Joining the High Rollers in the World Trade Network

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Overview

- Introduction / Motivation
- Data Collection / Processing
    - Network Implementation
    - Communities
- Analysis
    - Evolution in time
    - Rich Clubs
- Challenges
- Next Up

Introduction: World Trade Network

- Network representation of WTN is new
- Easy, intuitive implementation
- Allows new analyses
    - Communities, Centralities, etc…
- Exciting extensions and relations (economic networks, etc…)

Motivation: Trade Standing

- "Standing" in the world is hard to pin down
- Community structure and network metrics can be useful "wealth" evaluations
- **How does a country's standing in the World Trade Network evolve in time, and why?**

Data Collection

- Product Trade Network from O.E.C. (Observatory of Economic Complexity)
- Import/Export data for different products between ~250 countries for ~6 years

	year	origin	dest	hs07	export_val	import_val
0	2008	ago	civ	902	0.00	3053887.0
1	2008	ago	civ	1511	0.00	31017.0
2	2008	ago	civ	1704	0.00	56428.0
3	2008	ago	civ	2710	932121.72	0.0
4	2008	ago	civ	2711	492622.69	0.0

- GDP from World Bank Repository

Network Implementation

- "World Trade Network" is a good name
- Imports/Exports strongly imply directed, weighted edges
- Network implementation grants access to metrics and analysis techniques
  - Degree distributions
  - Centralities / Assortativity
  - **Community Structure**

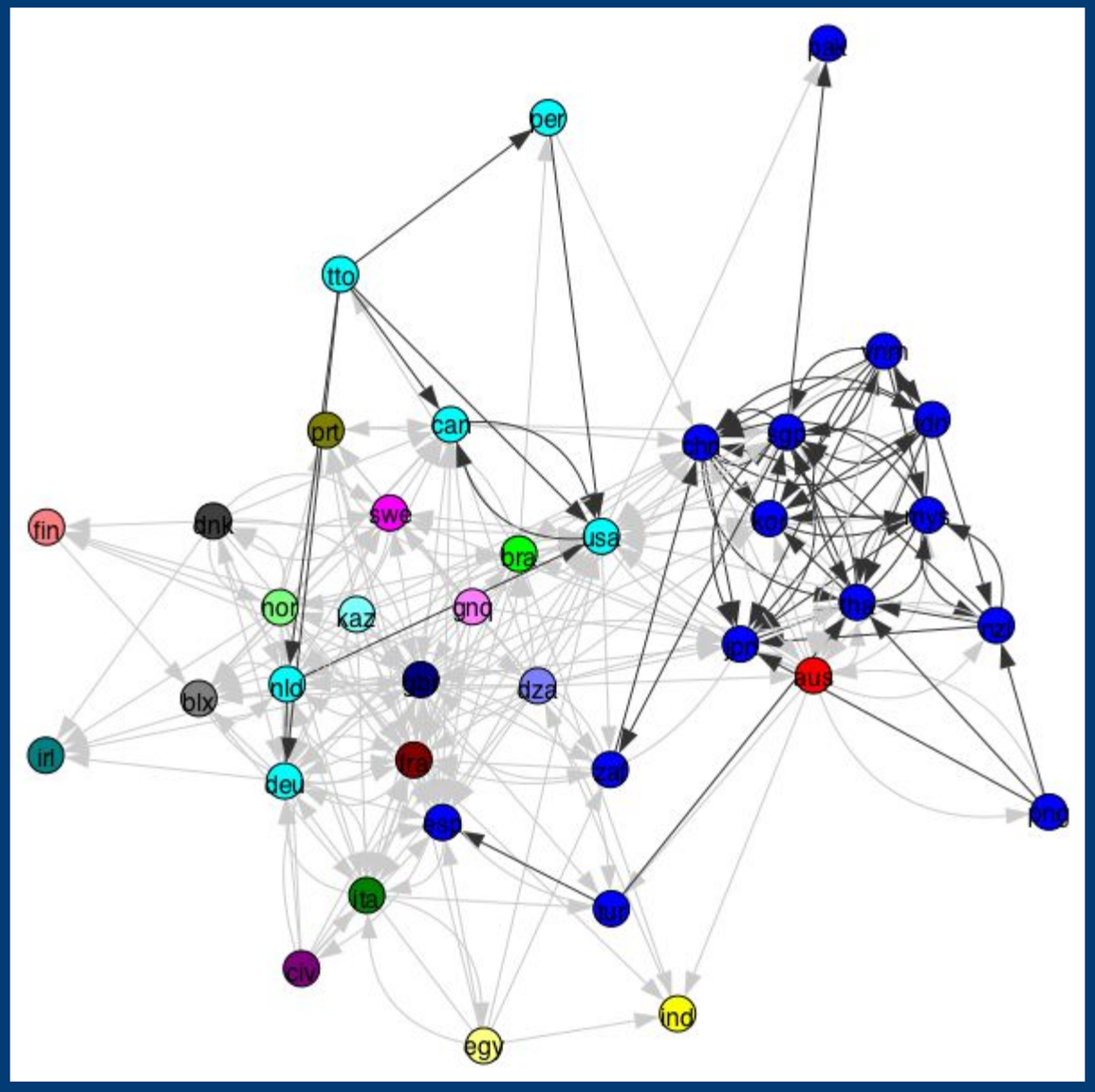
Communities

- Hypothesis: WTN standing is related to what groups a country is part of
- Track the "wealth" of the community a country is part of, over time
- Variety in aggregation methods / community algorithms poses challenges

Example: Oil

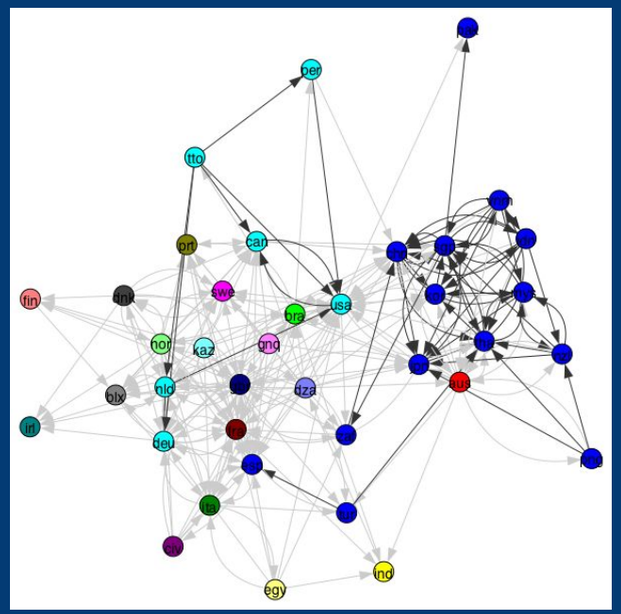
- Examine the oil trade between the countries with the top 40 average import values
- Betweenness community detection; includes weight and direction
  - Nodes between communities typically have high betweenness
  - Remove them until the graph falls apart into components to determine communities

Oil Community Structure (2008)

