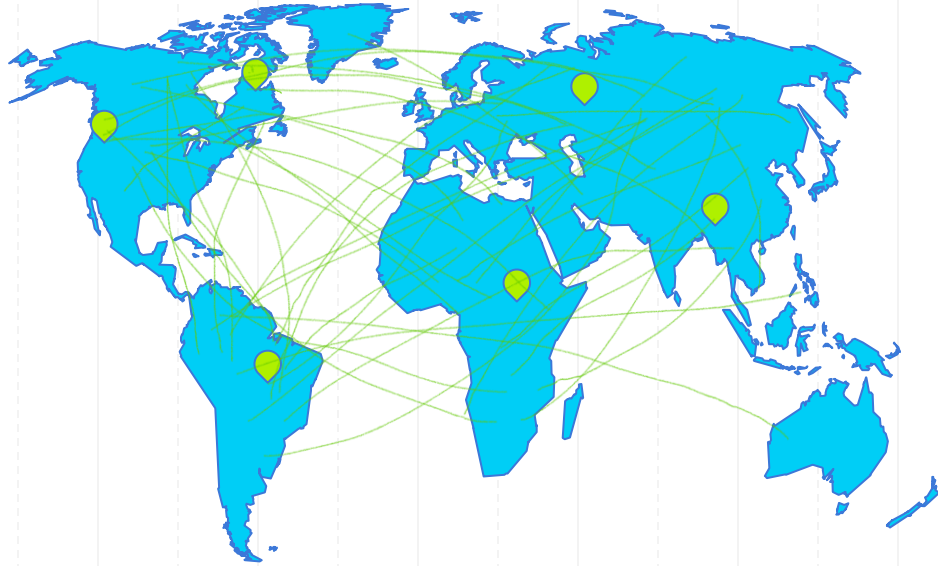


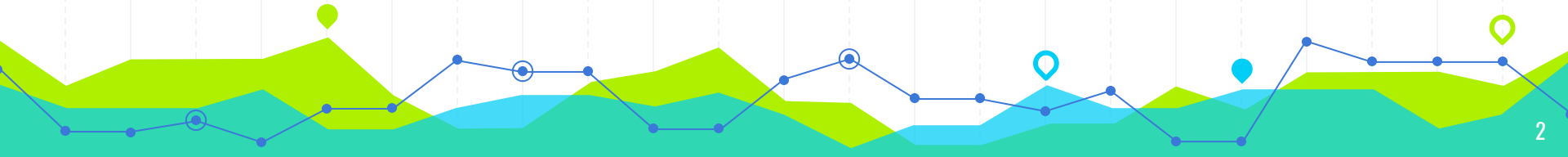


Land Market Analysis

An **ECONOMIC NETWORK** of global land acquisitions



represented with a
DIRECTED GRAPH ...



