

# **Network Analysis of Brazilian Chamber of Deputies and Voting Patterns**

by Lucas Moschen and Vitória Guardieiro

# Chamber of Deputies

## Data

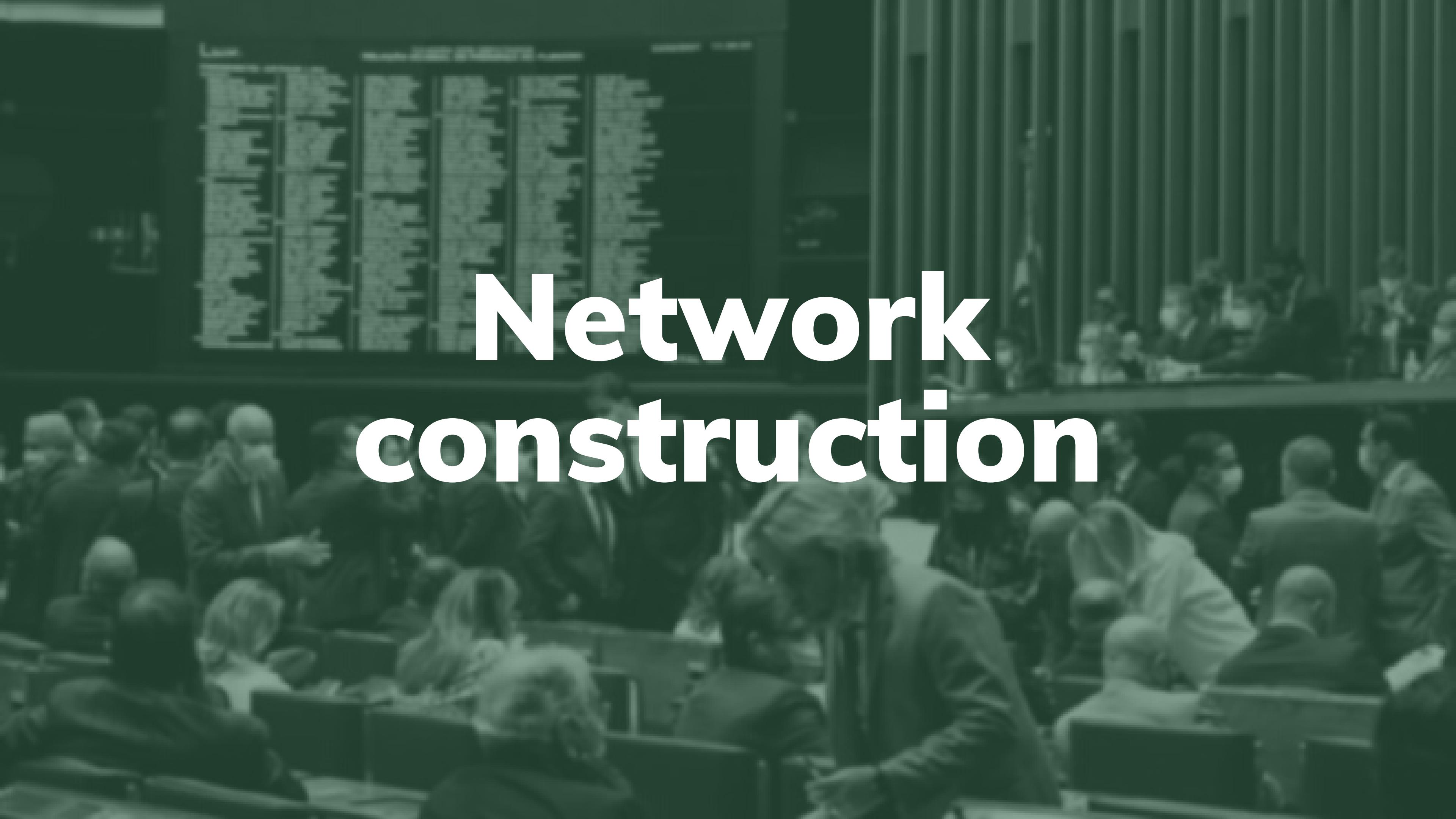
Voting

Votes

Deputies

The Python package *DadosAbertosBrasil*

<b>id</b>	<b>data</b>	<b>dataHoraRegistro</b>	<b>siglaOrgao</b>	<b>proposicaoObjeto</b>
2199215-85	2021-08-25	2021-08-25T21:25:57	PLEN	None
2247170-18	2021-08-25	2021-08-25T10:08:00	CCTCI	None
2285552-18	2021-08-25	2021-08-25T10:08:11	CCTCI	None
2295811-2	2021-08-25	2021-08-25T09:19:59	CAPADR	REQ 99/2021 CAPADR
2219676-98	2021-08-26	2021-08-26T15:59:47	PLEN	None
<b>tipoVoto</b>	<b>dataRegistroVoto</b>	<b>deputado_</b>		
Não	2021-08-25T20:54:30	{id': 160635, 'uri': 'https://dadosabertos.ca...}		