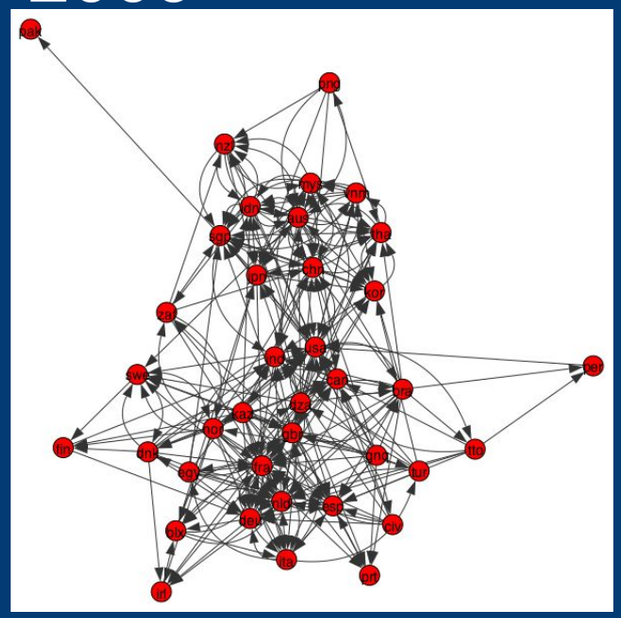


2008-2014

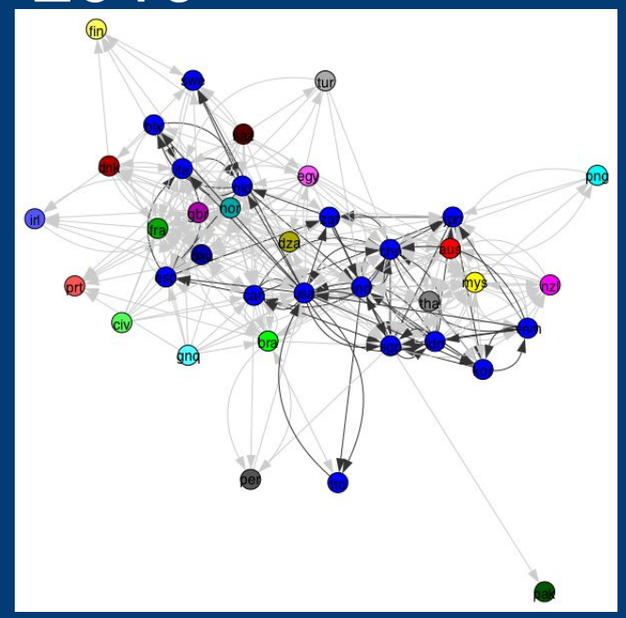
2008



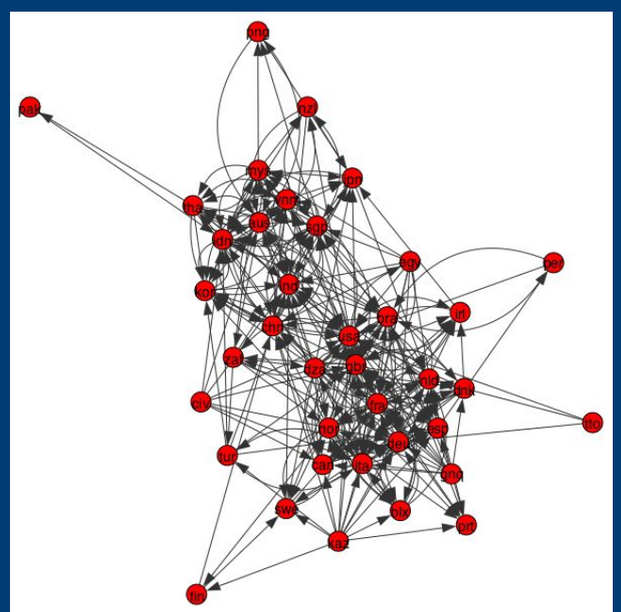
2009



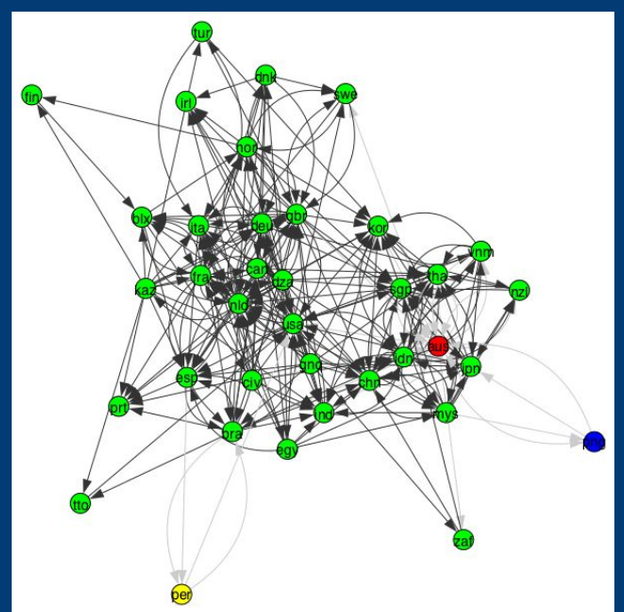
2010



2011



2012



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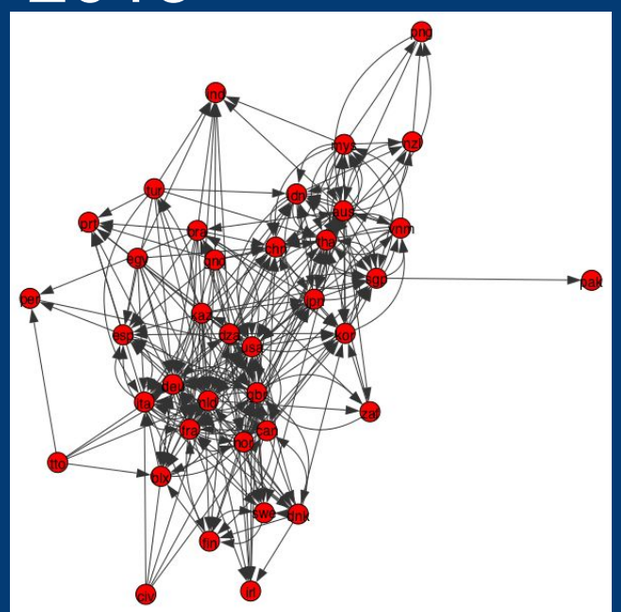
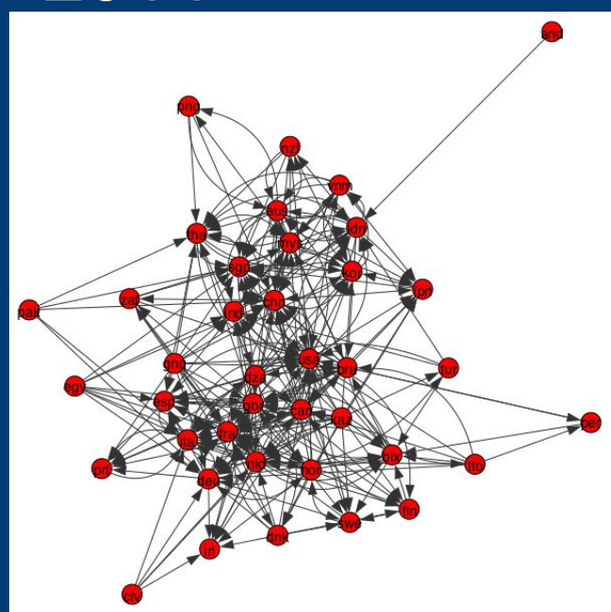


