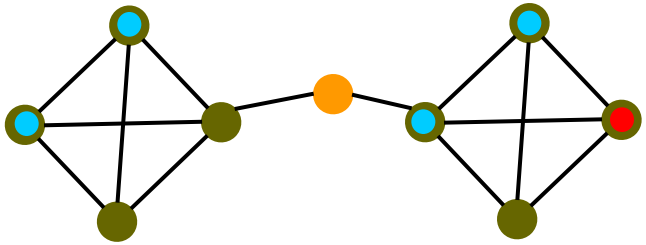
- Trust and access
  - Why would outsiders be granted access to resources formed within groups?

Intercohesion



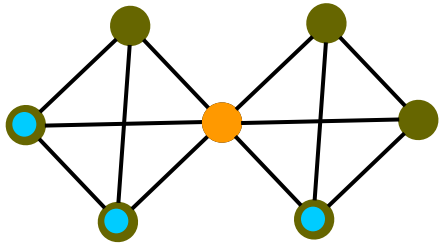
Intra-cohesion

- Group size
- Homophily
- Power



Extra-cohesion

- Brokerage
- Reachability
- Long distance ties



Inter-cohesion

- Multiple insider
- Combiner
- Tension point

The post-socialist case

- Network evolution from its inception
  - 1988 January 1st: corporate form established
- Epoch of profound transformations
  - state ownership decreases from 98% to 12%
  - foreign ownership increases from 0.5% to 60%
  - from COMECON market loss to global integration
- Substantial coverage of a small economy
  - 80% of export revenues
  - half of the GDP
  - more than a third of all employment

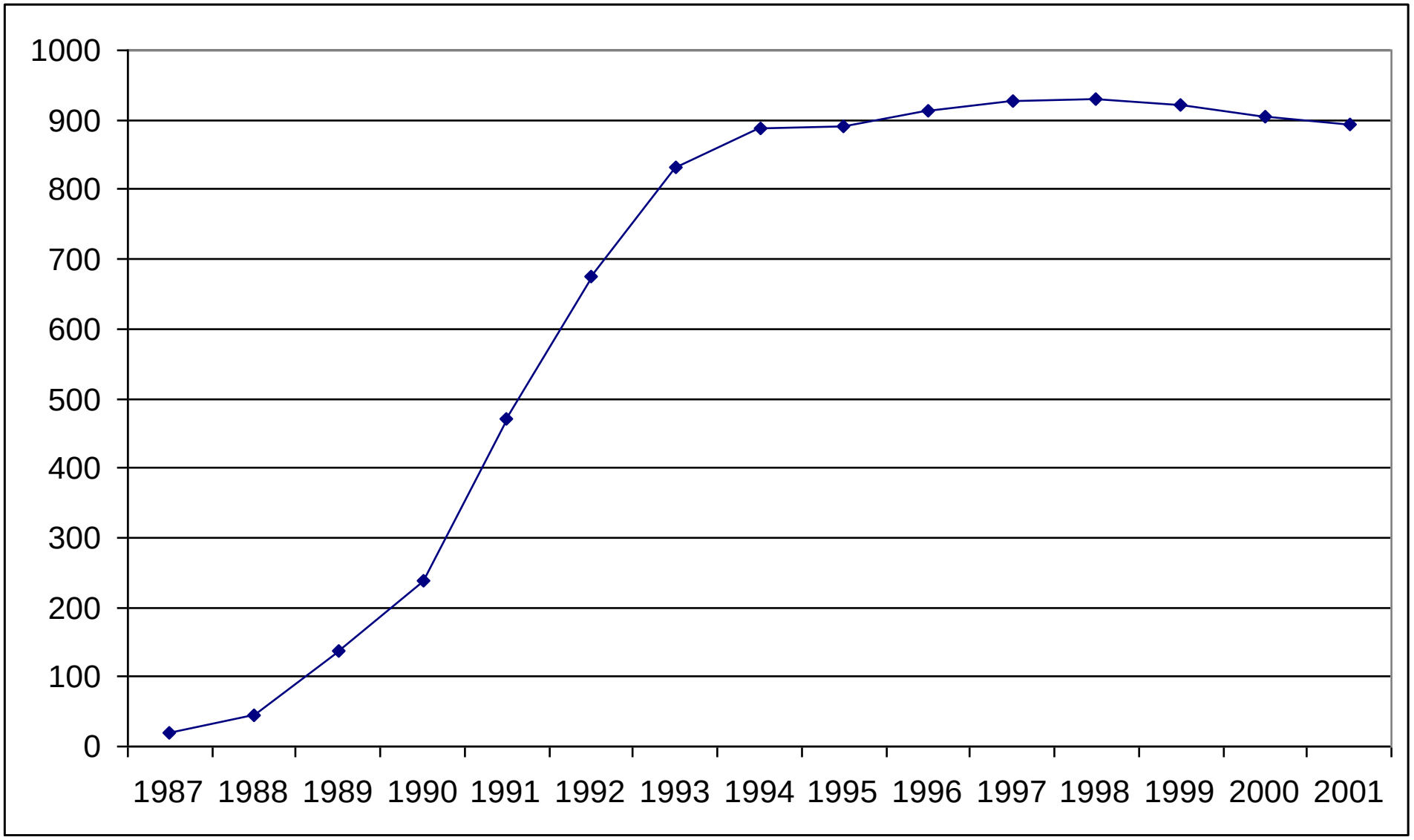
Data

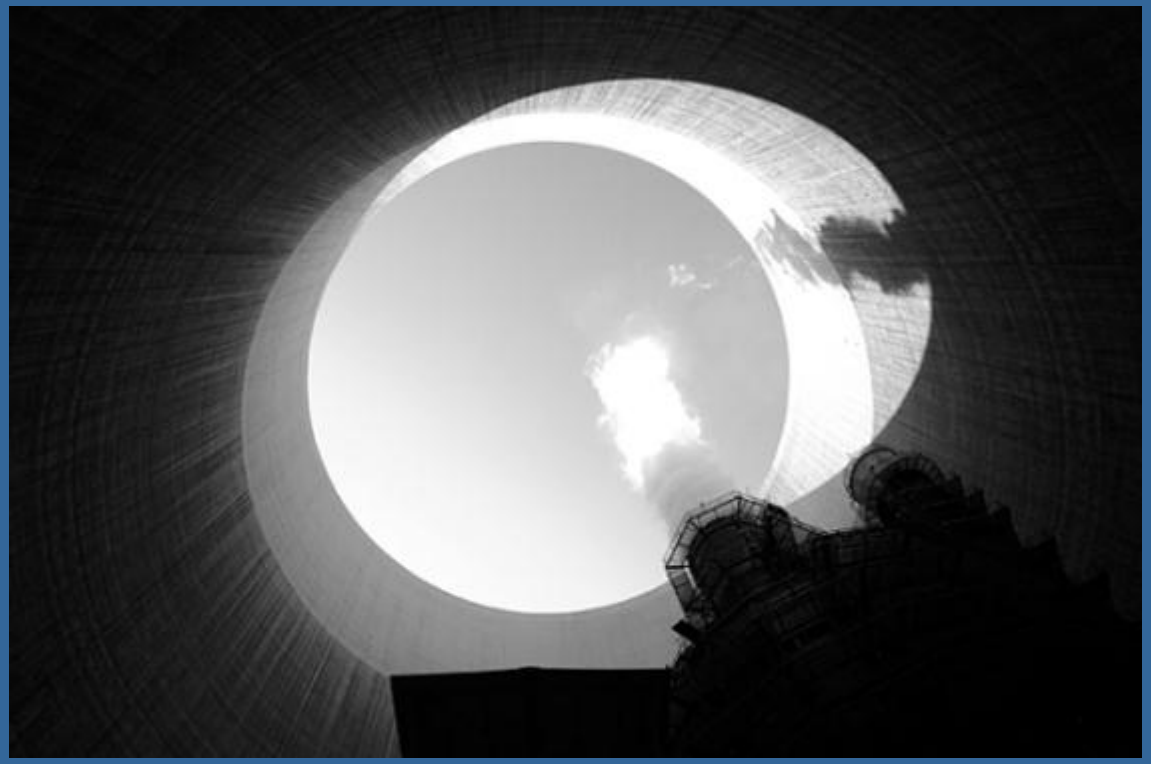
- A historical large-firm population
- Size is defined by revenues
- A firm is included in the population if it belonged to the top 500 at least once between 1987-2001
- We follow the complete histories of these firms (even if they were not in the top 500 in all of those years)
- 1,696 firm histories