Sim	2021-08-25T20:56:49	{id': 204391, 'uri': 'https://dadosabertos.ca...}		
Sim	2021-08-25T21:09:25	{id': 160600, 'uri': 'https://dadosabertos.ca...}		
Não	2021-08-25T20:53:55	{id': 178916, 'uri': 'https://dadosabertos.ca...}		
Sim	2021-08-25T20:51:45	{id': 75431, 'uri': 'https://dadosabertos.cam...}		
<b>id</b>	<b>nome</b>	<b>siglaPartido</b>	<b>siglaUf</b>	<b>idLegislatura</b>
204379	Acácio Favacho	PROS	AP	56
204476	Chiquinho Brazão	AVANTE	RJ	56
160535	Marcon	PT	RS	56
160635	Ruy Carneiro	PSDB	PB	56
160632	Zé Silva	SOLIDARIEDADE	MG	56



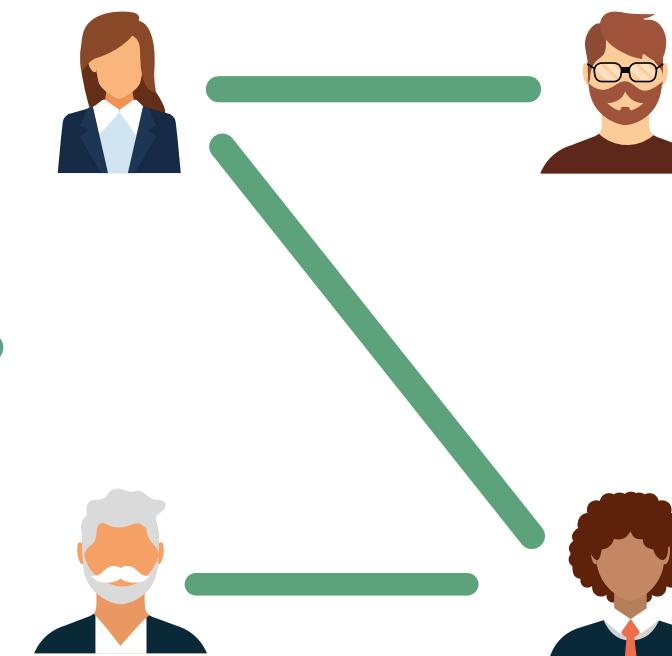
# Network construction

# Network structure

Deputies voting pattern

	Yes		Yes	
	No	No	No	Abstain
	Yes	Yes		Yes
	No		✗	No
	✗	✗	Yes	Yes
			Abstain	No
	Yes	Yes	Yes	Obstruction
		Abstain	No	

