



A Quantitative View of the Structure of Institutional Scientific Collaborations

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Introduction



Identifying cohesive subgroups among actors in a network is one the points of focus in the network analysis

Scientific and complex economic activities are concentrated in urban and metropolitan areas¹

A selective process of spatial proximity between knowledge producing and demanding institutions²

Remnants of a historical divide putting distance between institutions³

Multi-institutional collaborations != simple agreements among researchers⁴

Examining effectiveness of institutional scientific coalitions can inform future policies

We use examples of Berlin vs. Halle-Jena-Leipzig to answer **substantive questions**:

- Can we use network analysis methods, looking at the scientific collaboration in these regions, identify the role played by *known* strategic coalitions?
- (The reverse) Can we then use these methods on larger scale empirical results to identify potentially *unknown* coalitions?

• [1] Balland, P.-A., Jara-Figueroa, C., Petralia, S. G., Steijn, M. P. A., Rigby, D. L., & Hidalgo, C. A. (2020). Complex economic activities concentrate in large cities. *Nature Human Behaviour*, 4(3), 248–254. <https://doi.org/10.1038/s41562-019-0803-3>

• [2] Rammer, C., Kinne, J., & Blind, K. (2020). Knowledge proximity and firm innovation: A microgeographic analysis for Berlin. *Urban Studies*, 57(5), 996–1014. <https://doi.org/10.1177/0042098018820241>

• [3] Abbasifarofteh, M., & Broekel, T. (2020). Still in the shadow of the wall? The case of the Berlin biotechnology cluster. *Environment and Planning A: Economy and Space*. <https://doi.org/10.1177/0308518X20933904>

• [4] Shrum, W., Genuth, J., Carlson, W. B., Chompalov, I., & Bijker, W. E. (2007). *Structures of Scientific Collaboration*. MIT Press.

Why these cases?



Berlin:

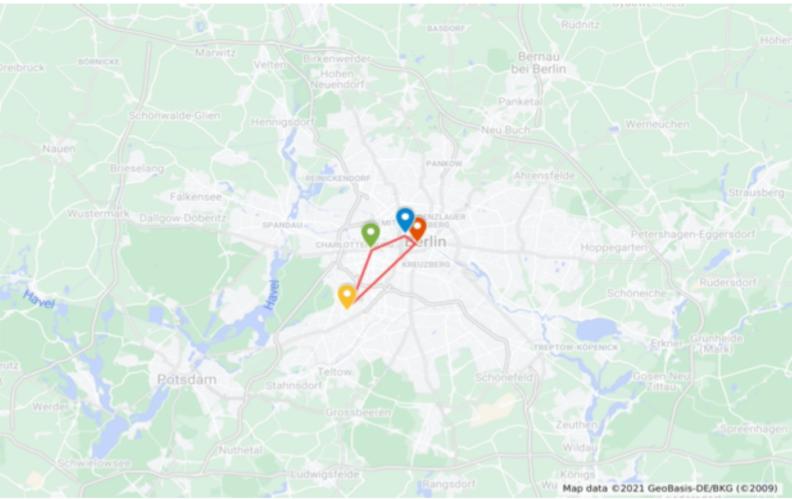
- Divide/competition
- Mutually exclusive identity
- Cooperation

Halle-Jena-Leipzig (HJL):