142 nodes

States participating in land market

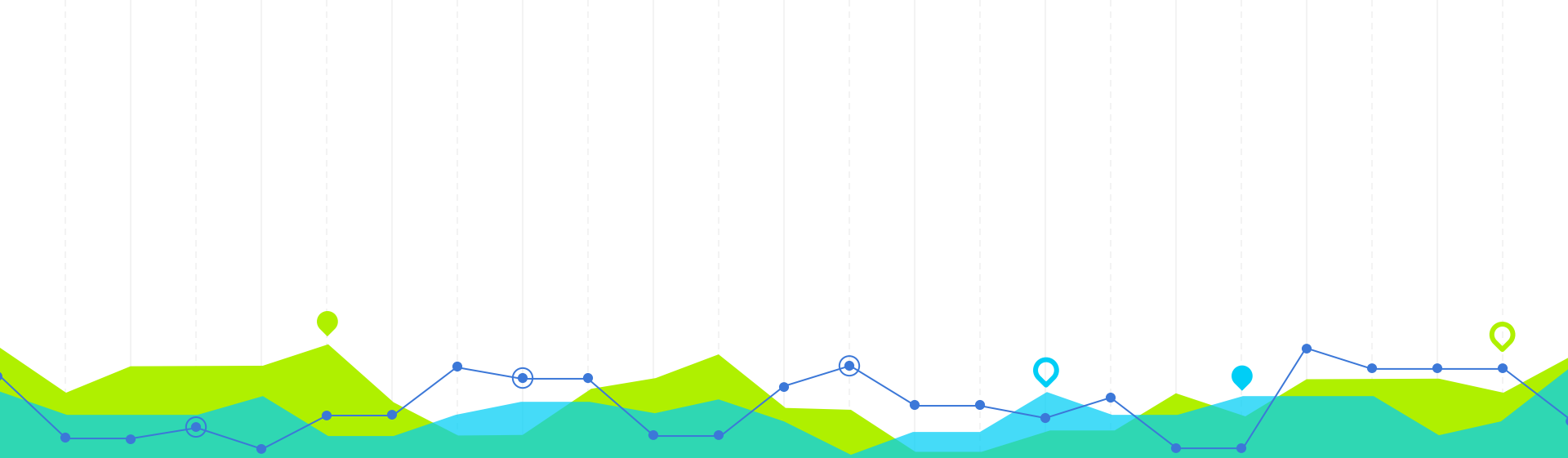
624 edges

Land investments

0,03 density

High sparsity





Degree analysis

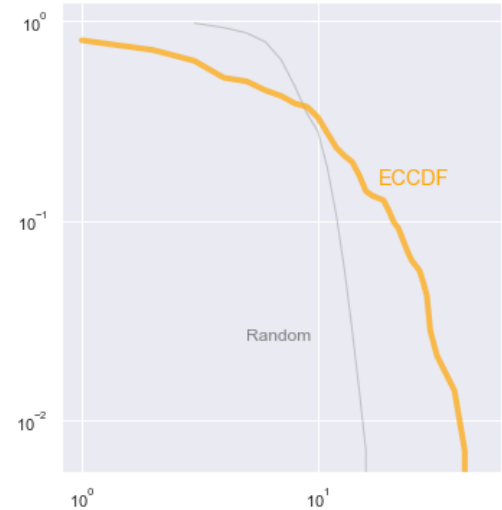
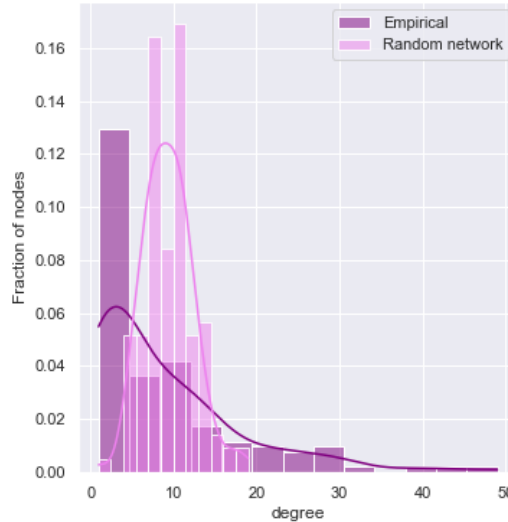
Does the land network display scale-free property?

1

Degree distribution

Substantial curvature on log-log scale.
However, the empirical cumulative degree distribution is clearly **heavy-tail**, with high degree nodes not predicted by a random Erdos-Renyi model $G(142, 0.03)$

...the network is scale-free.



In-Degree & Out-Degree distribution

Point statistics:

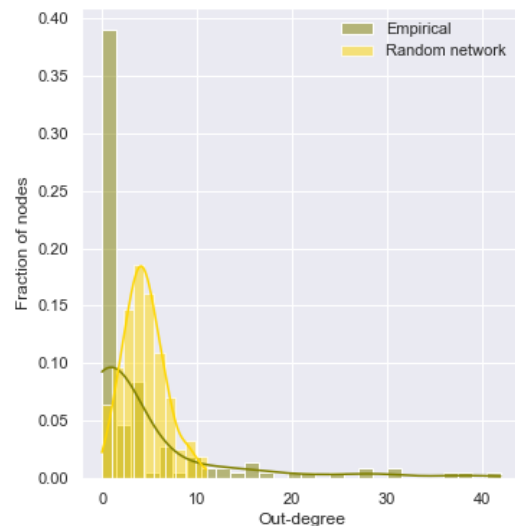
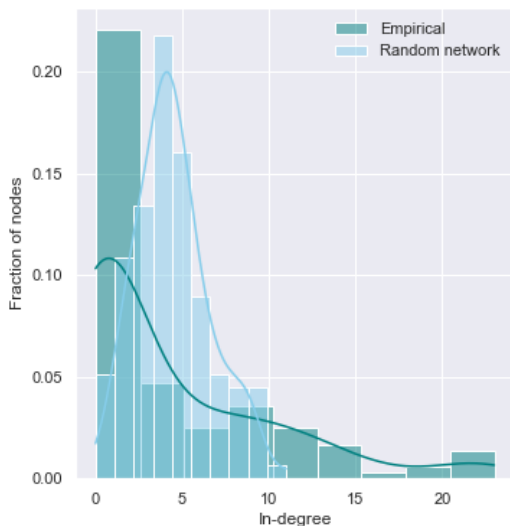
Average degree: 8.7

Average in/out degree : 4.4

Median degree : 2 (in) , 1 (out)

Standard dev. : 5.8 (in) , 8.2(out)

Natural cut-off: 23 (in), 42 (out)



Connectivity & Clustering & Assortativity

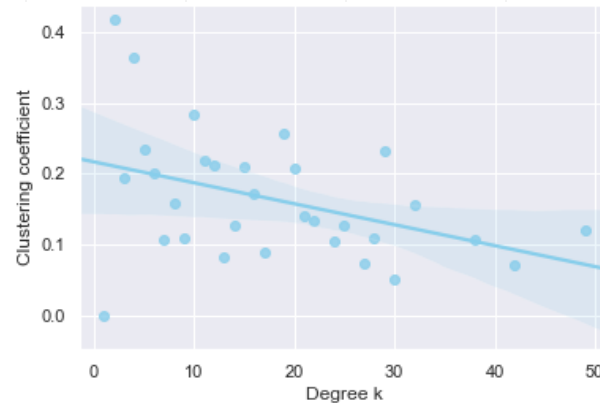
A negative degree assortativity of -0.24 suggests **structural disassortativity**, where high degree nodes mainly interact with low degree nodes.