2014



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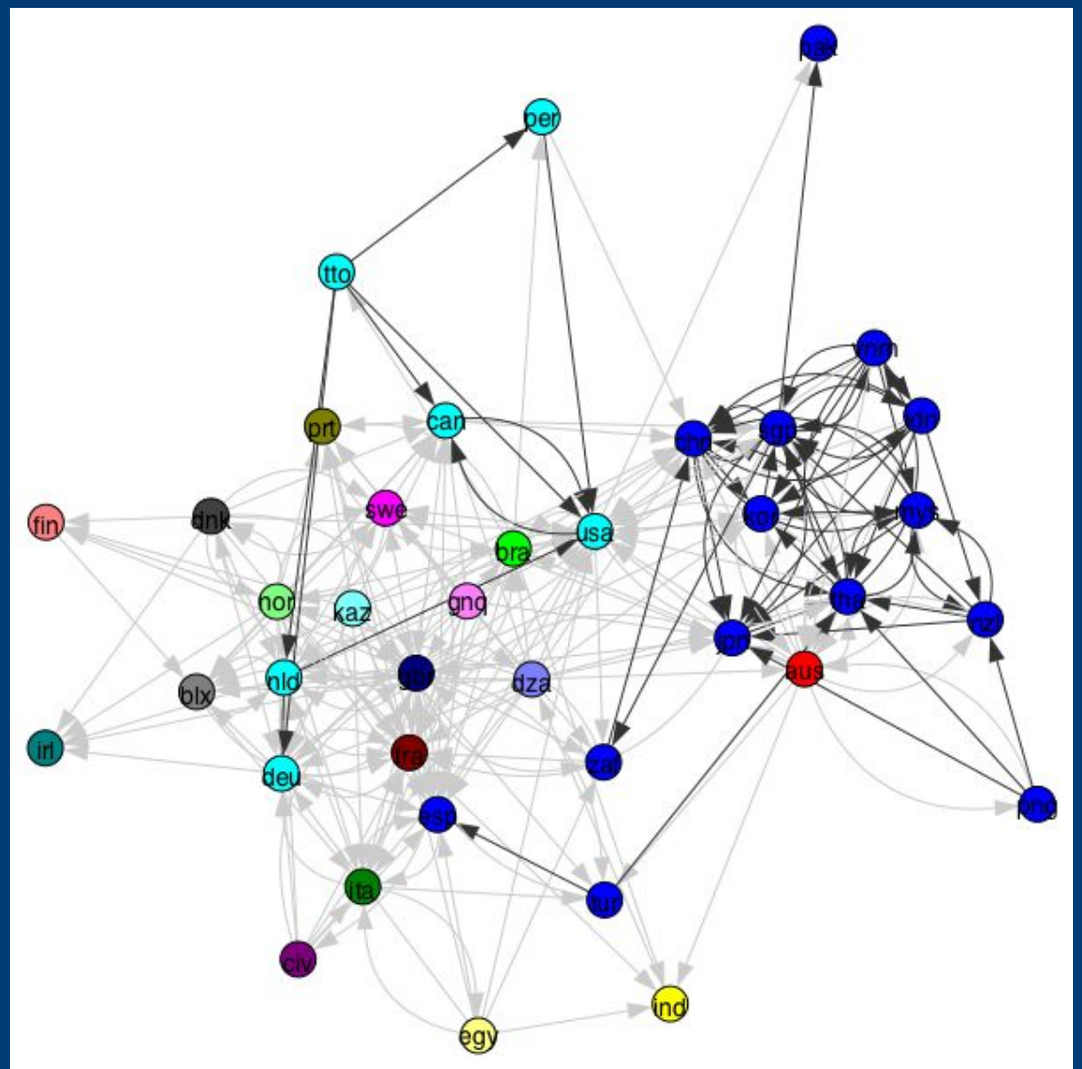
2008/2010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