- **Unibund** from 1995
- Established **iDiv** with DFG fund in 2012

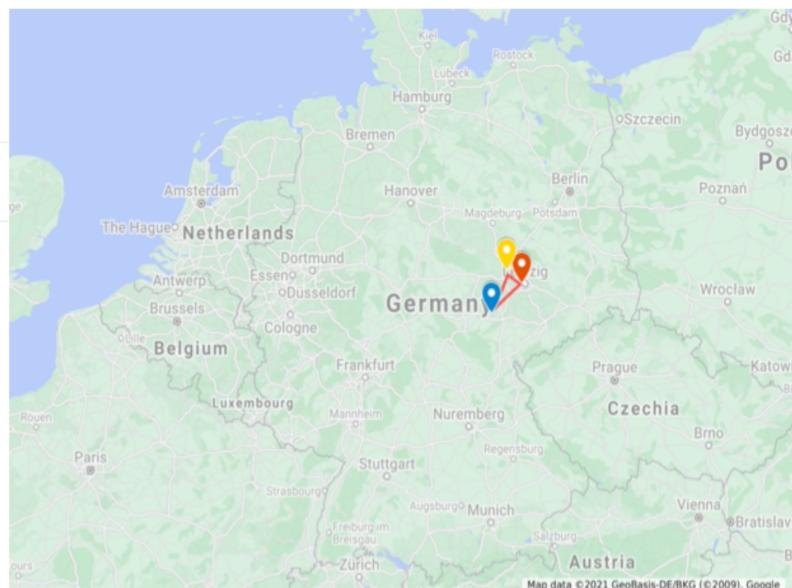
Berlin region

- Berlin region
- 📍 Freie Universität Berlin
 - 📍 Humboldt University of Berlin
 - 📍 Berlin Institute of Technology
 - 📍 Charité – Universitätsmedizin Berlin
 - 📍 HU-FU-TU-CH Berlin



HJL region

- HJL Cities
- 📍 Leipzig
 - 📍 Halle (Saale)
 - 📍 Jena
- Proximate Distance
- 📍 HJL region polygon

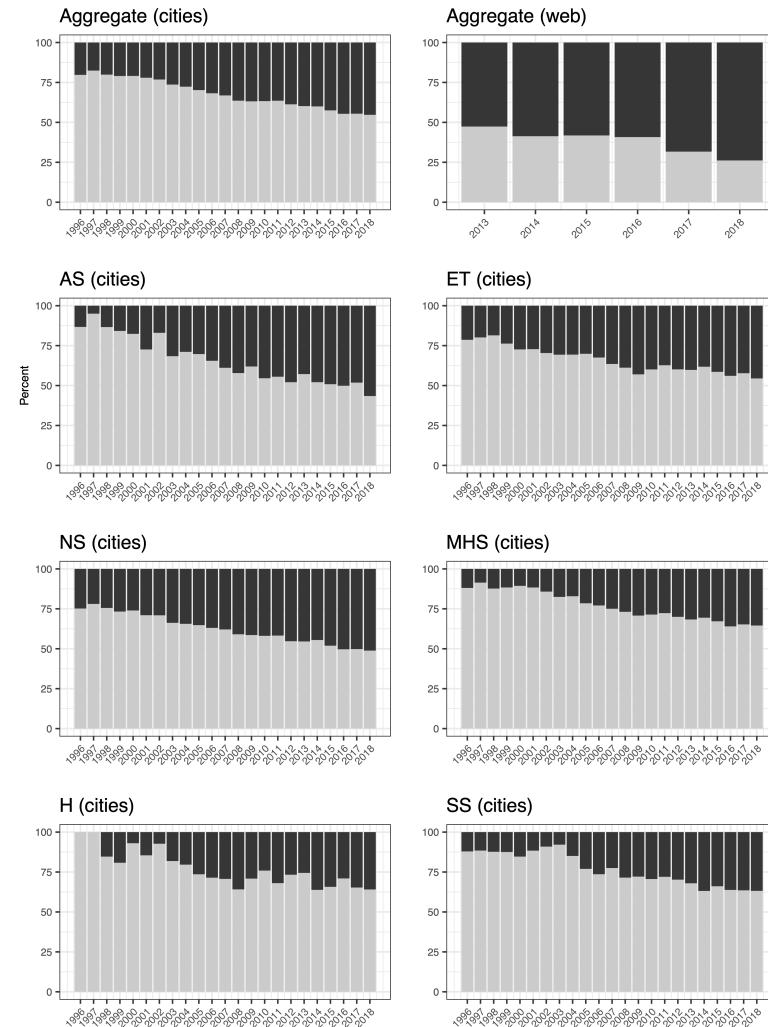
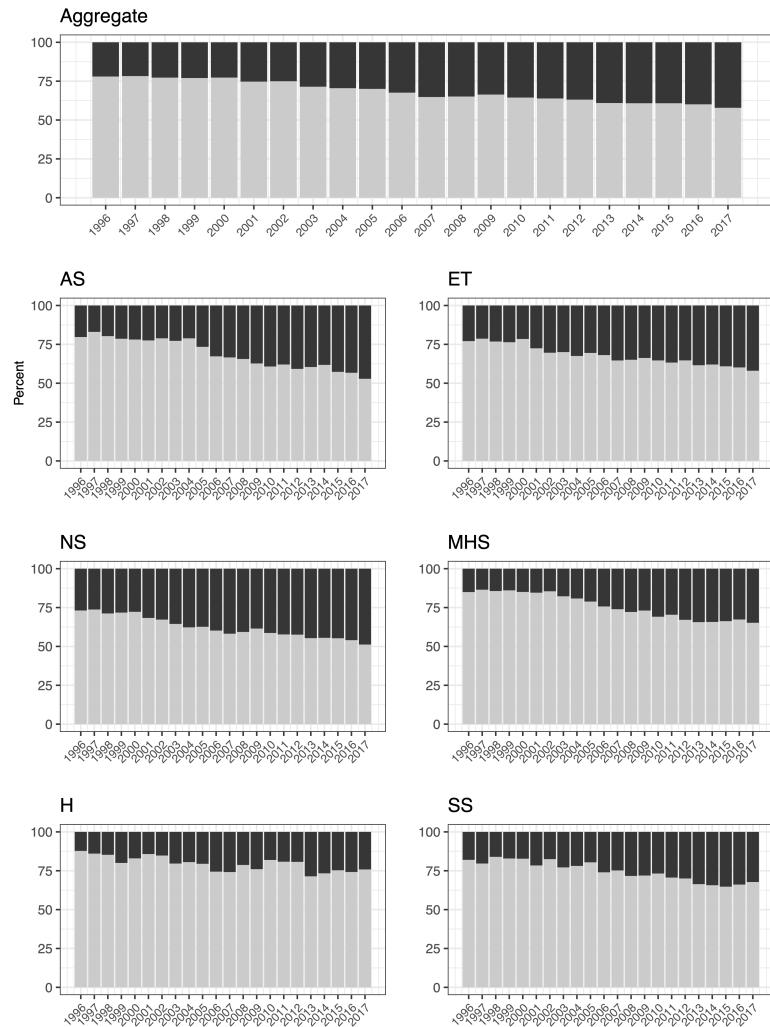