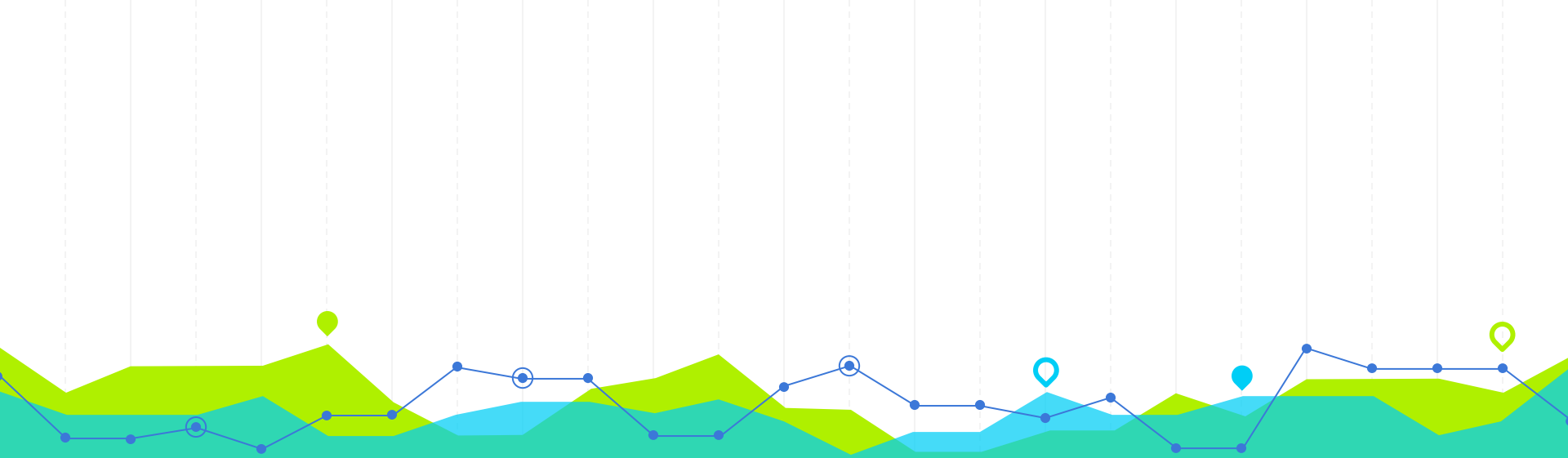
Out-in degree correlation : -0.14

Negative dependence of the local clustering coefficient on the node degree:
Low degree nodes tend to be more clustered, while high degree nodes have a lower clustering coefficient

Fully connected graph, as correctly predicted by ER model, since the average degree is $8.7 > \ln(142)$.
Unique strongly connected component with size greater than 1.