Data: Economic and Political Officeholders

- From the Courts of Registry
  - senior managers
  - members of Boards of Directors
  - members of Supervisory Boards
- Also names of every political officeholder
- With dates of entering and exiting office
- About 120,000 names
- Network dataset
  - Personnel ties between firms
  - Personnel ties between firms and parties, government
  - We use annual time resolution

Network size (N of firms)





Identifying cohesive groups in a historical context

The Clique Percolation Method (CPM)

- Goal:
  - to identify cohesion in a historical dataset

- Challenges (where conventional methods fail):
  - no change in ties of a locality should mean no change in classification
  - groups should not be exclusive

- CPM: local, allows for overlapping

- Definition:
  - building from full subgraphs of k (we use k=4),
  - two k=4 fragments sharing 3 nodes are connected
  - a cohesive group is a percolation cluster of the k=4 fragment

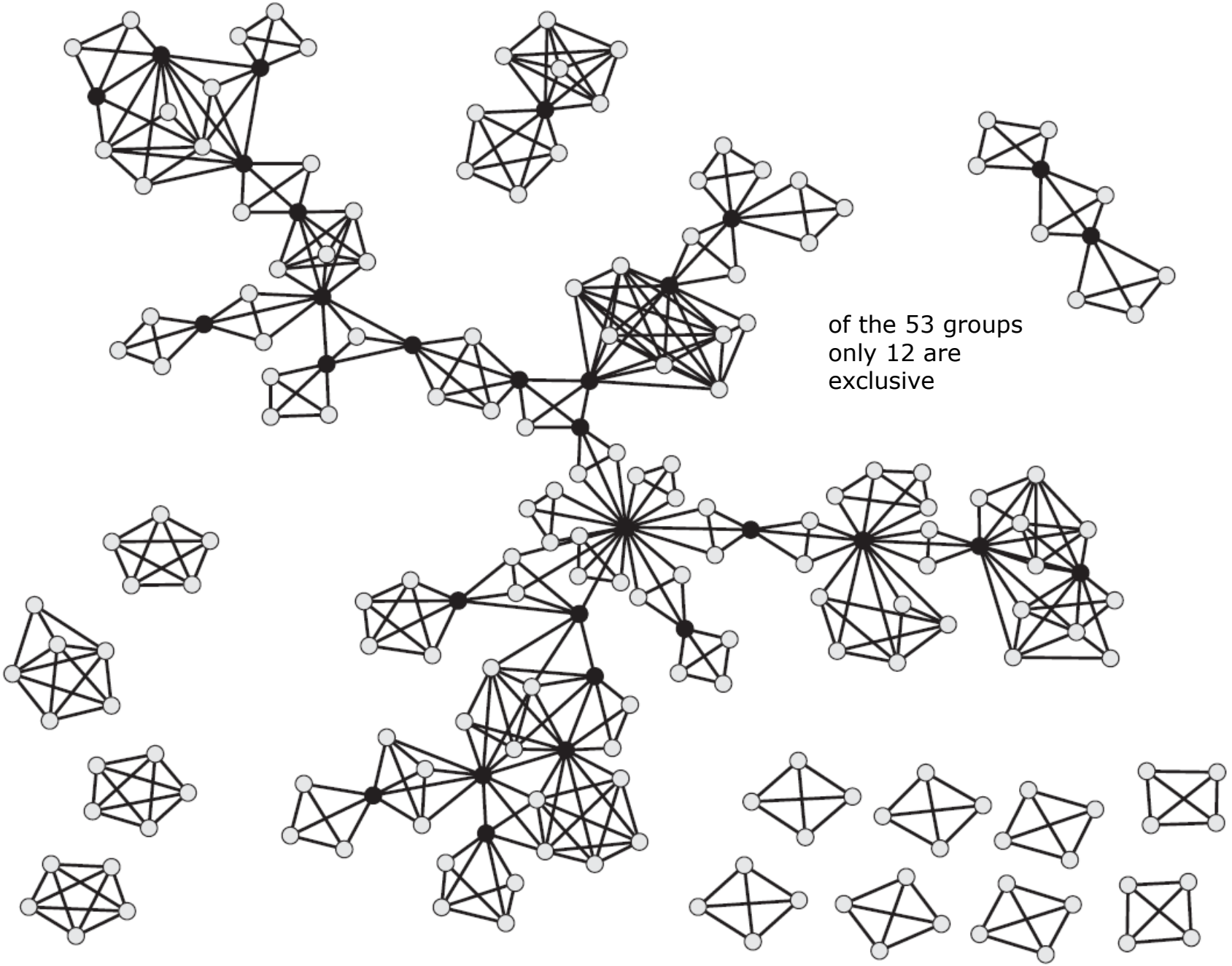
- Two groups might overlap by one or two nodes at a given location.

(Palla, Derenyi, Farkas, & Vicsek 2005)