- Scopus **1996-2017**
- *Article, Review and Conference proceeding*
- At least one institution of **Berlin, Germany**
- 256,909 publications, 356,918 *Non-disambiguated* institutions
- OECD fields (mapped to ASJC from Scopus)
- **Wikidata** 27 March 2019, **GRID** (Global Research Identifier Database) February & December 2019
- **Research Organization Registry (ROR)** [local] API (December 2019)
- Bipartite community detection, CPM (robustness: BimLPA, Infomap, 1-mode CPM or Leiden algorithm), $\gamma = 6 \times 10^{-3}$
- Scopus **1996-2018**
- *Article, Review and Conference proceeding*
- At least one institution of **HJL (Halle, Saale, Jena or Leipzig), Germany**
- 154,822 publications, 462,426 *Non-disambiguated* institutions
- iDiv website: **30th July 2020**; 2,371 unique DOIs, 1,749 on Scopus 2019 (74%), involving 12,828 *Non-disambiguated* institutions

Internationalization: Berlin (left), iDiv (right, aggregate web), HJL (right, cities)

- AS: Agricultural Sciences
 - ET: Engineering Technology
 - NS: Natural Sciences
 - MHS: Medical and Health Sciences
 - H: Humanities
 - SS: Social Sciences



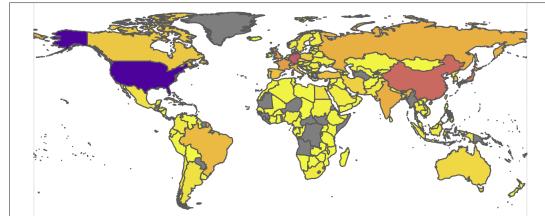
Country Status  Multiple Countries pubs  Single Country (DEU)

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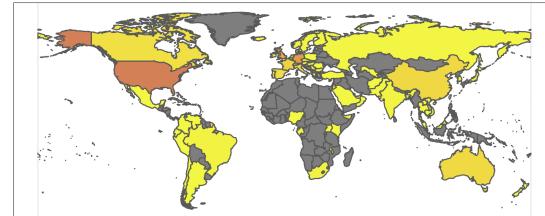


Groupings based on sectors: Only Berlin as an example (HJL is quite similar)