Clustering coefficient as a function of the degree

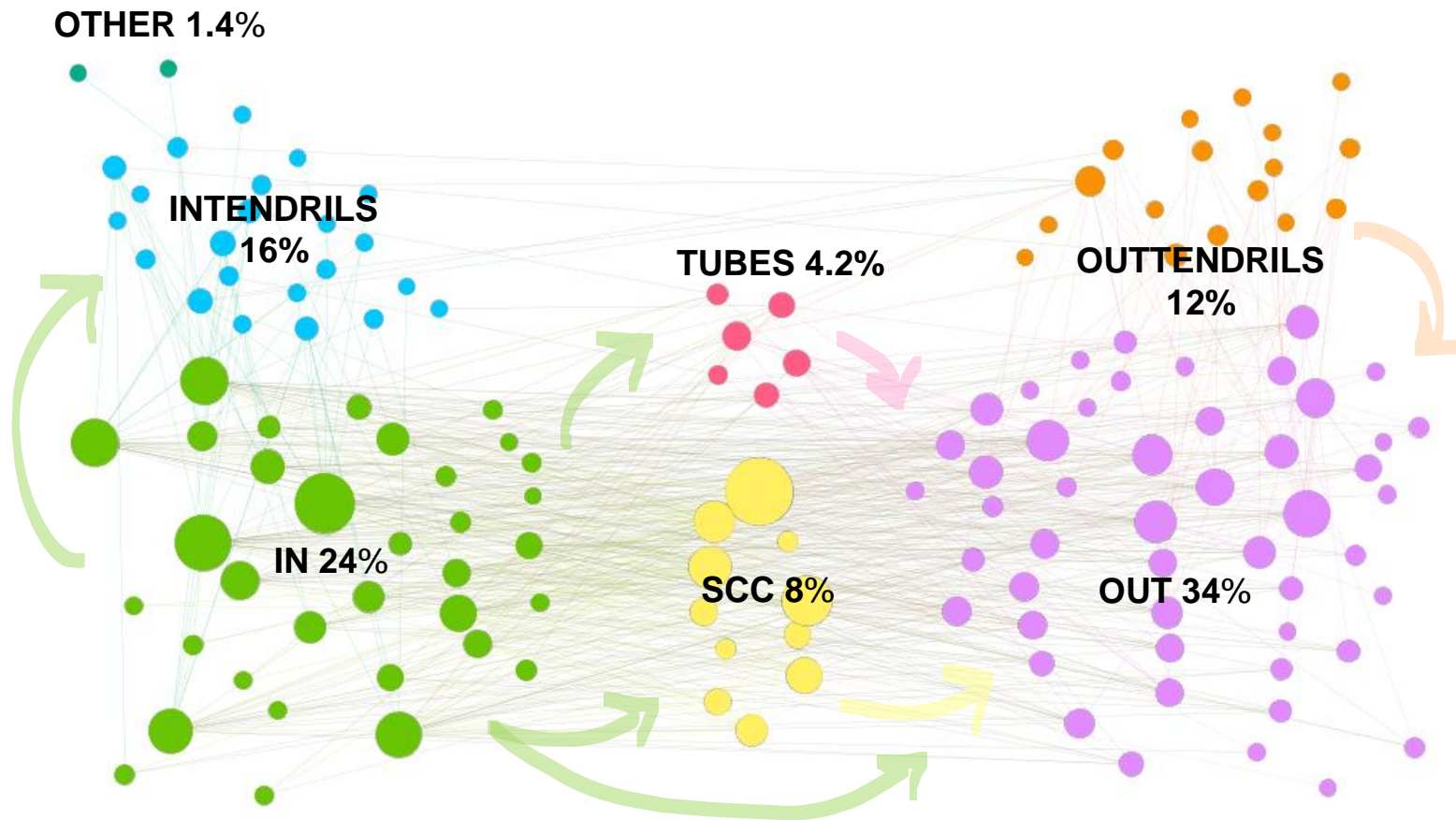




Bow-tie decomposition

2

https://www.researchgate.net/publication/252027520_Bow-tie_decomposition_in_directed_graphs



Investment flows (% number of deals)

Target

Investor

	SCC	IN	OUT	INTEN	OUTTEN	TUBES	Other	Total
SCC	4.3%	.	10.4%	.	.	.	.	14.7%
IN	13.5%	0.5%	39.9%	8.7%	.	3.2%	.	65.7%
OUT	.	.	6.9%	.	.	.	.	6.9%
INTEN	.	.	.	0.5%	.	.	.	0.5%
OUTTEN	.	.	6.7%	1%	.	0.5%	.	8.2%
TUBES	.	.	3%	0.5%	.	0.2%	.	3.7%
Other	.	.	.	0.3%	.	.	.	0.3%
Total	17.8%	0.5%	67%	11%	.	3.8%	0%	100%

Deal size distribution (in hectares of land)

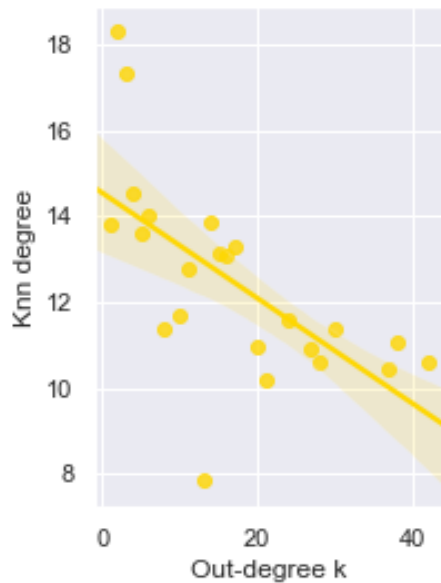
Target

Investor

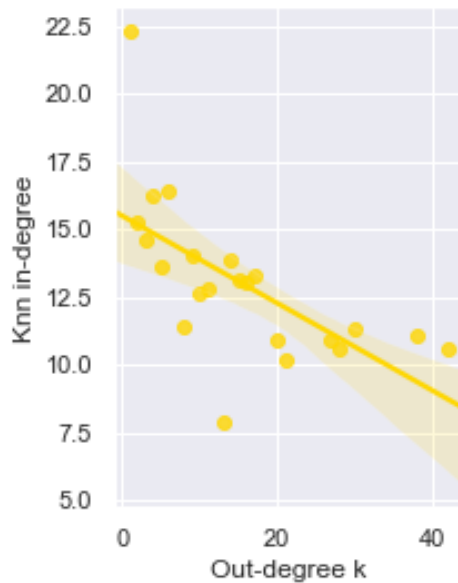
	SCC	IN	OUT	INTEN	OUTTEN	TUBES	Other	Total
SCC	14.4%	.	10%	.	.	.	.	24.4%
IN	24.3%	.	29.7%	7.3%	.	1.1%	.	62.5%
OUT	.	.	5.4%	.	.	.	.	5.4%
INTEN	.	.	.	.	.	.	.	0%
OUTTEN	.	.	5%	0.1%	.	0.2%	.	5.3%
TUBES	.	.	2.4%	.	.	.	.	2.4%
Other	.	.	.	.	.	.	.	0%
Total	38.6%	0%	52.5%	7.4%	0%	1.3%	0%	100%