Similar votes



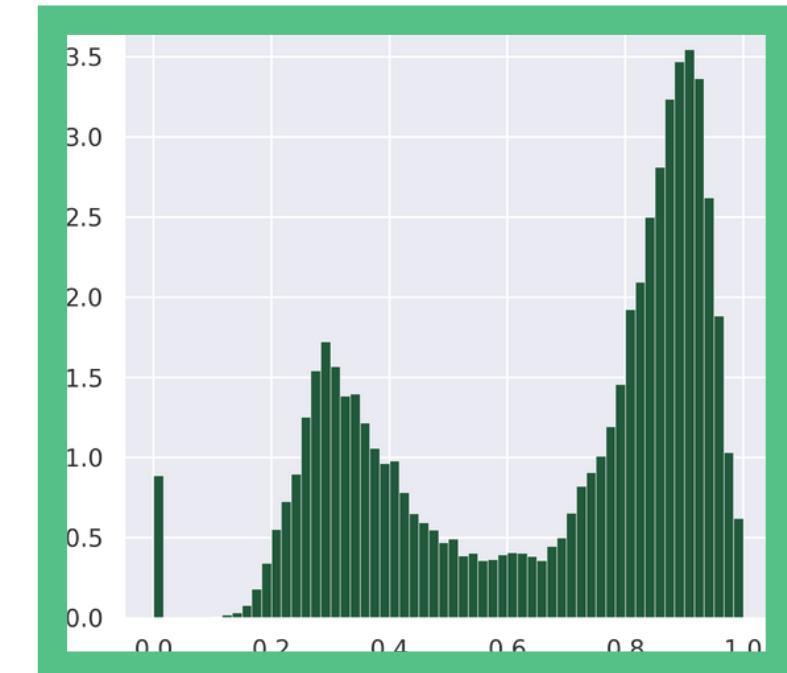
# How similarity is defined?

$$\mathcal{C}(d_i, d_j) = \frac{\sum_{\text{voting } k} v_{d_i}(k) = v_{d_j}(k)}{\sum_{\text{voting } k} d_i \& d_j \text{ vote}}$$

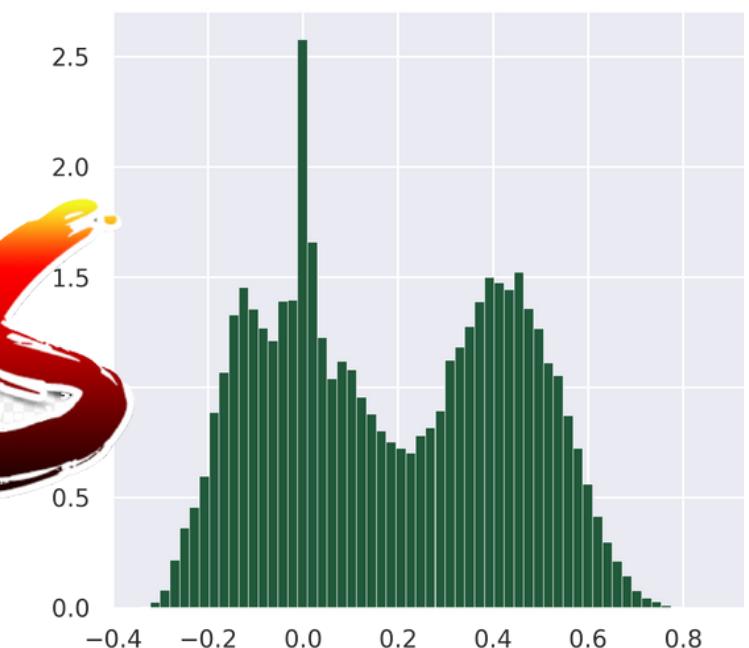
$$A_{ij} = 1 \iff \mathcal{C}(d_i, d_j) > 0.95$$

How to quantify similarity?