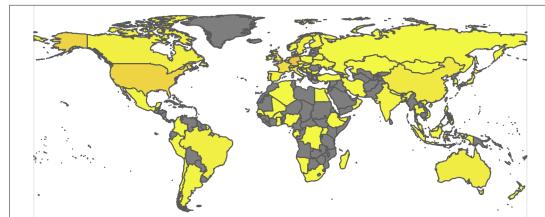
Education



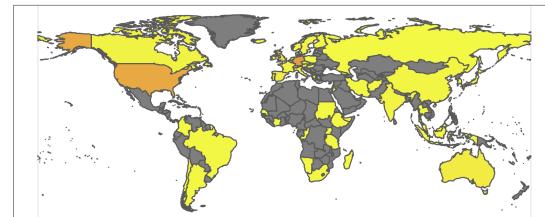
Healthcare



Government



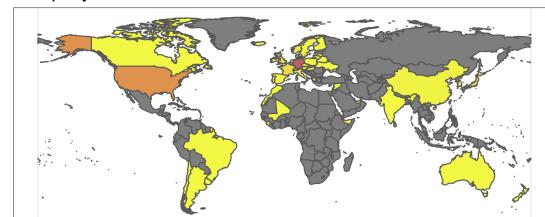
Nonprofit



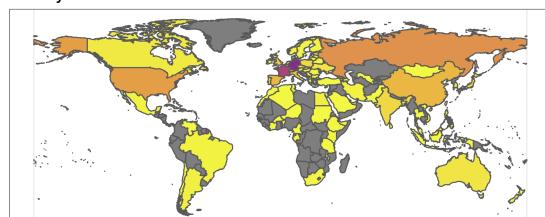
Other



Company



Facility



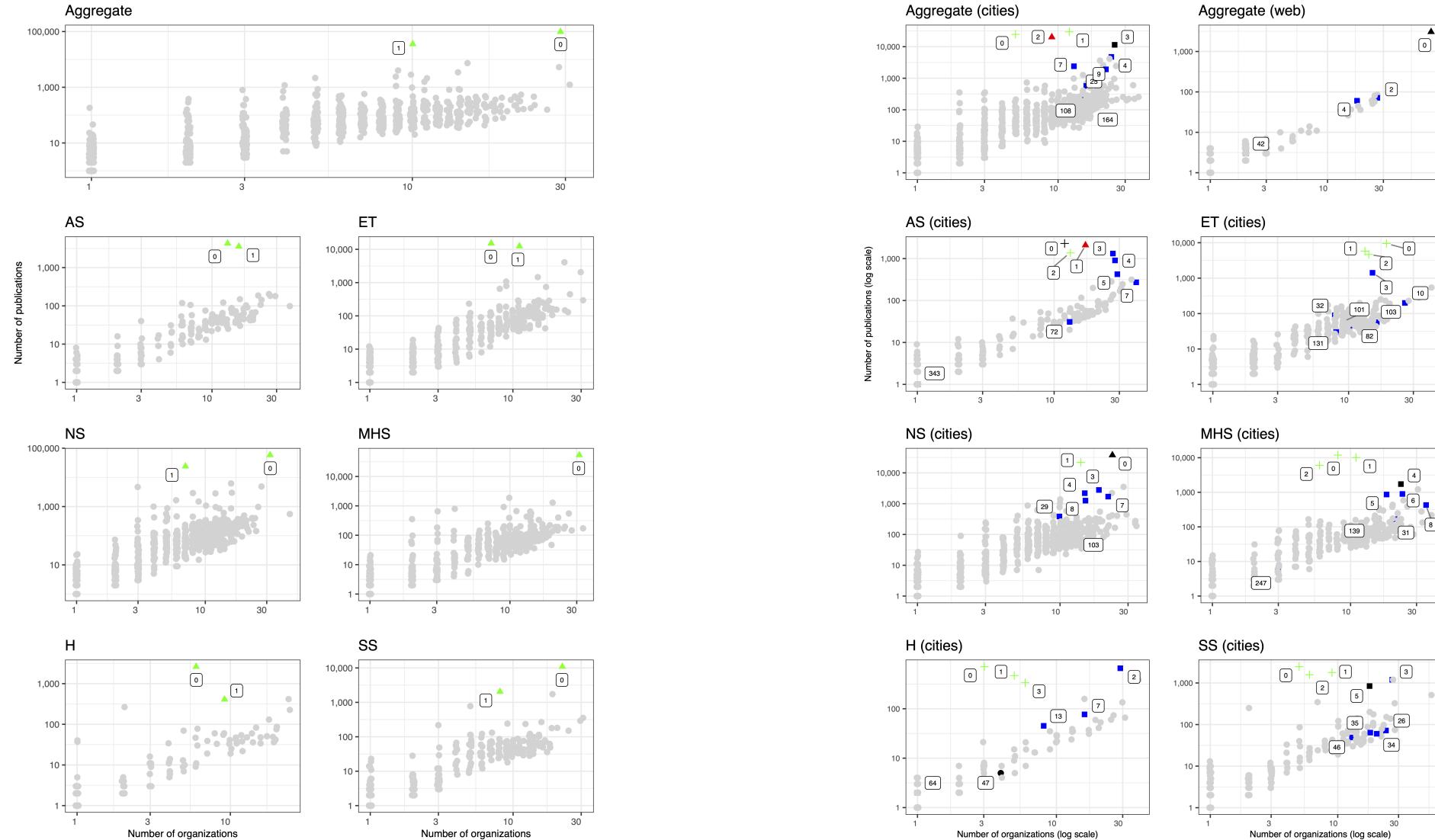
Archive



N. of organizations

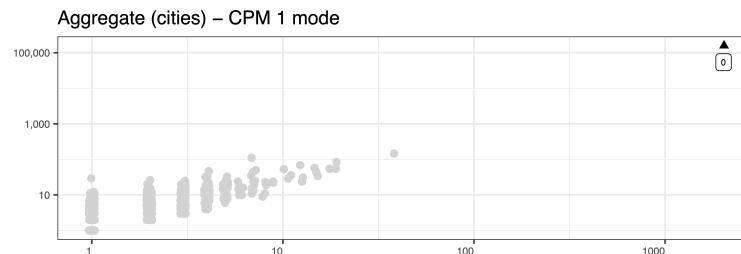