Degree correlation between components

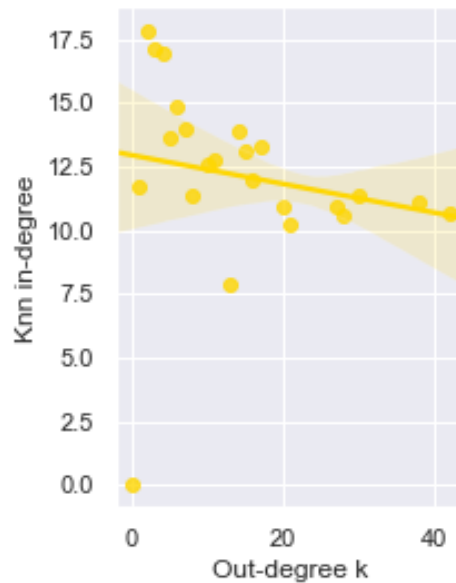
IN - SCC



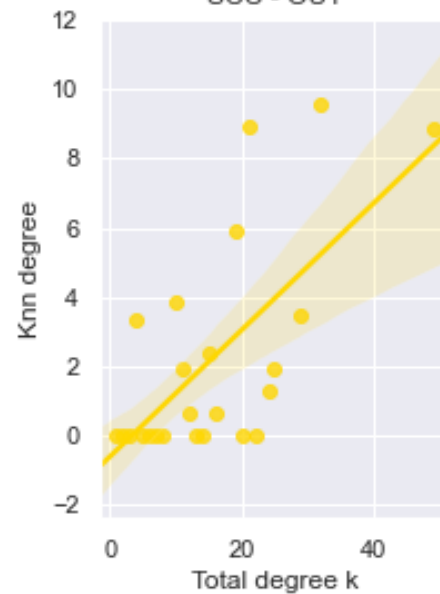
IN - TUBES

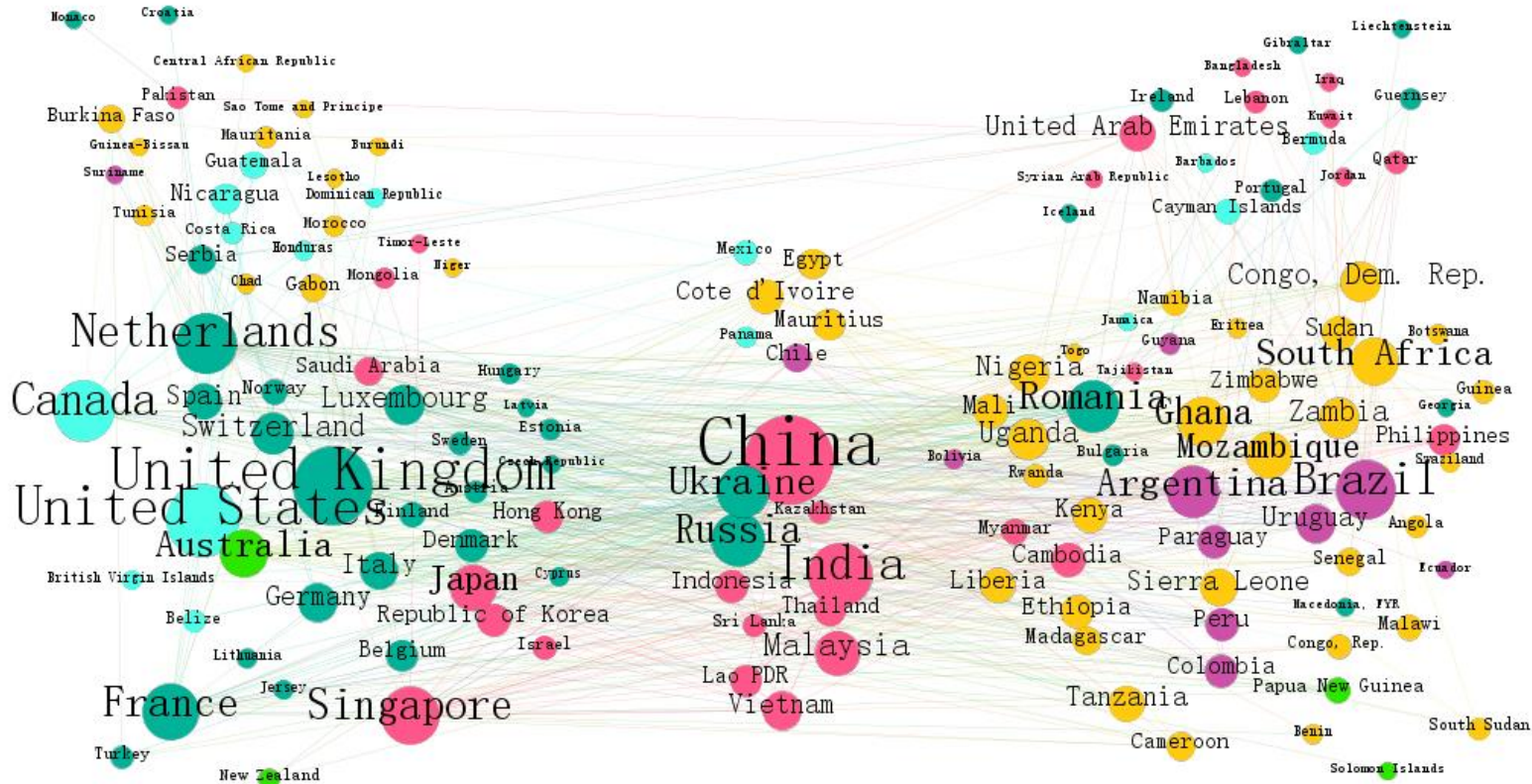


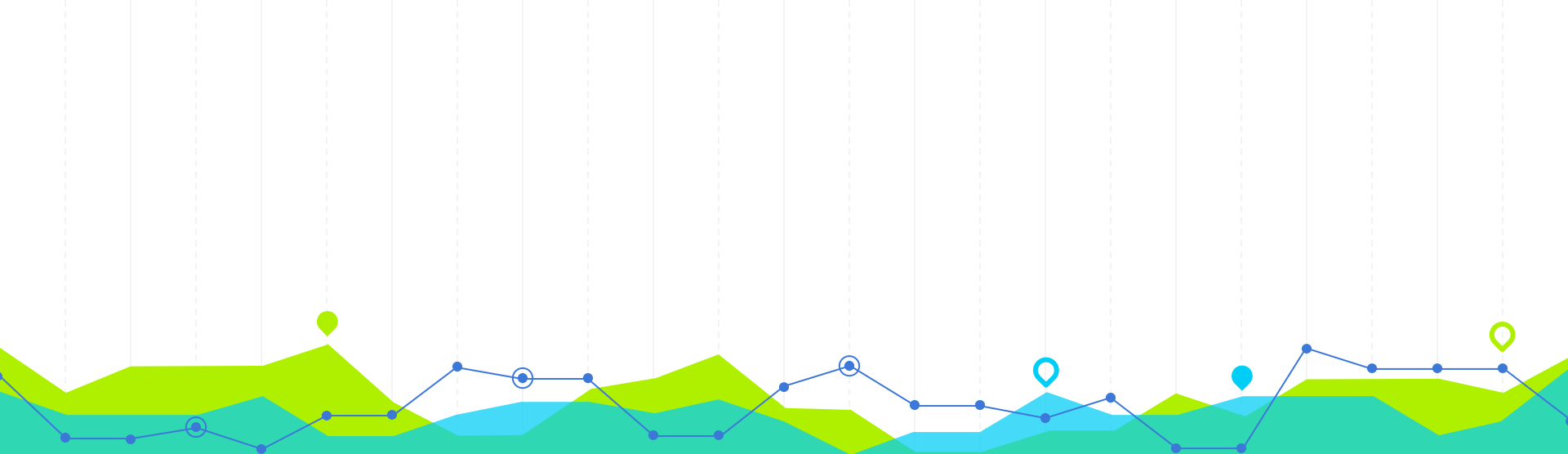
IN - OUT



SCC - OUT





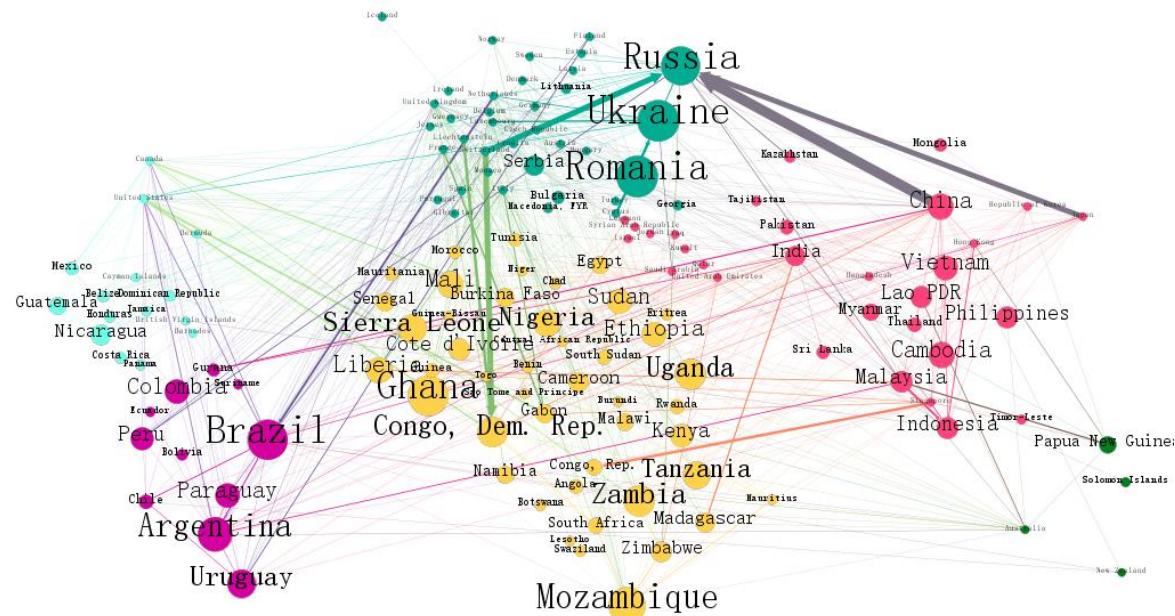


Continental analysis

Focus on international land acquisitions

3

Centrality in the land market



	Deals %	Surface %
Asia	16.5	10.3
South America	15.5	16.6
Africa	49.5	39.6
North America	4.3	0.7
Europe	13.0	30.8
Australia	1.1	1.9

1st place

Africa is the most targeted continent (50% of global acquisitions are settled there), but the main target countries are elsewhere

Most central nodes (betweenness)