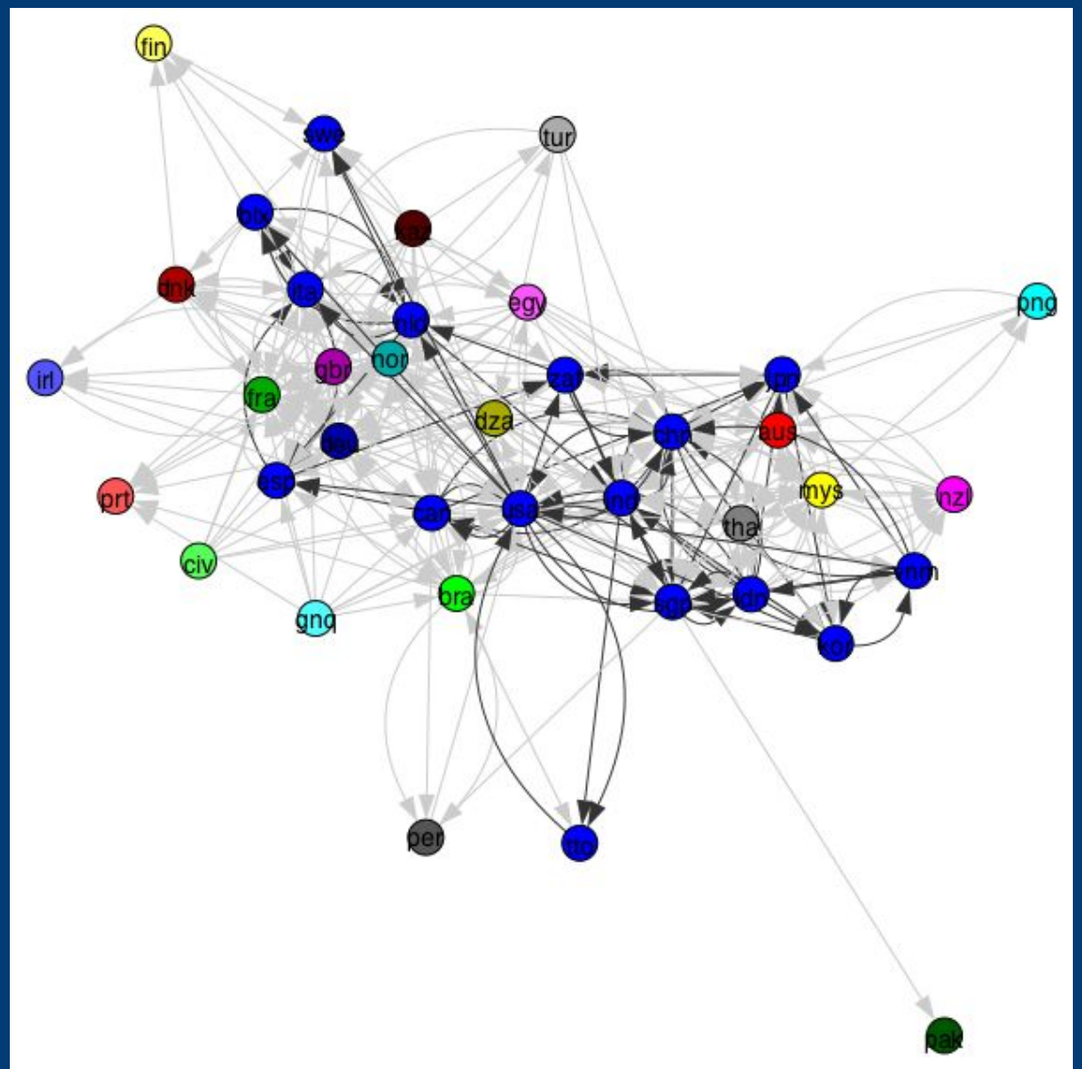
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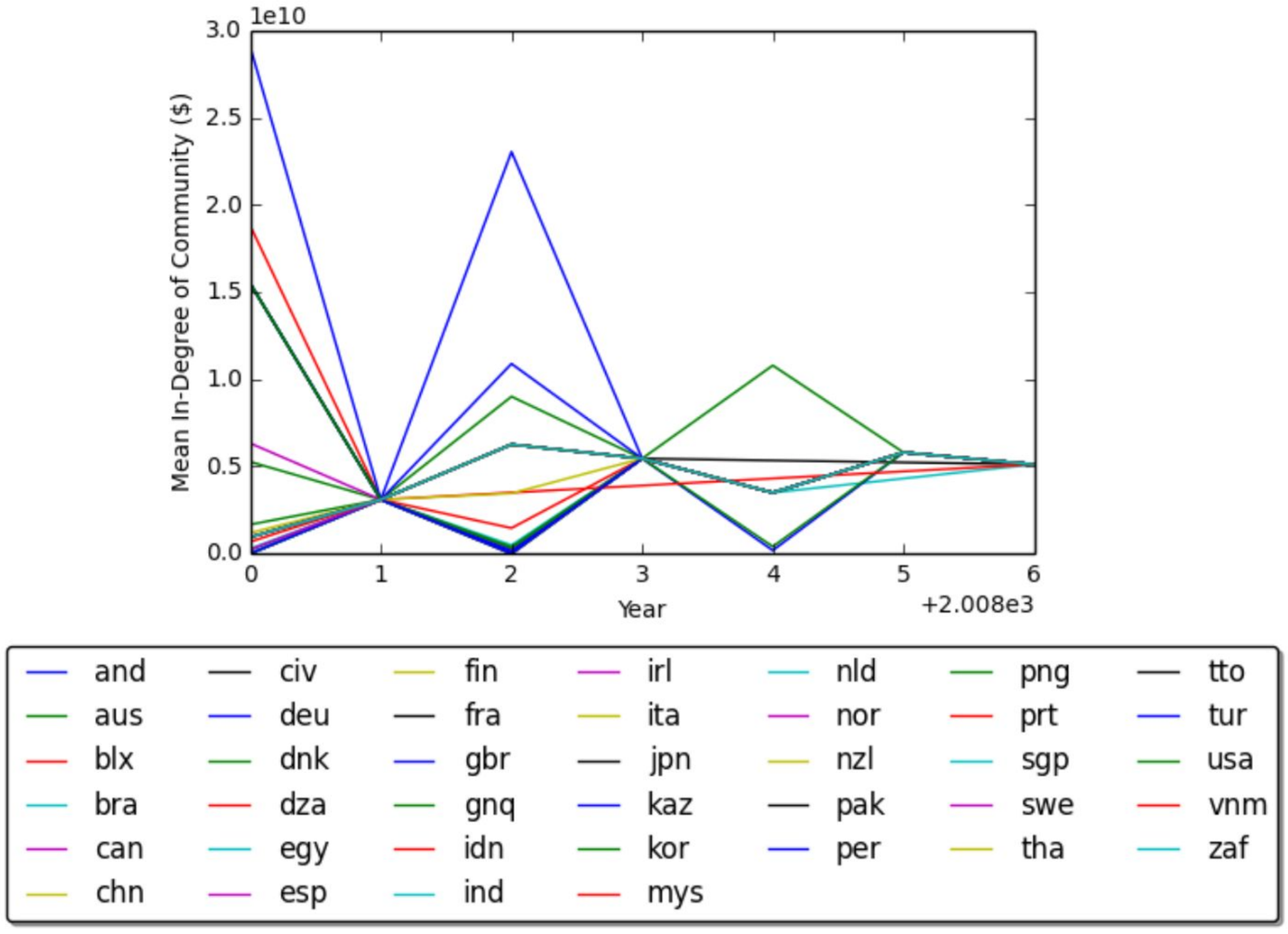
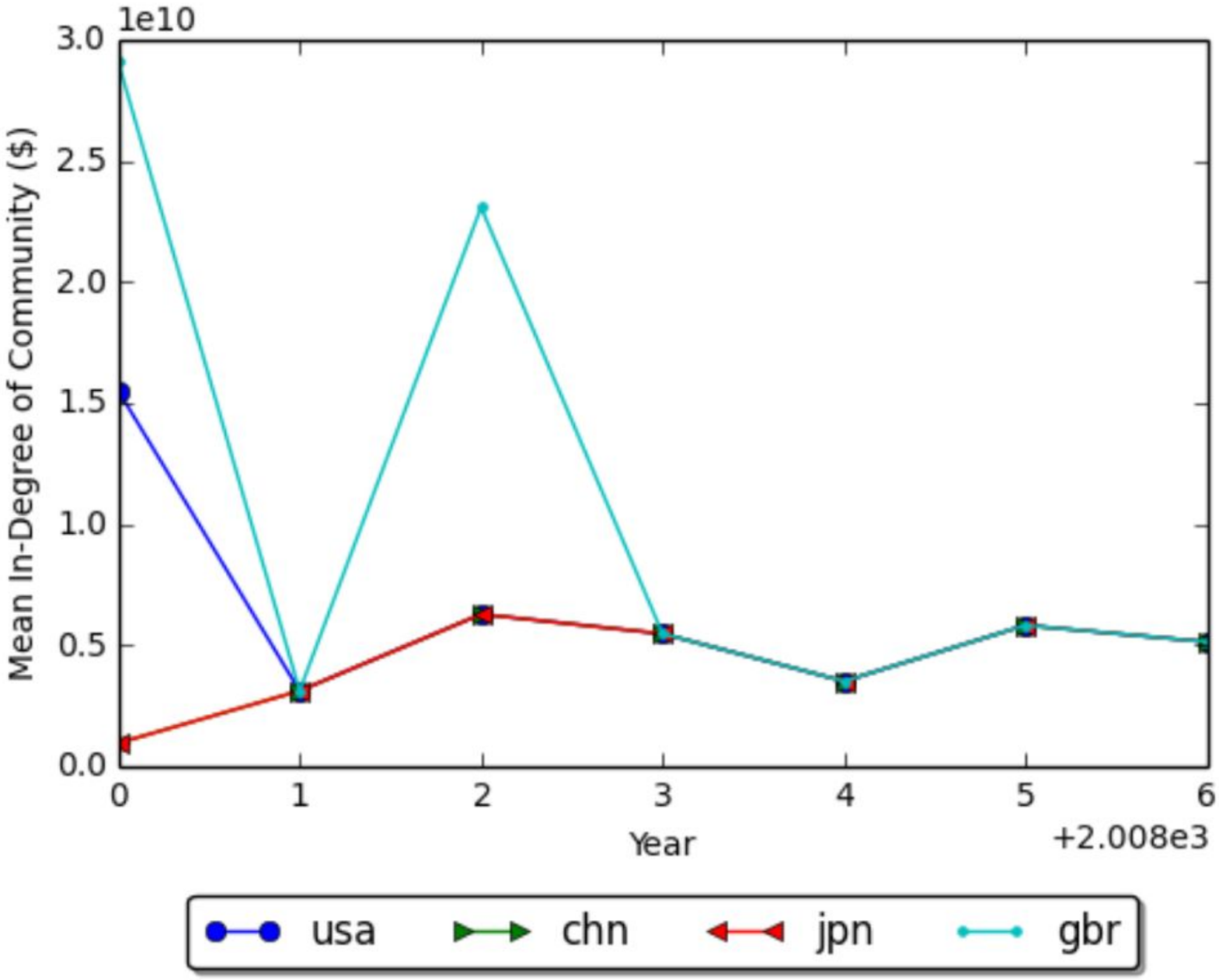