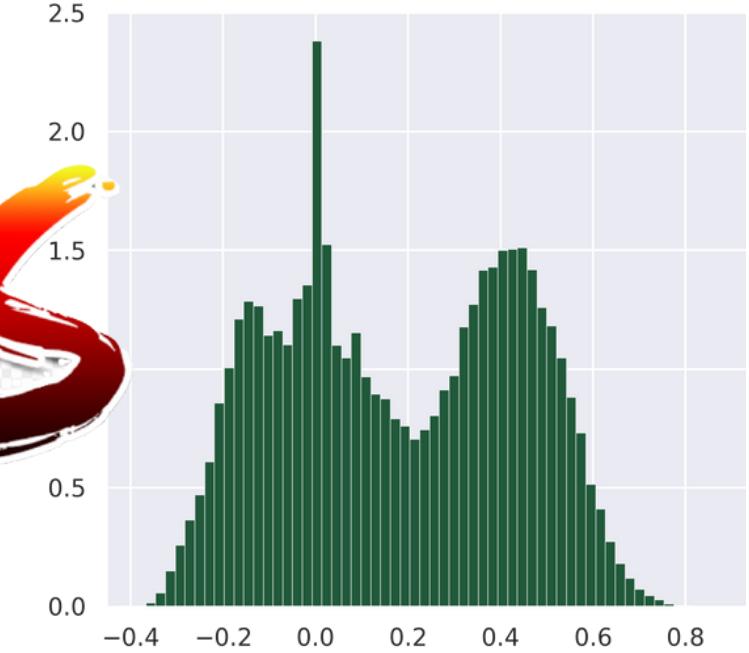
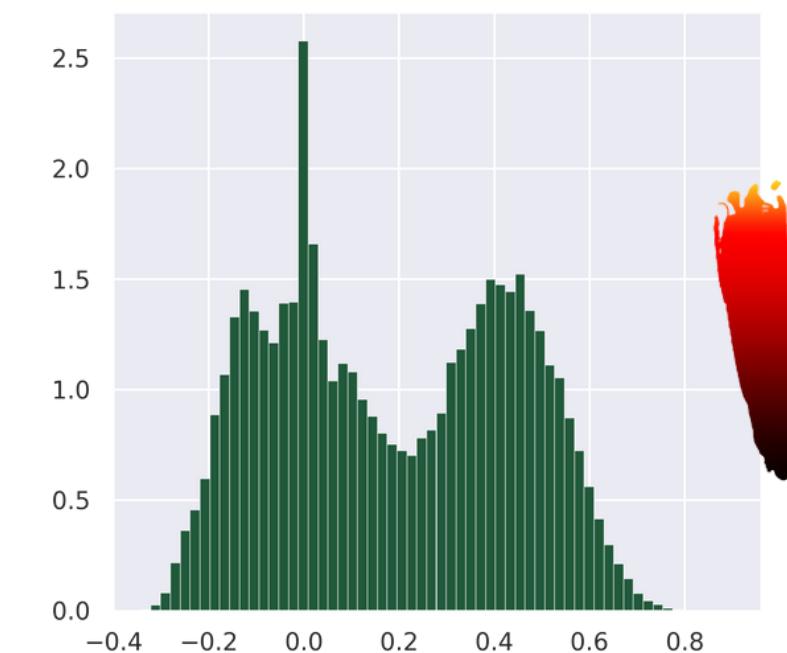
Conflict = 0