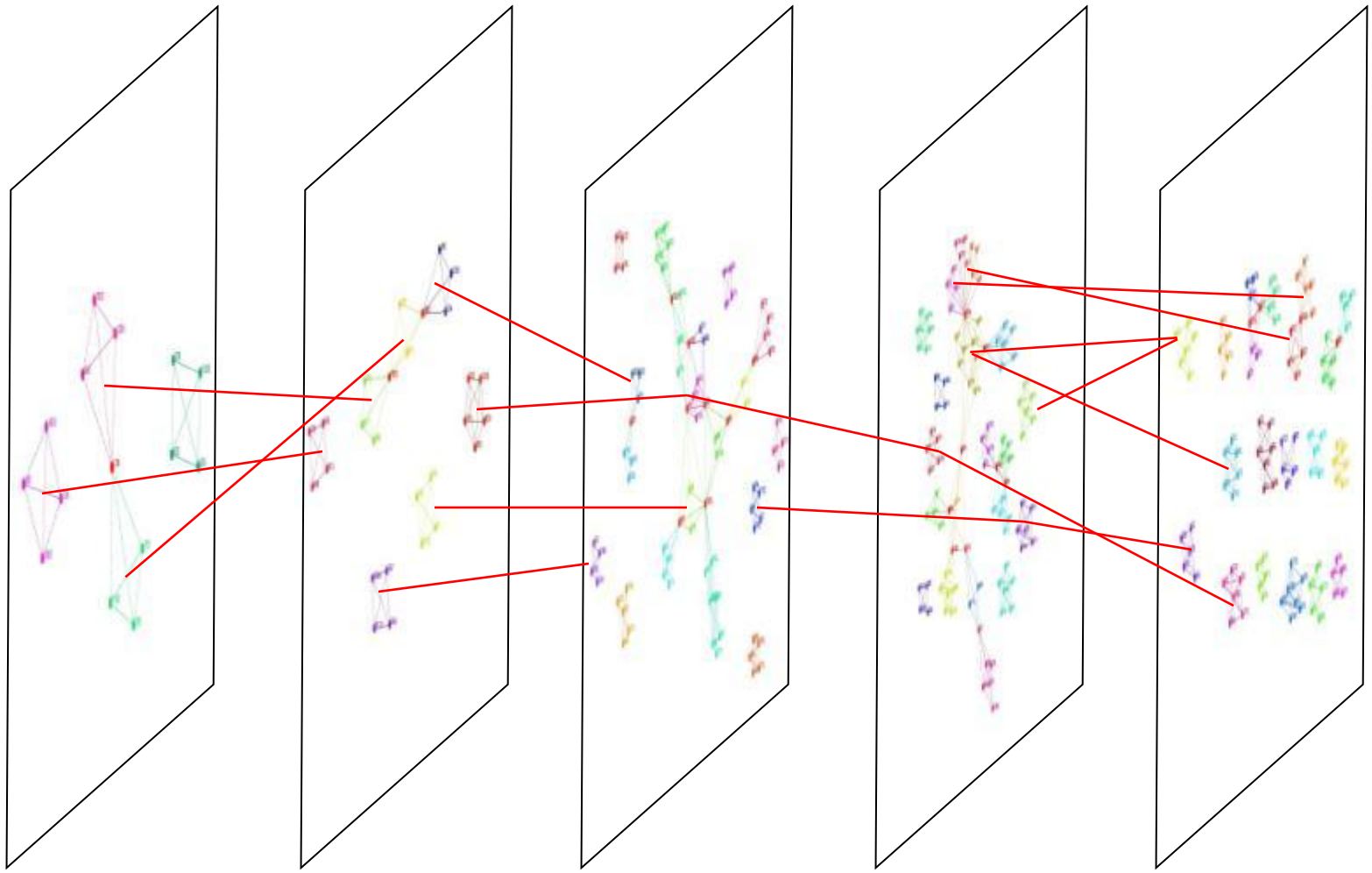
Choice of k=4: near side of the percolation transition

Year	k=2		k=3		k=4		k=5	
	Largest group[a]	Node coverage[b]	Largest group	Node coverage	Largest group	Node coverage	Largest group	Node coverage
1989	18.40	48.76	1.25	20.85	1.00	5.65	-	.00
1990	33.80	45.23	1.20	25.38	1.25	5.53	1.00	.95
1991	53.00	57.02	4.73	32.20	1.50	11.26	1.20	5.57
1992	53.30	61.72	4.85	38.83	1.57	14.93	1.17	7.05
1993	140.60	62.92	1.27	42.98	1.17	15.86	1.17	8.01
1994	106.86	63.13	1.47	45.48	1.13	16.44	1.29	7.26
1995	106.86	61.32	1.41	42.81	1.13	17.48	1.14	6.81
1996	69.18	60.12	5.00	43.38	1.10	21.36	1.17	9.69
1997	130.83	59.56	4.37	40.18	1.10	22.66	1.17	8.47
1998	131.67	58.41	4.33	40.97	1.38	22.08	1.17	7.28
1999	132.17	56.71	3.64	39.35	1.14	18.72	1.14	4.62
2000	109.14	55.11	3.41	37.65	1.14	15.75	1.14	5.60
2001	124.67	54.06	2.11	37.05	1.13	14.89	1.29	5.02
Mean	93.11		3.00		1.21		1.17	
Min.	18.40		1.20		1.00		1.00	
Max.	140.60		5.00		1.57		1.29	

groups from 1995



Groups are connected in time by the flow of members



1989 1990 1991 1992 1993 …

Group performance

Dependent variable

- Profits?
  - Often manipulated

    "We need to do something about our profits: they will be too high for this year." (interview)
  - Low validity in a turbulent environment

- Revenue decline and growth
  - Much less manipulated
  - Losing or capturing markets is key concern

- We use change in the revenues of the group
  - Decline
  - Fast growth (top 25%)

- Temporality
  - Performance at the end of t2
  - Intercohesion during t2
  - Stability from t1 to t2

Independent variables

- Intercohesion
  - the number of overlaps with other groups
- Intra-cohesion
  - Group size
  - Capital size of largest firm
  - Size difference btw largest and second
  - Financial members
  - Industry homogeneity
- Extra-cohesion
  - Brokerage (number of brokered ties to other groups)
  - State owned proportion
  - Foreign owned proportion
  - Politicized proportion
  - Politically mixed group
  - Governing party tie
  - Group embeddedness vis-à-vis other groups (K-connectivity)
- Controls
  - Time-based variables
  - Efficiencies (labor, capital)
  - Industry dummies

Predicting Performance at t2

Binomial logit

Protects from decline
- **Stability**
- Group size
- Brokers around the group

Contributes to decline
- Financial members
- Industry homogeneity

Contributes to high growth
- **Inter-cohesion**
- Government tie

Prevents high growth
- Large dominant firm
- Financial members
- Industry homogeneity
- Politicized proportion
- Political mix

Independent variables	Declining revenue (yes=1)	Top quartile revenue growth (yes=1)
Inter-cohesion	-.022	.126**
Group stability from t-1	-1.498**	.228
Intra-cohesive processes		
Group size	-.472***	-.106
Capital size of the largest firm	-.134	-.496**
Size difference	.086	-.148
Financial members	.532***	-.516**
Industry homogeneity	.447*	-.909*
Extra-cohesive processes		
Brokerage	-.027*	-.005
State owned proportion	.387	.055
Foreign owned proportion	-.441	-.624
Politicized proportion	1.059	-2.914***
Political mix	-.012	-.561†
Governing party tie	-.145	.371*
Group embeddedness	.143	-.134

Performance at t2 (controls)

Independent variables	Declining revenue (yes=1)	Top quartile revenue growth (yes=1)
Controls		
Year	-.047	-.017
Group age	.036	.180*
Newly formed group	-.268	-.102
Labor efficiency (log)	-1.006***	1.345***
Capital efficiency (log)	-.265	.468**
Industry		
Energy	-.131	-.627
Mining	.755	1.468
Chemical	.261	.314
Metallurgy	.120	-.798
Heavy industry	.407**	-.048
Light industry	.614***	-.307
Wood and textile	.574*	-.022
Food industry	.385**	.157
Construction	.096	.446*
Wholesale	.629*	-.396
Retail	.302	-.312
Transport	.337	-.536
Services	.409**	.089
Constant	6.639	-5.595
N	430	430
-2LL	518.458	403.743
R^2	.192	.233

Sensitivity?