Temporal Effects



Community Analysis

Label propagation	Fast-Greedy
Spinglass	Walktrap
Multilevel	Edge betweenness
Infomap	Leading Eigenvector

Community Analysis

N < 1000

Label propagation	Fast-Greedy
Spinglass	Walktrap
Multilevel	Edge betweenness
Infomap	Leading Eigenvector

Community Analysis

N > 1000

Label propagation	Fast-Greedy
Spinglass	Walktrap
Multilevel	Edge betweenness
Infomap	Leading Eigenvector

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Communities: Walk Trap

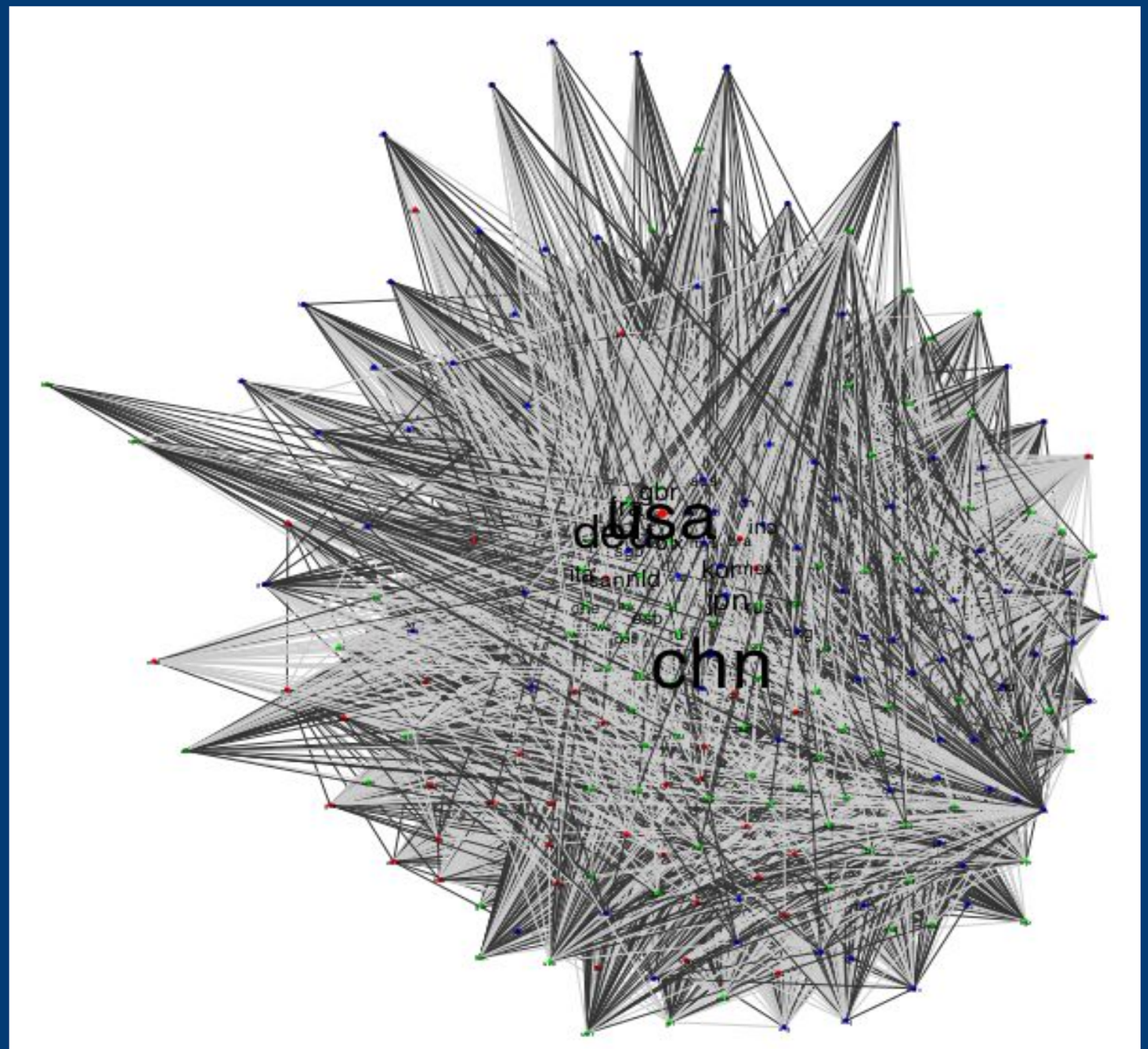
Edge-betweenness: Full dendrogram, no intuition, slow, top-down

Fast-Greedy: no parameters to tune, bad accuracy, bottom-up

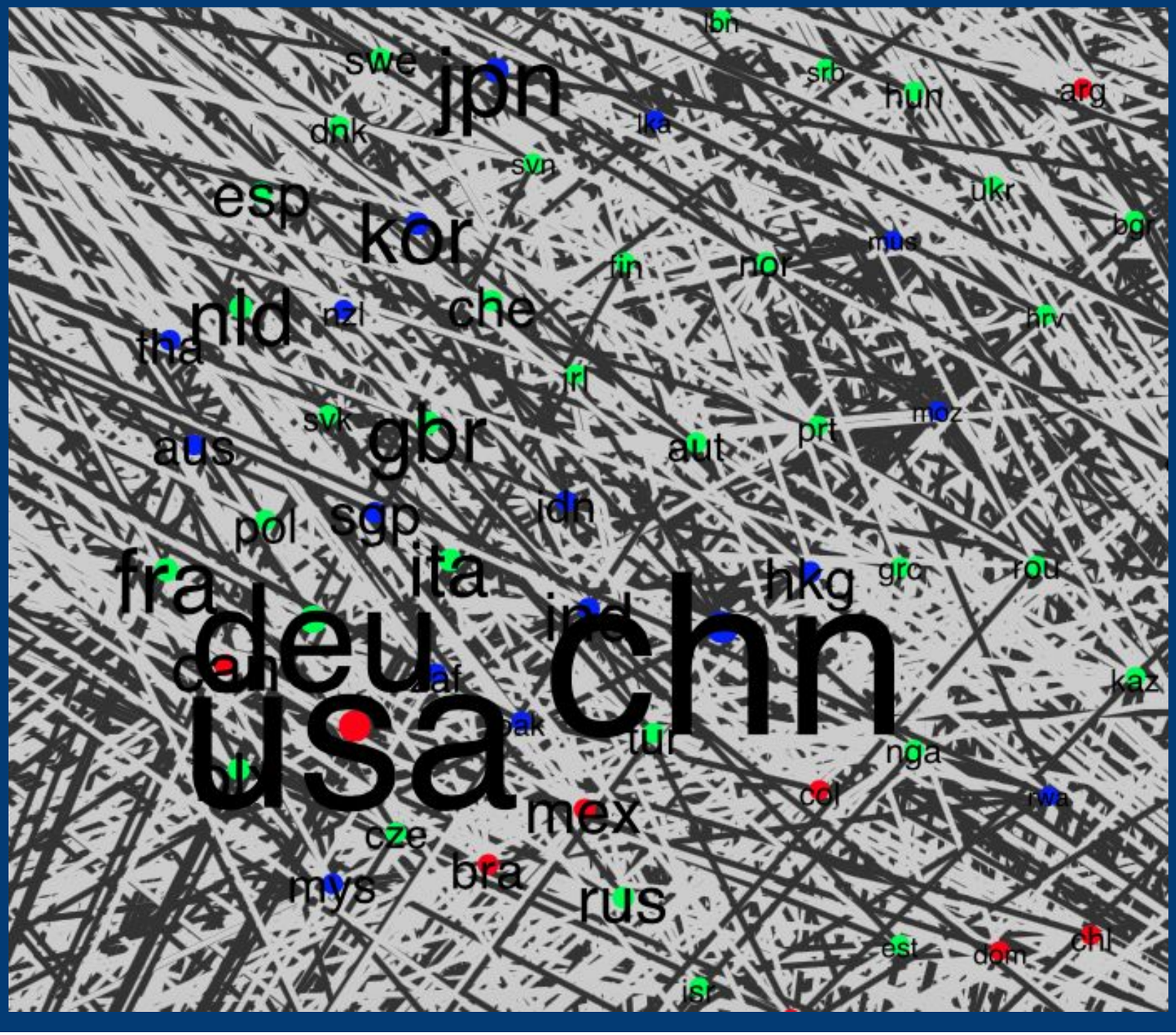
Walk-Trap: short random walks, accurate, bottom-up