India, Thailand, China, Malaysia, Ukraine

Top 5 investors

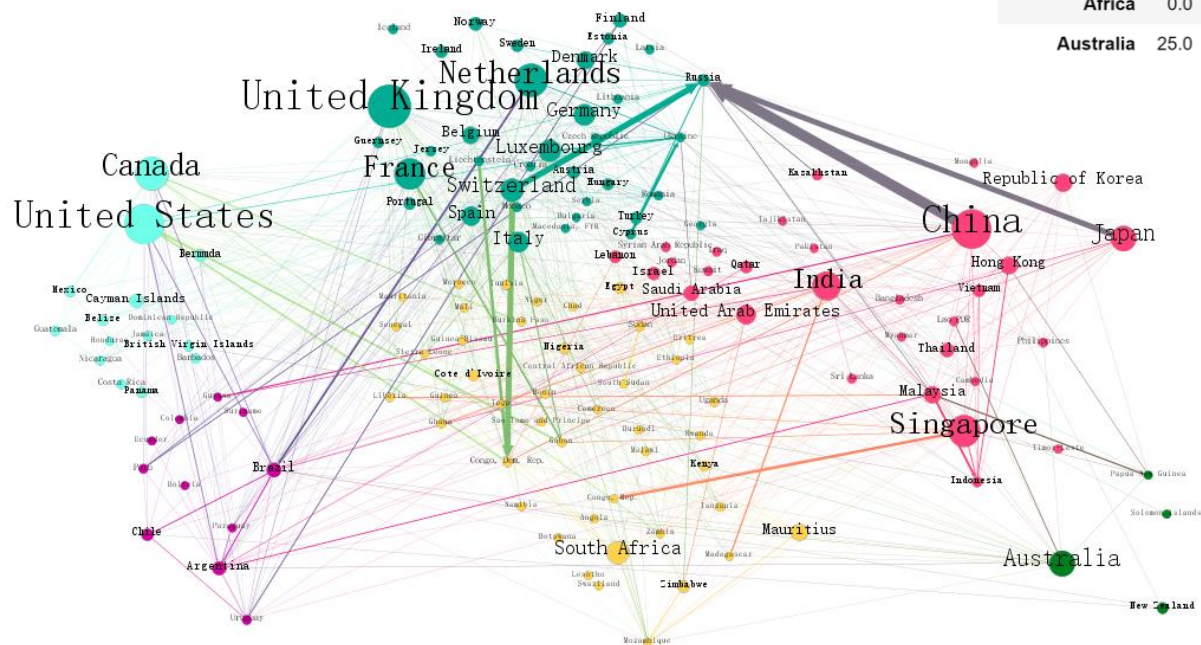
UK, USA, China, Canada, Netherlands

Top 5 suppliers

Russia, Ukraine, Romania, Ghana, Brazil



INTER-CONTINENTAL INTERACTION



	Asia	Europe	North America	South America	Africa	Australia	Total
Asia	31.6	9.7	0.5	10.2	45.4	2.6	100.0
Europe	10.2	20.5	4.7	14.2	50.0	0.4	100.0
North America	10.0	10.0	14.4	23.3	42.2	0.0	100.0
South America	0.0	0.0	0.0	73.7	26.3	0.0	100.0
Africa	0.0	2.4	0.0	4.9	92.7	0.0	100.0
Australia	25.0	0.0	4.2	16.7	50.0	4.2	100.0

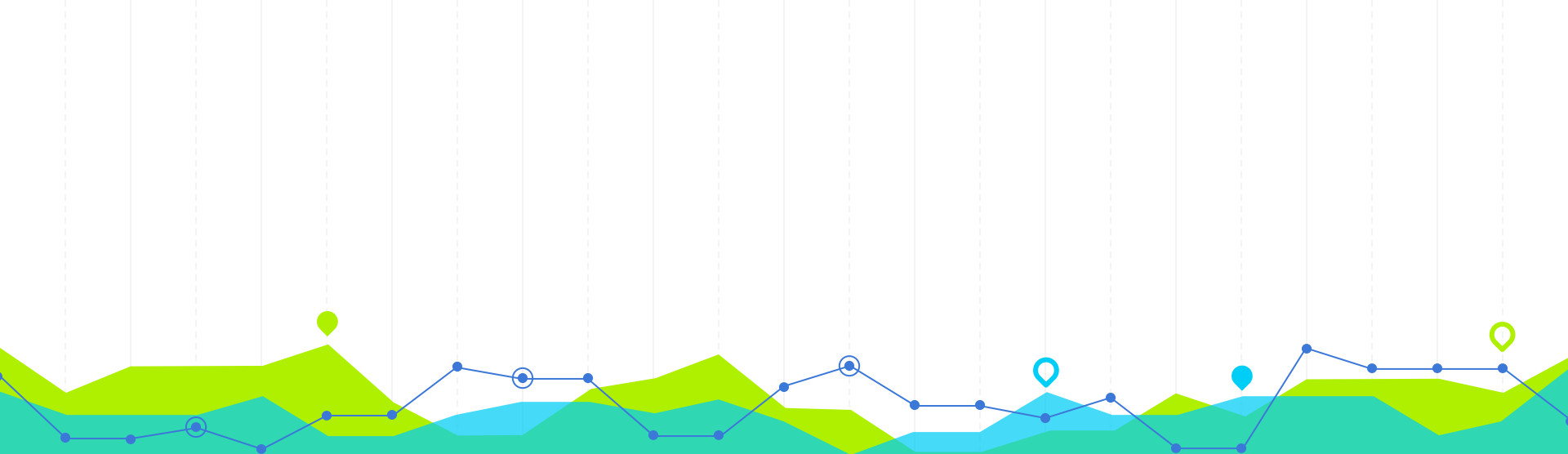
Regional trends

Positive attribute assortativity in the global South, where investors show a preference for investing in their own regions.

While the highest level of intra-continental interactions characterizes Asian continent.

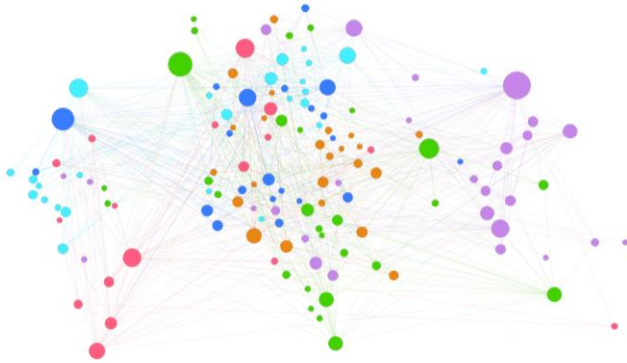
Connectivity

Asian countries and Eastern Europe form the largest strongly connected component, representing the core of the system.