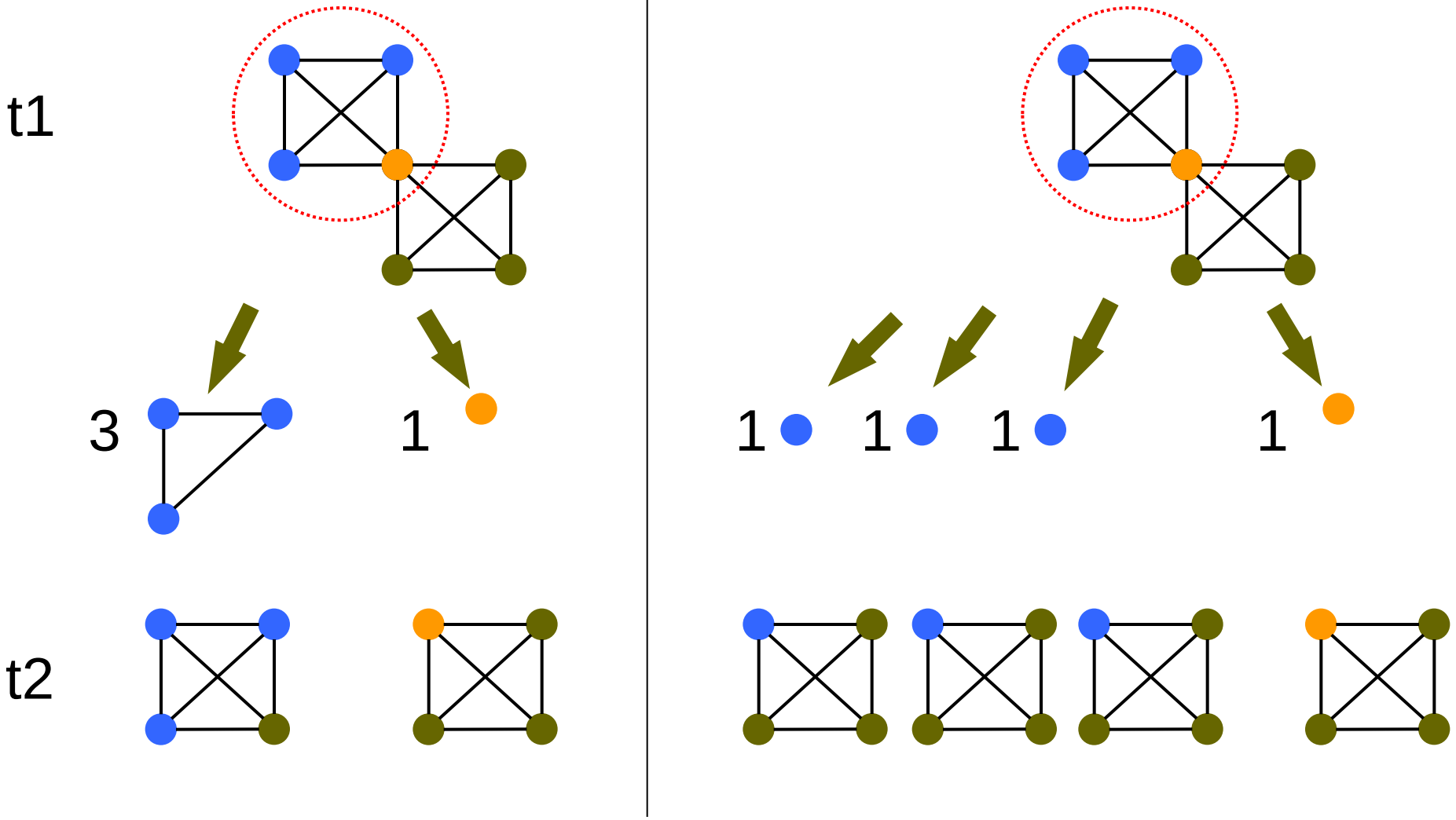
Same results with high growth at various percentiles: 20, 15, 10, 5

Unmeasured variable bias?

Not enough degrees of freedom for fixed effects
What is "the same group"

Predicting group stability

Group stability



Group stability: The average size of fragments staying together, divided by group size

OLS Predictors of group stability from t1 to t2

De-stabilizing

- Inter-cohesion
- Larger dominant firm
- Brokers around the group

Stabilizing

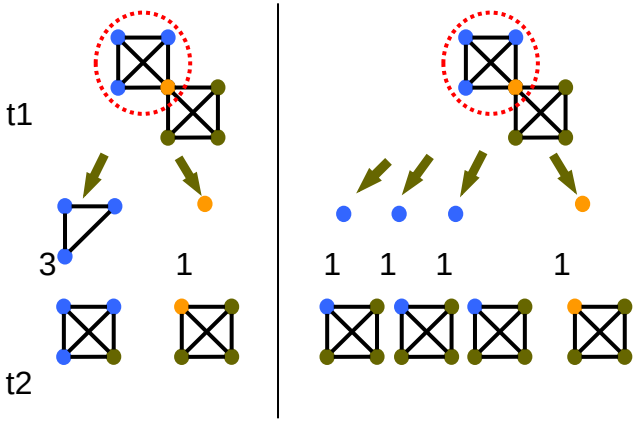
- Foreign ownership
- Later year

Independent variables	Group stability with all members	
	Model 1	Model 2
Inter-cohesion		-.031***
Intra-cohesive processes		
Group size	-.011	-.005
Size of the largest firm	-.024***	-.019**
Size difference	.001	.000
Financial members	-.056***	.023
Industry homogeneity	-.011	.011
Extra-cohesive processes		
Brokerage	-.011***	-.008***
State owned proportion	-.023	-.002
Foreign owned proportion	.109***	.090**
Politicized proportion	-.040	-.017
Political mix	-.008	-.016
Governing party tie	-.016	.009
Controls		
Year	.023***	.026***
Group age	-.004	-.001
Constant	-1.171***	1.516***
N	525	525
R^2	.372	.432
P-value	.000	.000

OLS Predictors of group stability from t1 to t2 Without multiple members

Inter-cohesion is still a significant predictor:

Instability is not only about multiple members leaving



Independent variables	Group stability, without multiple members	
	Model 1	Model 2
Inter-cohesion		-.014**
Intra-cohesive processes		
Group size	-.047***	-.056***
Size of the largest firm	-.029***	-.027***
Size difference	.010	.009
Financial members	.060**	.072***
Industry homogeneity	.058	.064*
Extra-cohesive processes		
Brokerage	-.006***	-.005***
State owned proportion	.010	.013
Foreign owned proportion	.051	.046
Politicized proportion	.148*	.129
Political mix	-.004	-.006
Governing party tie	-.047	-.032*
Controls		
Year	.016***	.016***
Group age	.018**	.021***
Constant	-.318	-.293
N	402	402
R^2	.232	.242

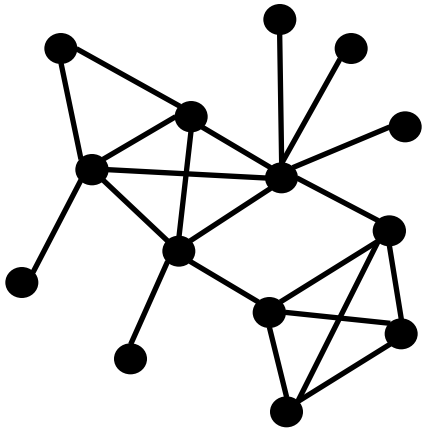
Simulation test of robustness

- Goal:
  - to see if the negative correlation between intercohesion and stability can result from random network change

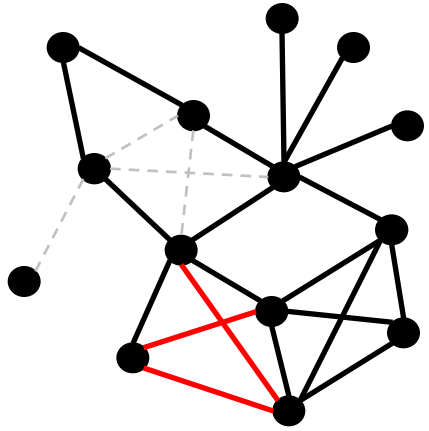
- Steps:
  - Take network at t1 and t2
    - number of broken ties
    - number of new ties
  - Create a network t2*, from t1, where
    - broken ties are randomly allocated across existing ties in t1
    - new ties are randomly allocated across unconnected active node dyads (non-isolates in at least one of t1 and t2)
  - Identify communities in the simulated network t2*
  - Measure the correlation between inter-cohesion in t1 and group stability from t1 to t2*