[2] Y. Zhao et al., Scientific Reports, Vol 6, 2016.

Communities: Walk Trap



Communities: Walk Trap



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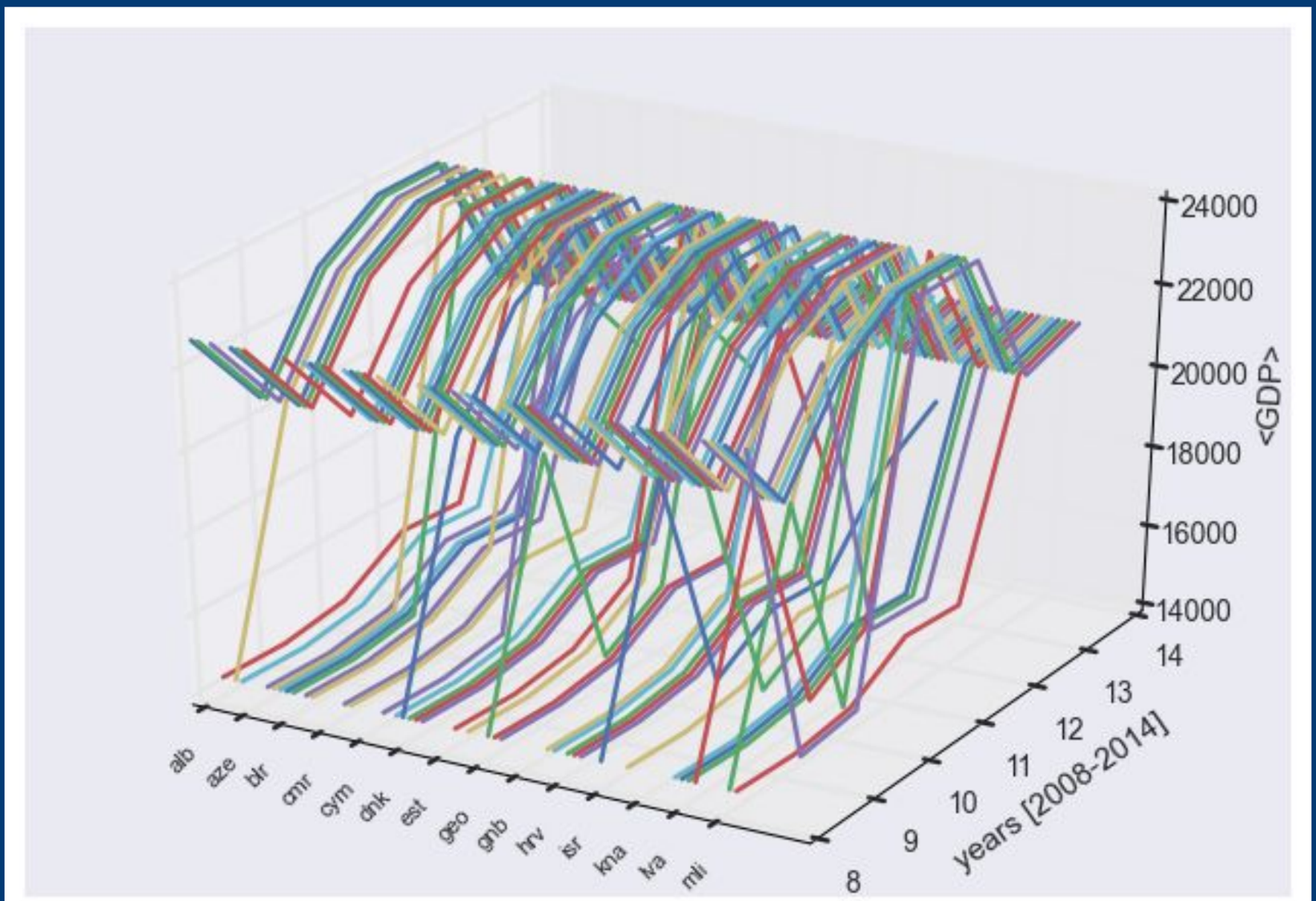
Community-Based Wealth Measurements