Community detection 4

Partition Evaluation



Louvain algorithm

(6 communities)

Coverage: 0.453

Modularity:0.277

Performance:0.82



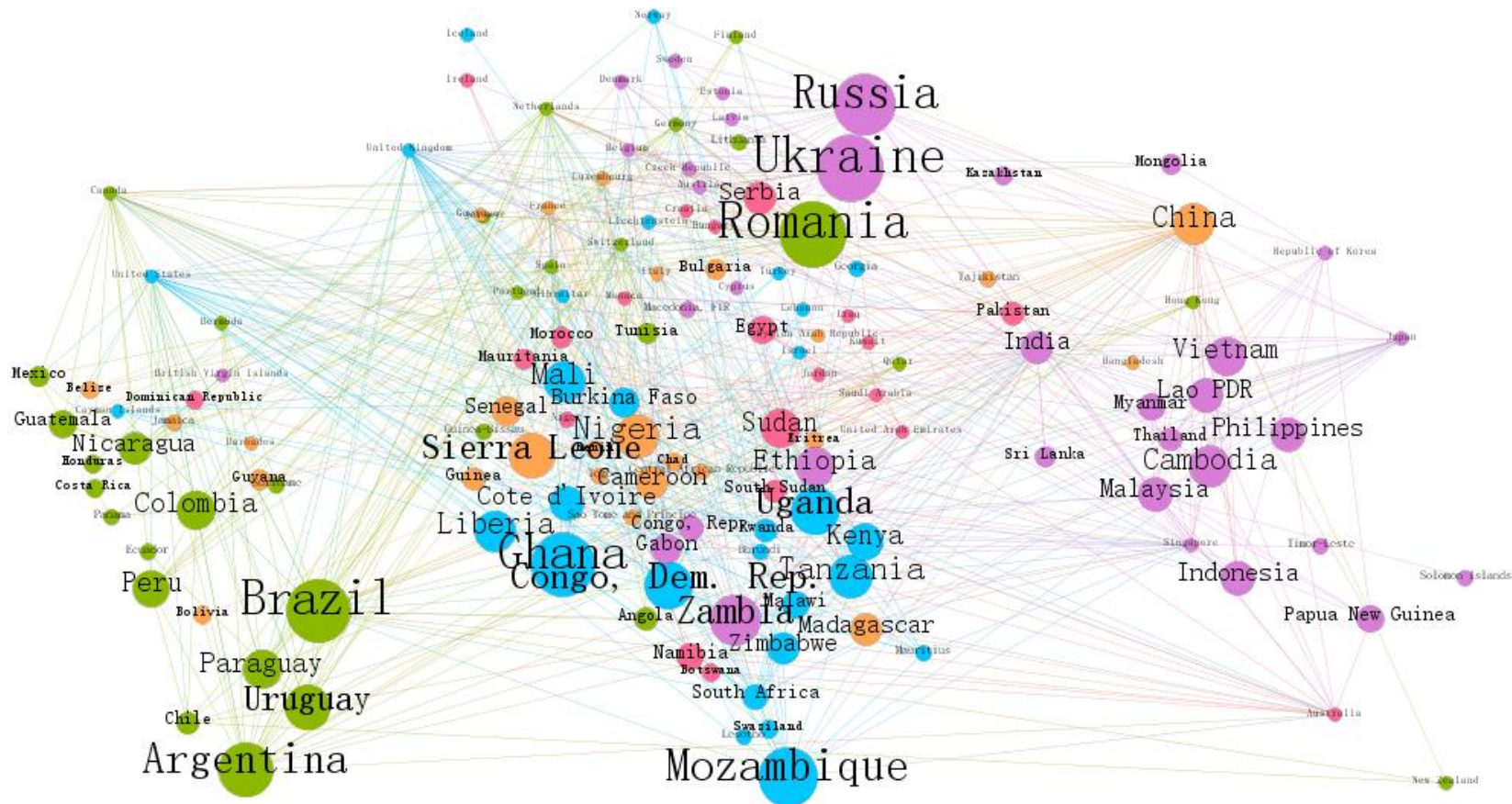
Greedy approach

(5 communities)

Coverage: 0.503

Modularity:0.279

Performance:0.80



Group	Major Supplier	Major Investor	Betweenness	Closeness	SIZE	Density	Interactions
1	Russia, Ukraine	Singapore, Japan	India, Thailand	Russia	34	8.1%	Asia + Europe
2	Brazil, Uruguay	Netherlands, Canada	Brazil, Uruguay	Brazil	32	8.7%	South America + Europe
3	Congo, Ghana	UK, USA	Uganda	Congo	29	8.9%	Africa + US/UK
4	Sierra Leone, Nigeria	China, France	China, Nigeria	China	26	5.8%	North Africa + Europe and China
5	Sudan, Serbia	Arab Emirates, Australia	Egypt	Sudan	21	6.2%	Africa + Asia



Thank You!

Shlyk Darya

darya.shlyk@student.unimi.it