Conflict = -1



Abstein / Obstruction

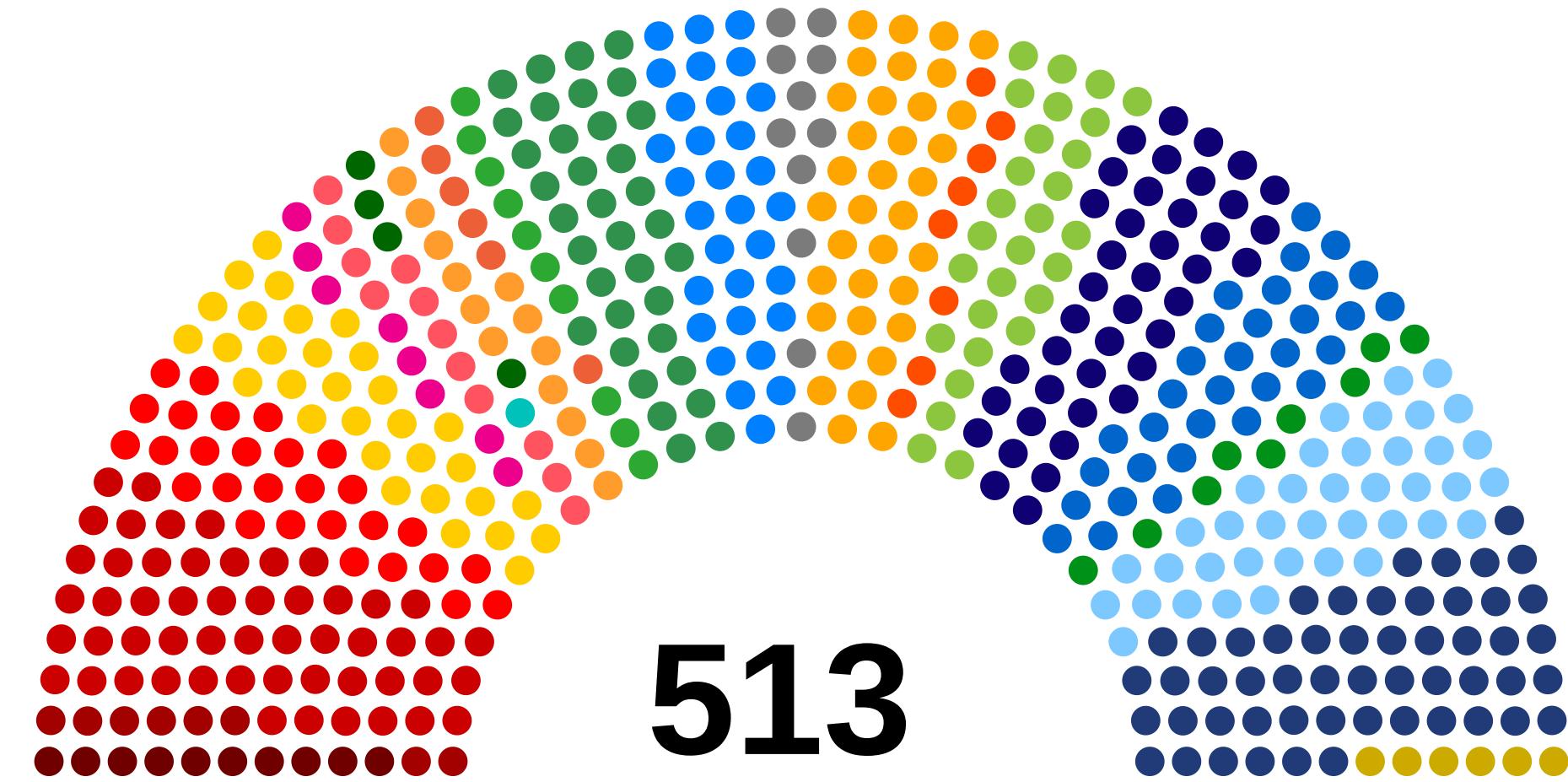


# Party colors

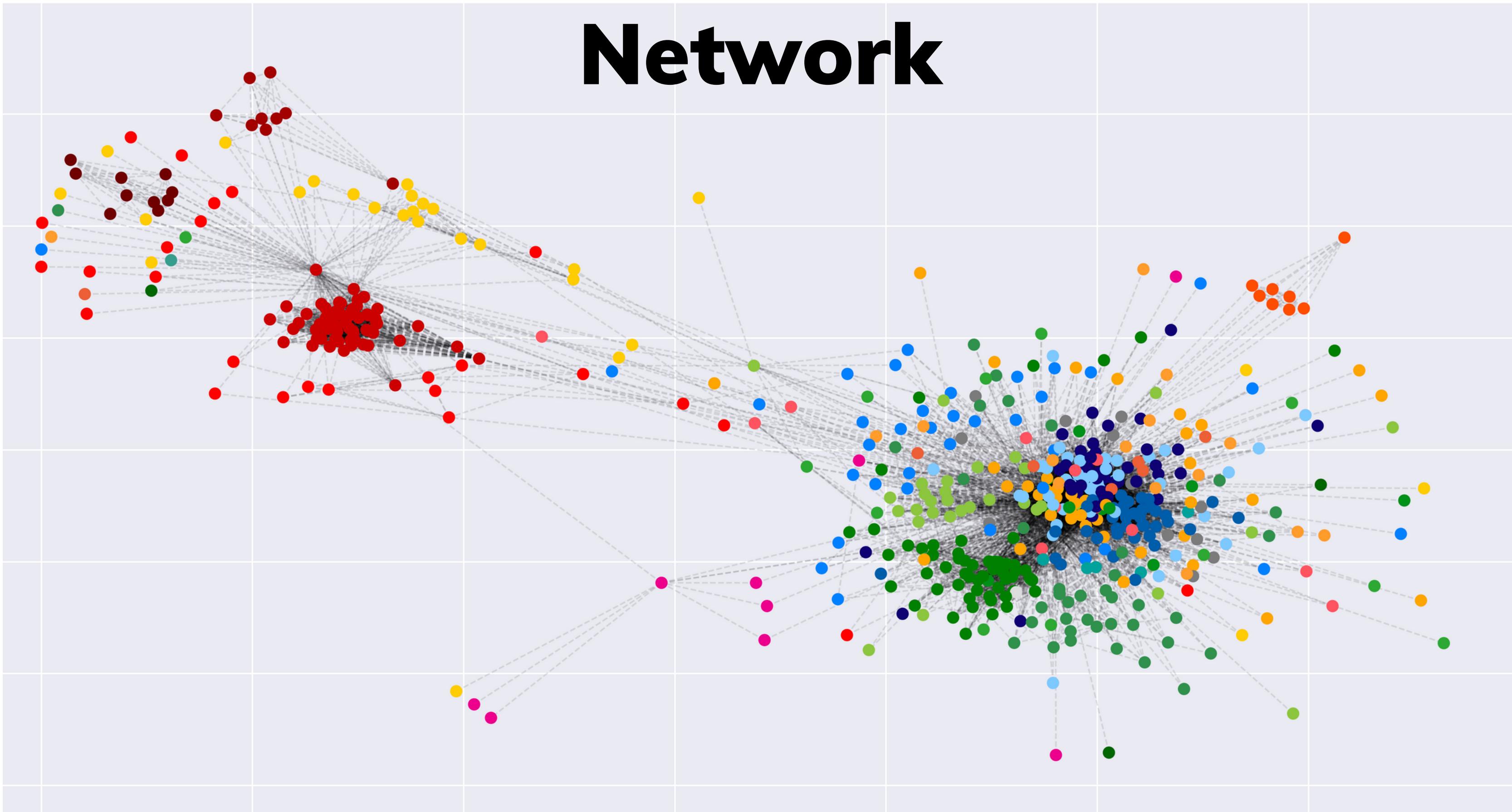
Legend to the following visualizations

	PSOL: 10 seats
	PCdoB: 8 seats
	PT: 53 seats
	PDT: 28 seats
	PSB: 31 seats
	CDN: 8 seats
	PROS: 12 seats
	REDE: 1 seat
	PV: 4 seats
	SDD: 14 seats
	AVANTE: 6 seats
	PODE: 10 seats

	MDB: 35 seats
	PSDB: 31 seats
	PTB: 11 seats
	PSD: 35 seats
	NOVO: 8 seats
	DEM: 28 seats
	PL: 41 seats
	REP: 32 seats
	PSC: 9 seats
	PP: 39 seats
	PSL: 53 seats
	PATRI: 6 seats