Simulation test of robustness

Observed networks t1

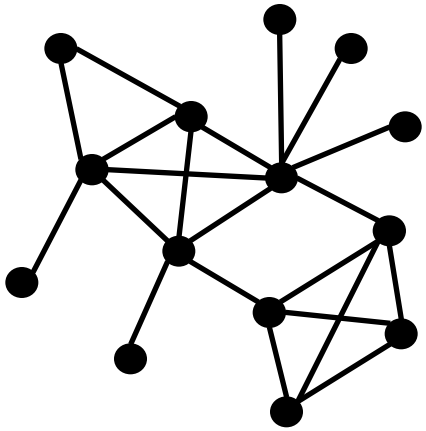


t2

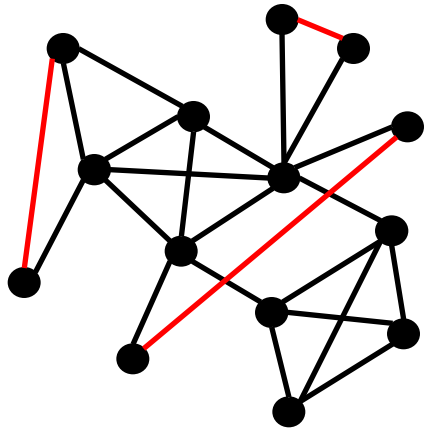


4 broken ties
3 new ties

Observed network t1

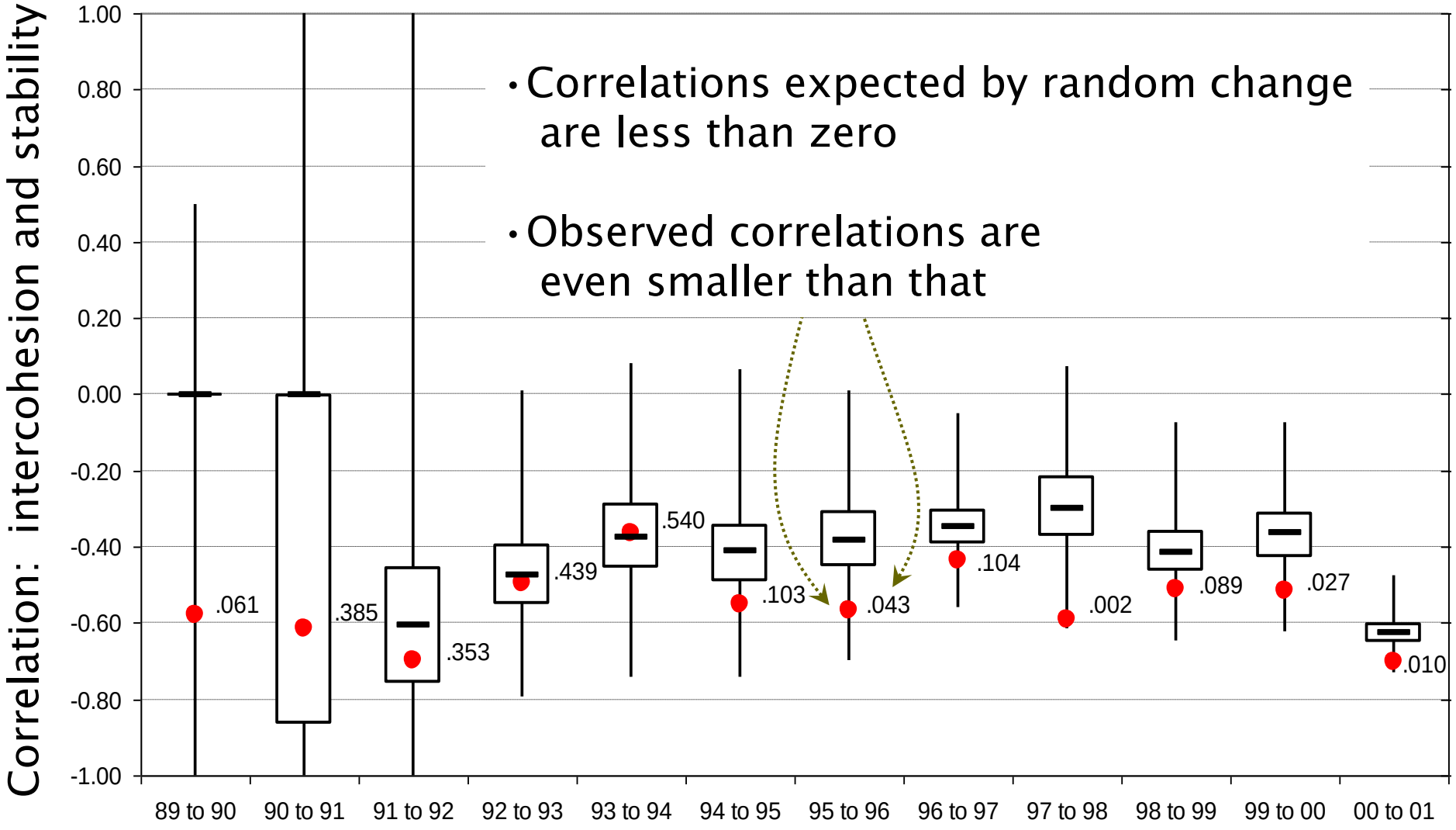


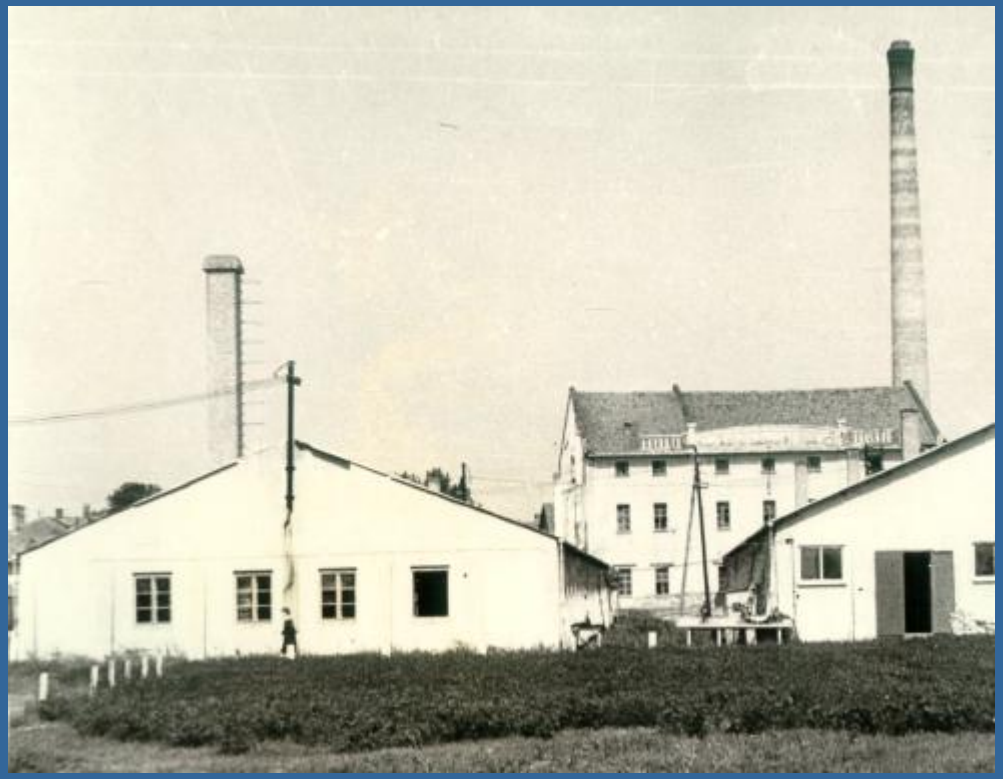
Simulated network t2*



take net t1
break 4 ties
add 3 ties

Simulation results – 1000 per year





Lineages of cohesion

Transcending tradeoffs

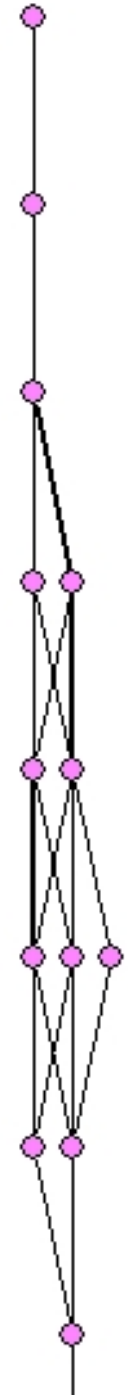
- Intercohesion
  - contributes to high performance
  - de-stabilizes groups.