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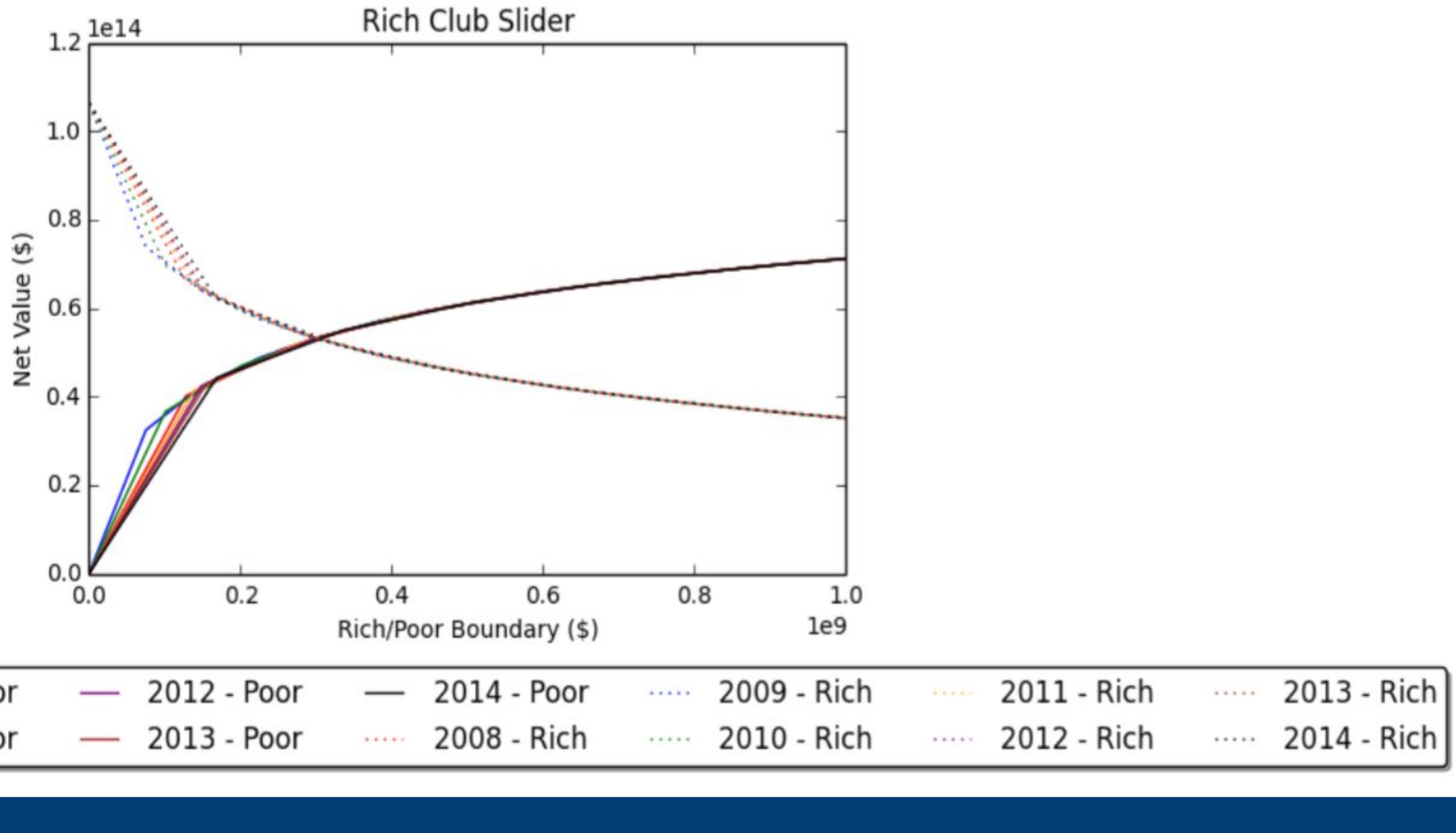
Community-Change and Economic Wealth



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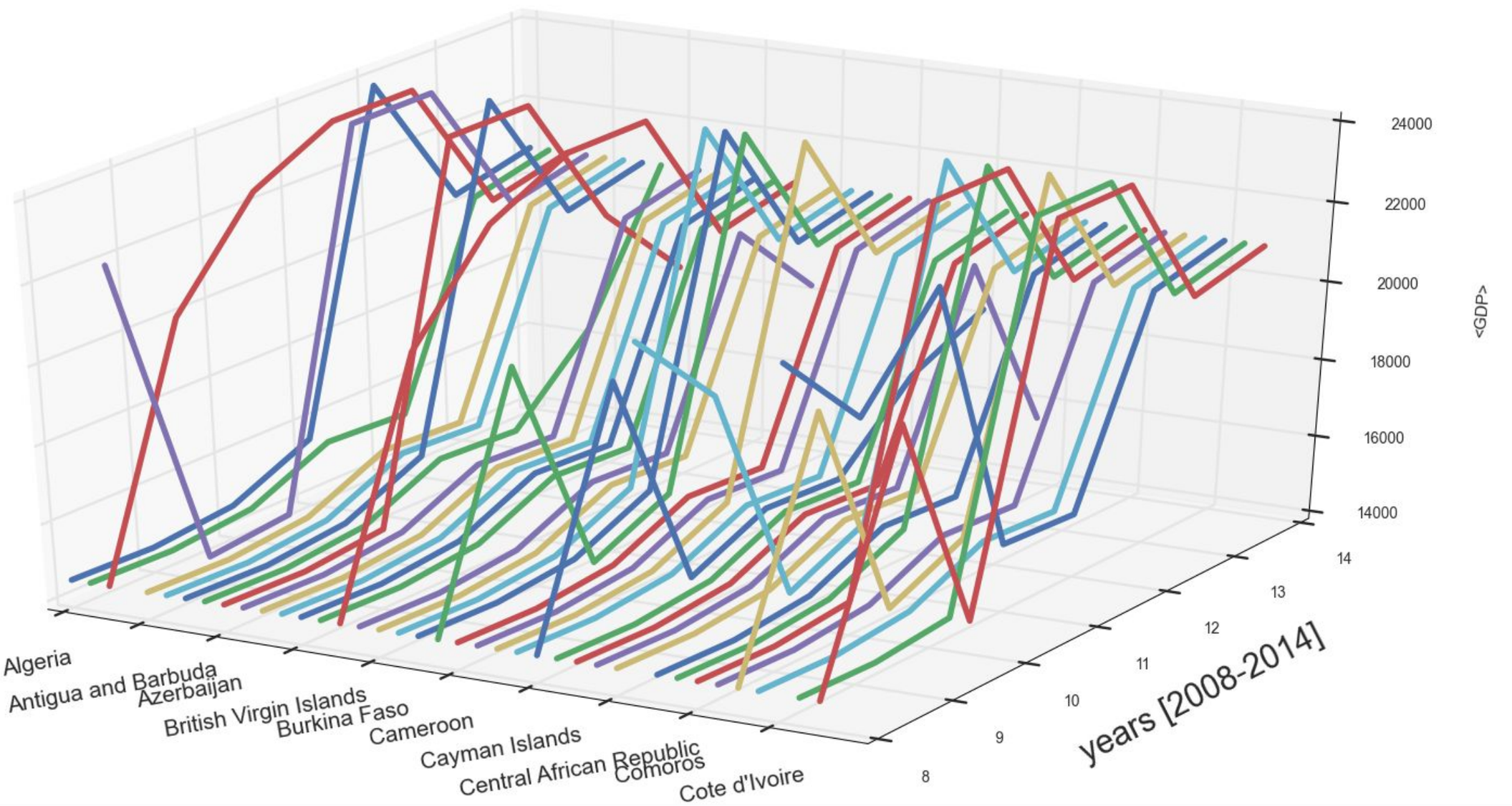
Community-Change and Economic Growth