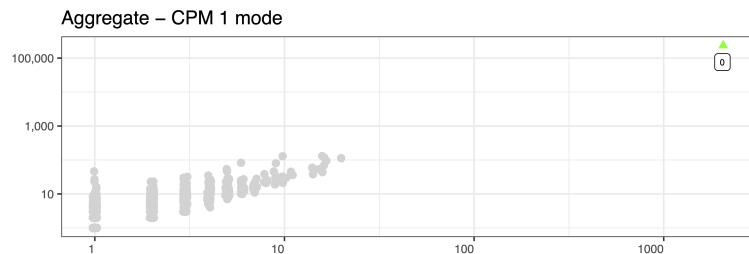
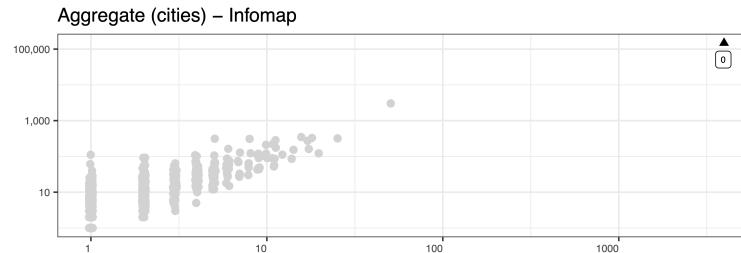
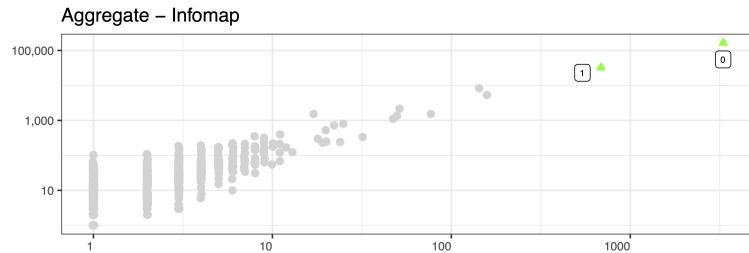
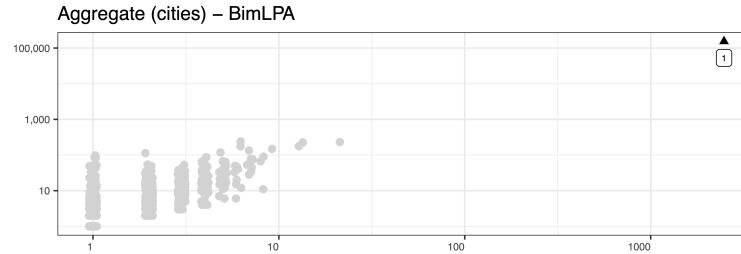
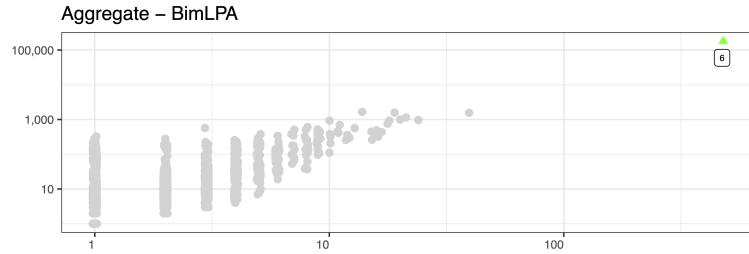
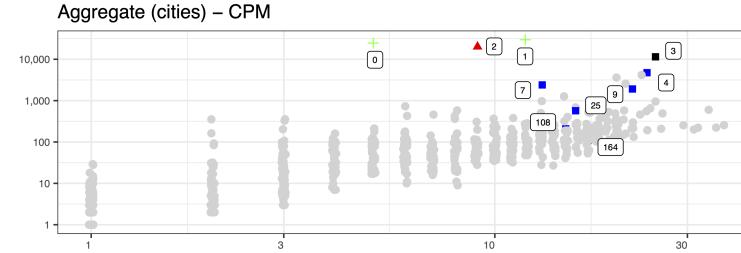
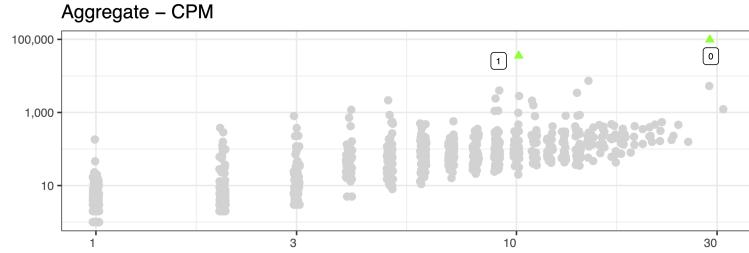
Cohesive communities, Berlin (left), HJL (right)