- Stability and high performance
  can not be achieved at the same time
  – at the level of individual groups.

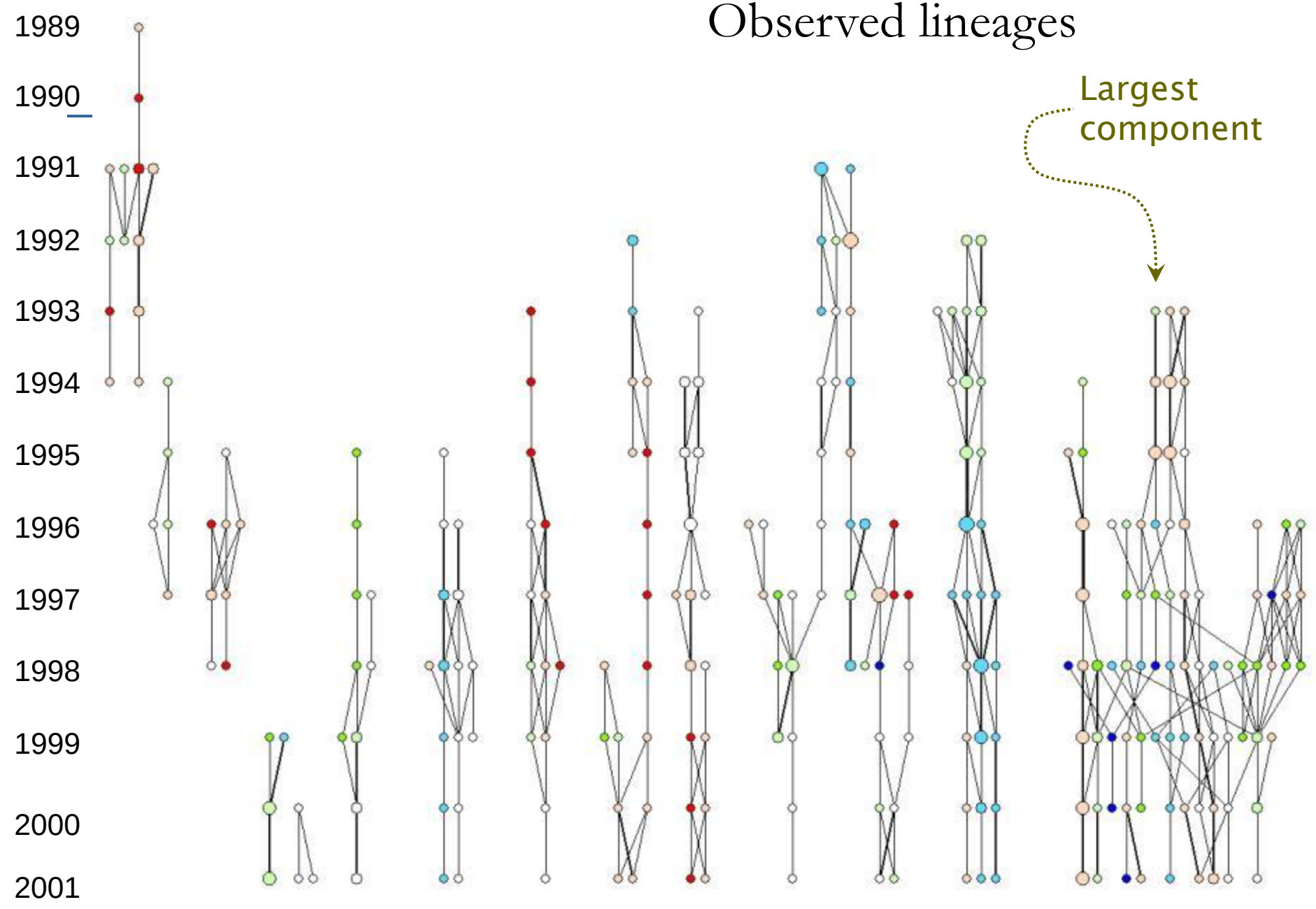
- But: small populations of groups
  can apply inter-cohesion,
  and also aciheve (population level) stability

Cohesion lineages: branching sequences of member flows

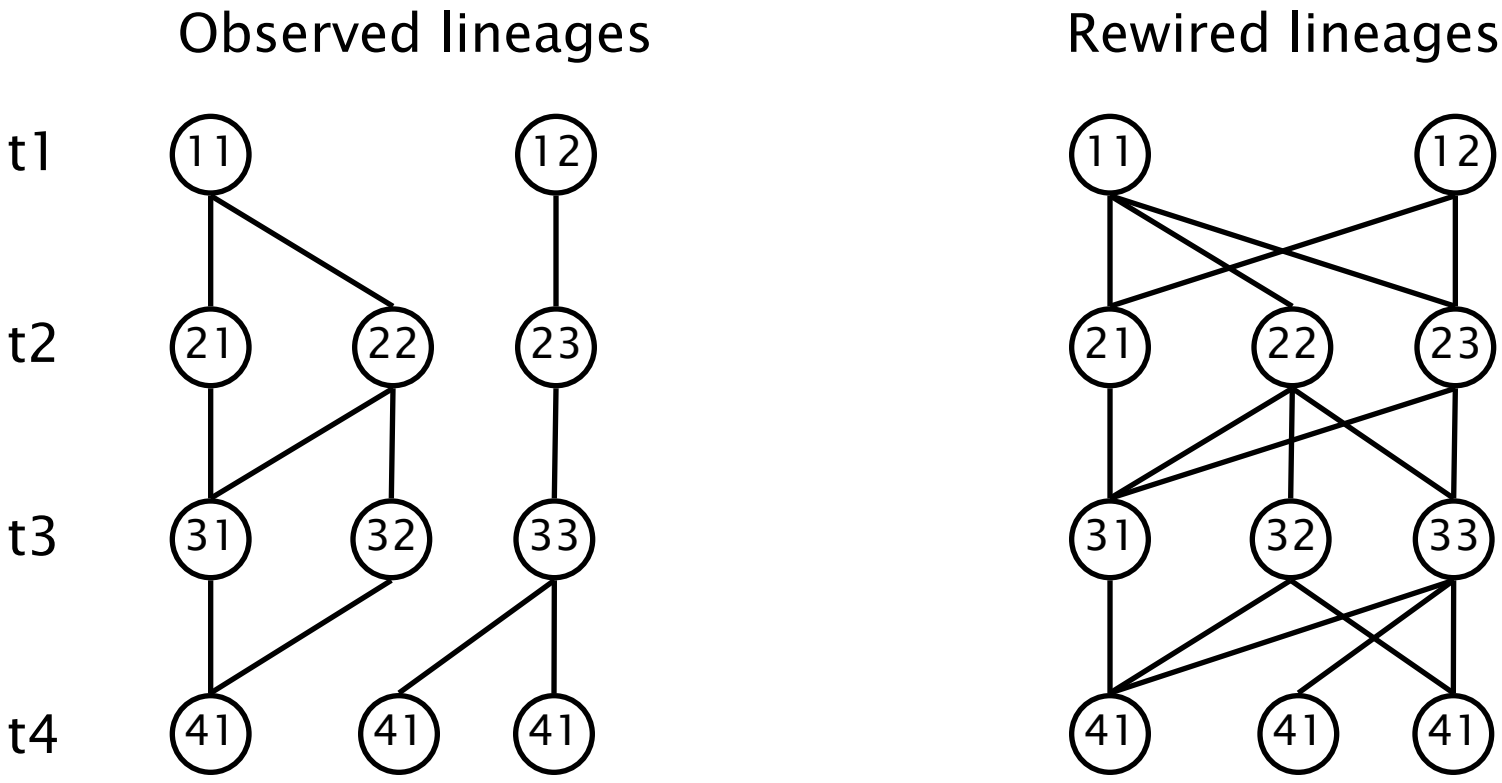
- The cohesion lineage graph:
  - a node is a group identified in a given year
  - nodes are layered by years
  - a node at t can only connect to a node at t+1