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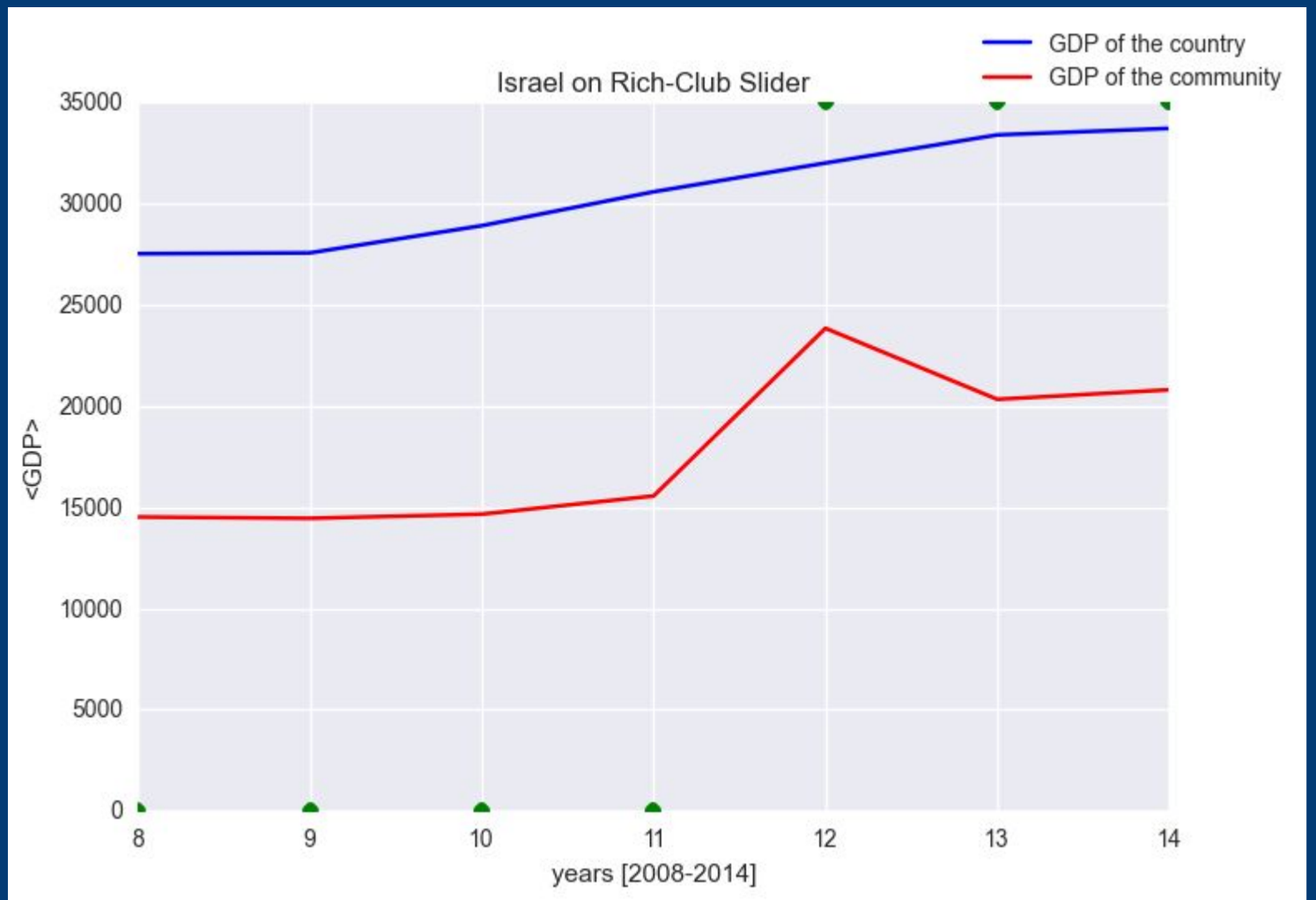
Community-Change and Economic Growth



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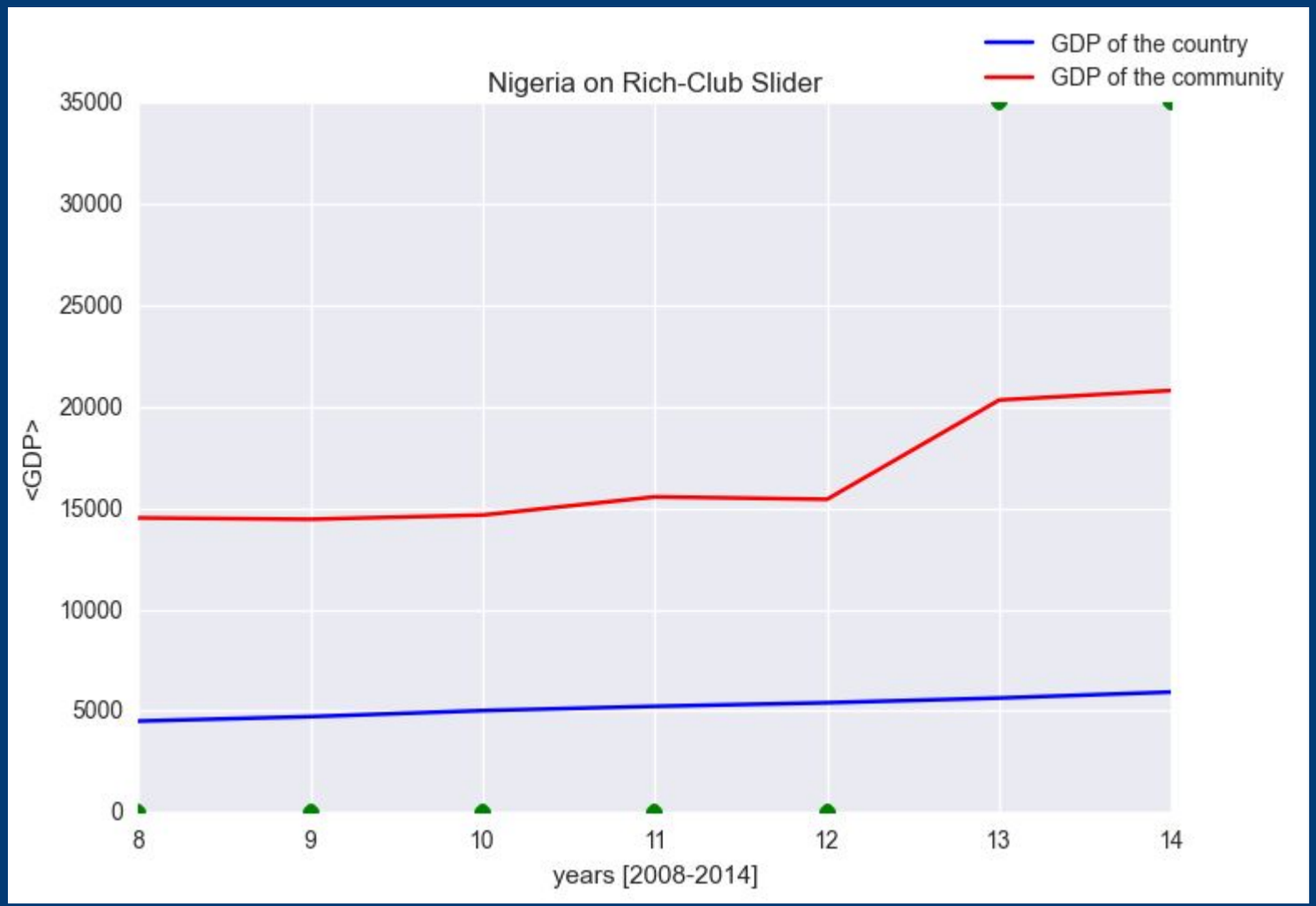
Community-Change and Economic Growth



Conclusions

- Community membership in time can be a useful measure of wealth, if aggregation parameters chosen carefully

Limitations

- Limited availability of weighted/directed community detection
- “Insightful” aggregation choices
- Time resolution
- Size of data set

Next Steps

- Other goods, aggregation methods, etc…
- Other definitions of wealth
  - PageRank, centrality, etc...
- Financial network

Thanks!

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