- Green triangle: includes BUA member(s)
- Green plus: includes Unibund member(s),
- Blue square: includes iDiv member(s),
- Black: includes iDiv center,
- Triangle/red: includes Unibund/iDiv member(s)



Robustness check: Berlin (left), HJL (right)

- Green triangle: includes BUA member(s)
- Green plus: includes Unibund member(s),
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- **Internationalization** is increasing, not prevalent yet
- Geographical proximity is not enough for cohesive institutional collaboration
- Low integration of business sector (companies)
- Simultaneous look at **fields, sectoral** and **geographical** composition of communities



Thank you for your attention

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Berlin paper: https://doi.org/10.1162/qss_a_00131

HJL/iDiv preprint: <https://arxiv.org/abs/2101.05784>

Co-authorship networks: Berlin (top), HJL/iDiv (bottom)



Metrics	Non disambiguated	PyString	Fuzzy	ROR
N. of connected components	10,269	66	159	100
N. of bipartite nodes	613,827	135,057	58,547	133,387
N. of bipartite edges	1,083,775	246,704	89,199	246,472
% of bipartite nodes in G	95	100	99	100
% of bipartite edges in G	98	100	100	100
N. of organizations	356,918	5,244	4,978	7,257
N. of organizations in G	337,755	5,176	4,809	7,153
N. of publications (%)	256,909	129,813 (51%)	53,569 (21%)	126,130 (49%)
N. of publications in G	245,203	129,657	53,248	125,949

Metrics	Non disambiguated web	Disambiguated web	Non disambiguated cities	Disambiguated cities
N. of connected components	228	1	61,906	22
N. of bipartite nodes	14,577	1,604	617,248	86,233
N. of bipartite edges	16,485	4,312	631,291	168,078
% of bipartite nodes in G	87	100	55	100
% of bipartite edges in G	90	100	65	100
N. of organizations	12,828	686	462,426	6,289
N. of organizations in G	11,243	686	264,938	6,268
N. of publications	1,749	918	154,822	79,944
N. of publications in G	1,462	918	75,055	79,894