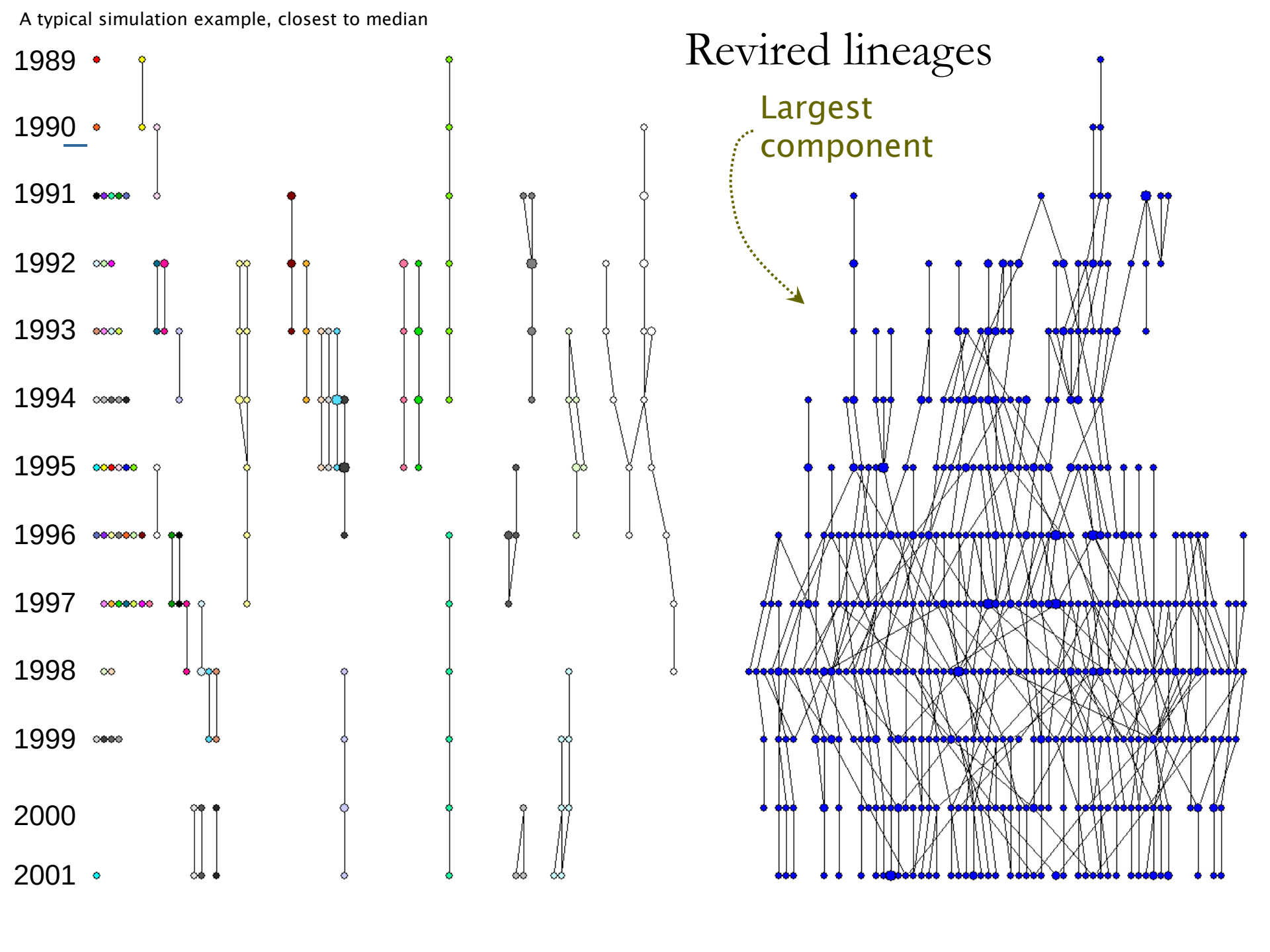
Observed lineages



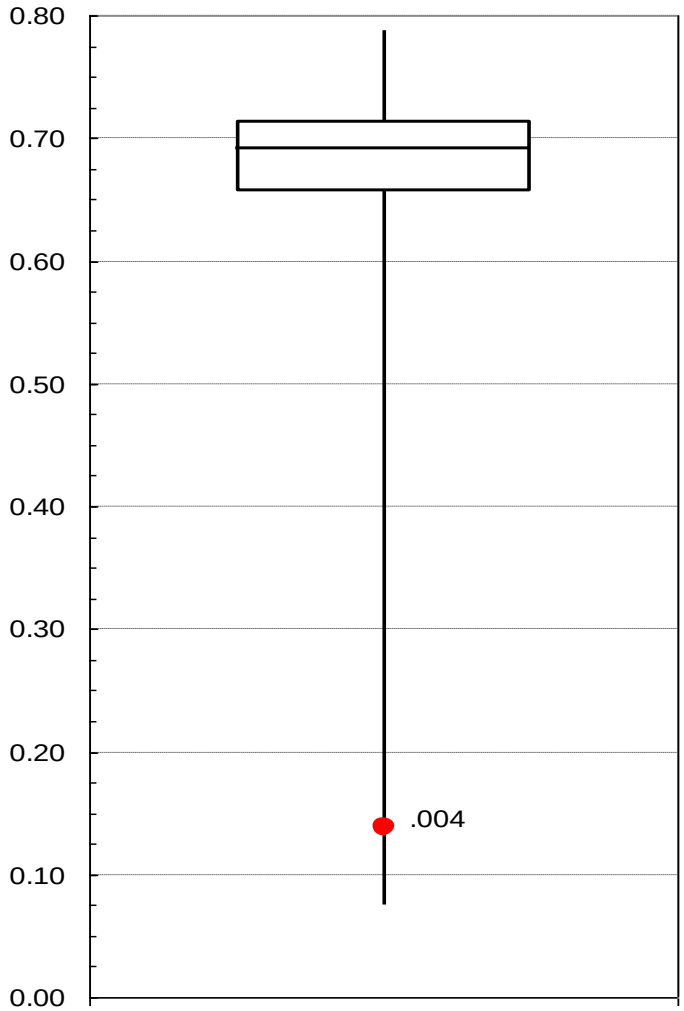
Simulating lineages



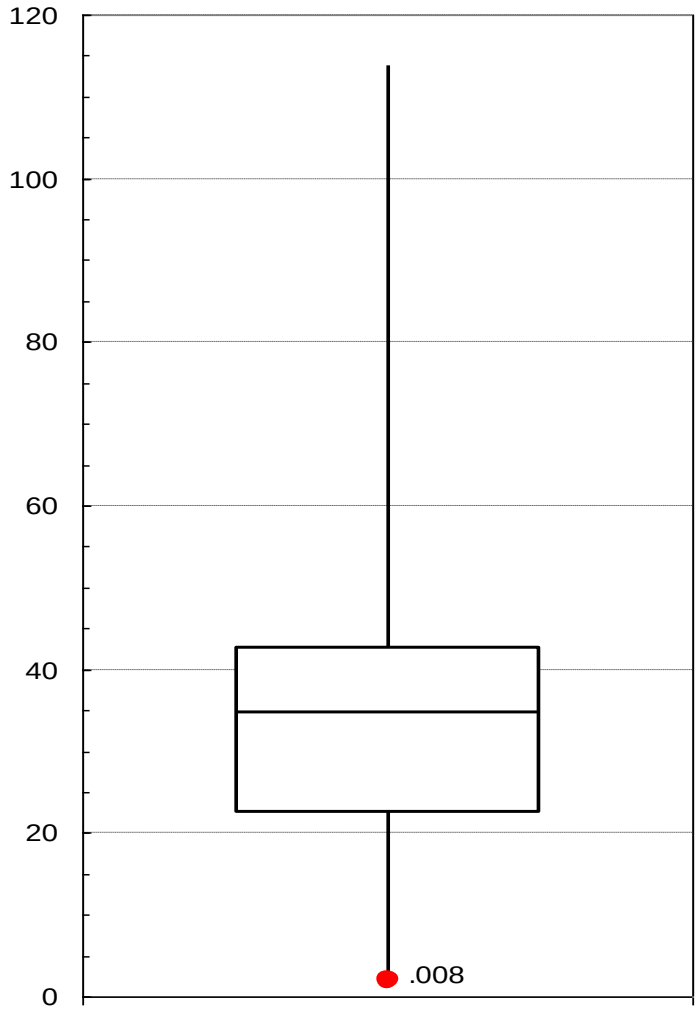
A typical simulation example, closest to median



Lineage simulations



Size of largest component



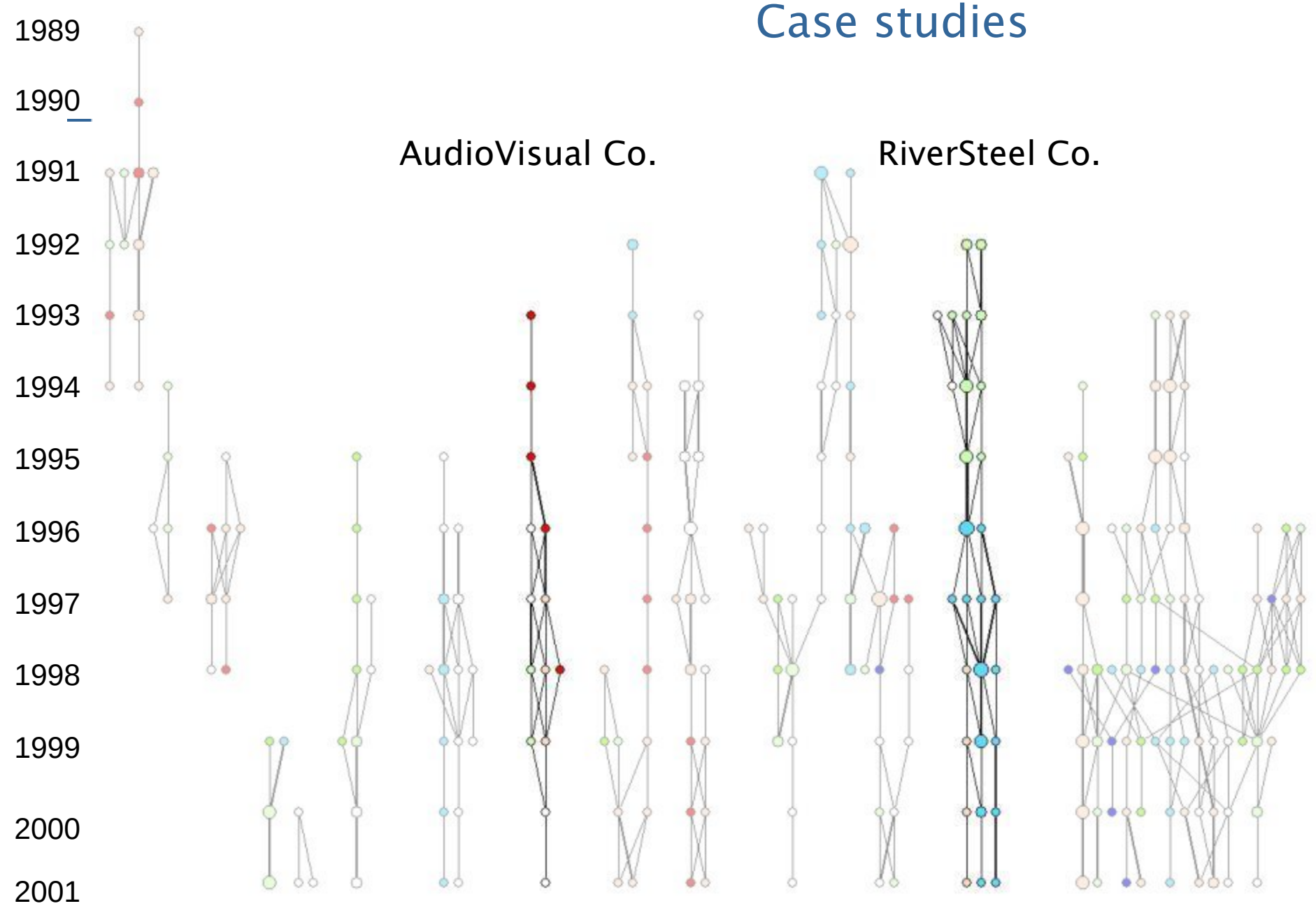
Largest to second component

Cases

- River-Steel Co.
  - steel mill and related products
  - reorganized product lines into a business group for survival, efficiency, and flexibility
  - separating liabilities and assets

- Audio-Visual Co.
  - contractor for short runs in electronics
  - reconfigures itself into a business network for optimal interfacing with buyers
  - organizing for flexibility and trust

Case studies



Case studies

- Common points
  - Both groups have a dominant firm
  - Both large firms (and their lineages) would surely be out of business today if they believed the unit of economic action was the firm

- Differences
  - RS
    - initial motivation was survival
    - formed by separating assets from liabilities
    - reshapes groups to reshape assets and liabilities
  - AV
    - motivation was interfacing with foreign partners
    - formed by separating functional areas
    - reshapes groups to adopt to market trends

Conclusions

- Intercohesion is a resource with risks
  - It can contribute to high performance
  - But it risks decline through instability

- The risks of intercohesion can be managed by lineages
  - Instability becomes member recombination