Community composition (Berlin)

			Region (%)										Sector (%)						
Data	cluster	N	P	B	Africa	Americas	Asia	Berlin	DEU	Europe	Oceania	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	
ROR	0	29	98,408	3				21	76	3		3	62	10	3	21			
ROR	1	10	35,734	1				60	30	10		30	60	10					
ROR	2	15	7,356			20	7	7	20	47		33	40	20		7			
ROR	3	9	4,002			11	11	22	56			33	56			11			
ROR	4	29	5,285			10	21	3	10	55		7	62	21	3		3	3	
ROR	5	9	2,414					11		89			67	33					
ROR	6	10	2,822			20	30	10		40		10	80	10					
ROR	7	5	2,157					20	40	40			40	40		20			
ROR	8	14	3,441			14		7	14	64			79	14		7			
ROR	9	11	2,110			9	18		18	55			18	45	18			18	
ROR	10	11	1,571					18	45	36			18		55	9	9	9	
ROR	23	31	1,230		3	3	61	3	16	10	3	3	68	10	3	3	10	3	

- N: size of community
- P: total publications
- B: number of BUA members

Community composition (HJL cities (top), iDiv web (bottom))



Data	cluster	N	P	iDiv	Region (%)										Sector (%)									
					I	U	Africa	Americas	Asia	Berlin	DEU	Europe	HJL cities	Oceania	No region	Archive	Company	Education	Facility	Government	Healthcare	Nonprofit	Other	
ROR web	0	77	3,061	Y	5	3	3	5	9	4	38	29	10	3		1		70	22	3		3	1	
ROR web	1	27	86					30	33		15	11	7	4			4		81	7	4			4
ROR web	2	27	71	1		4			15		22	59				7			63	7	22			
ROR web	3	25	81			4	28				64	4				12			64	16	4			4
ROR web	4	18	60	1	33		17			11	33	6				6	6	50	11	6		11	11	
ROR web	5	24	51					67	21		4	8				12	4	71	12					
ROR web	6	24	53				21	21	17		29		12			4		71	8	4		8	4	
ROR web	7	25	57					32	4		52	12				8		64	16	8			4	
ROR web	9	24	61					50		4	4	38	4				4	83	4	4			4	
ROR web	12	18	59					61	6		6	17	11			6		78	6				6	6
ROR web	42	2	3	1						100								100						
ROR cities	0	5	24,616			1				20	20		60					60	20		20			
ROR cities	1	12	29,608		1					25	17	50	8				42	42		17				
ROR cities	2	9	20,127	1	1					67		33					67	33						
ROR cities	3	25	11,481	Y	1					48	36	12	4				72	20	4	4				
ROR cities	4	24	4,741	1			42			8	46	4					79	17	4					
ROR cities	7	13	2,398	1			31	15		46	8						62	31	8					
ROR cities	8	26	2,437				19	12		19	46	4					38	46	12			4		
ROR cities	9	22	1,912	1	5	14			27	50	5						27	45	14		9	5		
ROR cities	25	16	569	1	6	6	12		44	31						6	56	19	6	12				
ROR cities	36	34	599			12	6	6	9	59		6	3	3	3		29	44	9	3	6	3		
ROR cities	49	37	255			5	24	51		16		3				3	68	16	3	8	3			
ROR cities	63	26	491			4	8	19	4	27	35		4				35	23	8	27	4	4		
ROR cities	79	35	223				11	49		40						6	60	14		20				
ROR cities	81	29	254			3	3	90		3						3	69	14	7					
ROR cities	92	31	200				16	3	6	74						6	3	29	45	3	3	6	3	
ROR cities	93	32	221				75	3	6	6		9					38	22	19	9	9	3		
ROR cities	108	15	208	1	7		27		27	40							47	33	7		7	7		
ROR cities	125	26	209				15	8	4	73						4	46	35	8	4	4			
ROR cities	164	17	109	1			6	6		12	76					18	6	29	35	6				6

N: size of community, P: total publications, iDiv: includes iDiv center, I: number of iDiv members, U: number of Unibund members