# Network



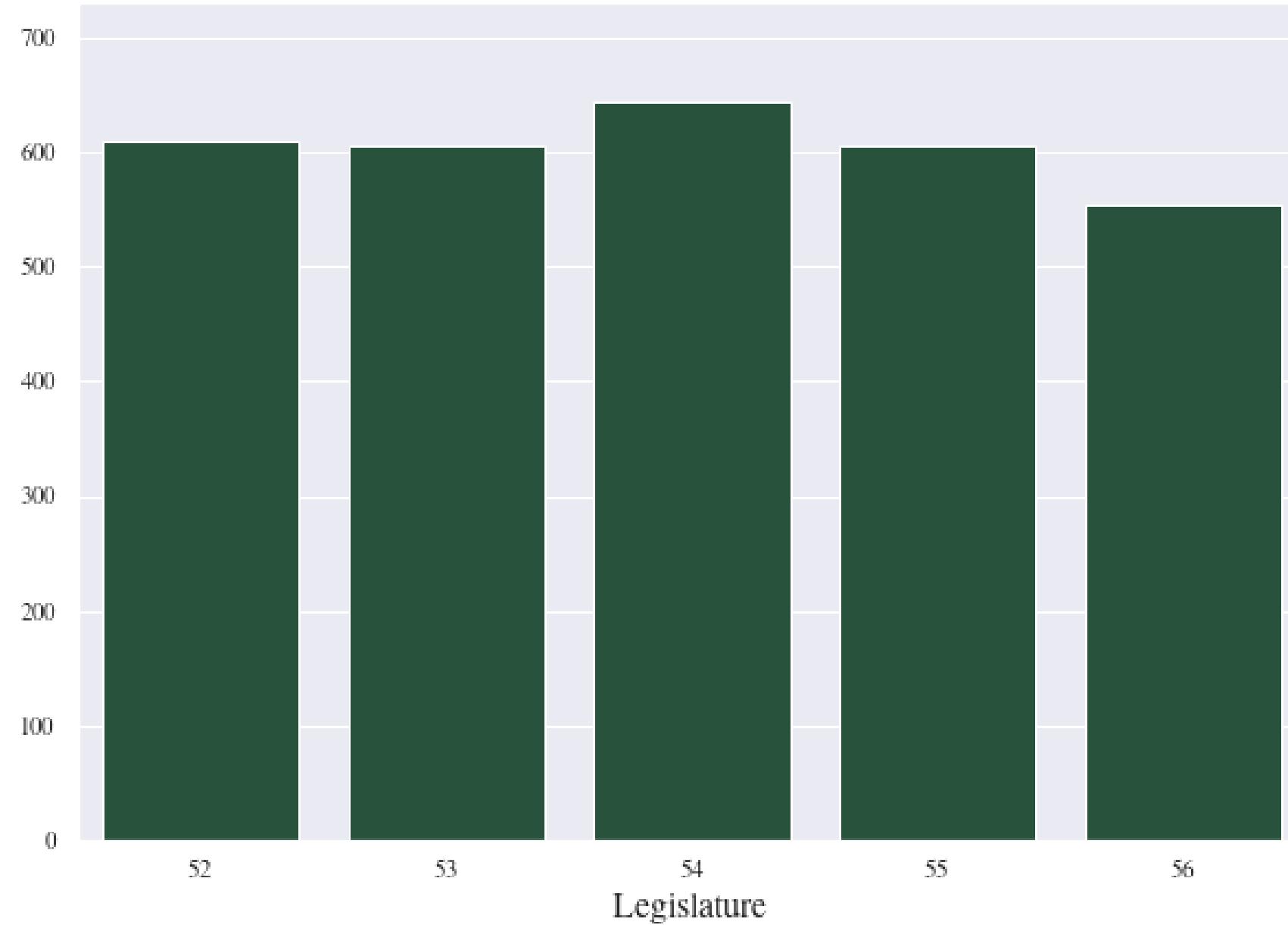
For legislature 56 (current)

# Deputy-based questions

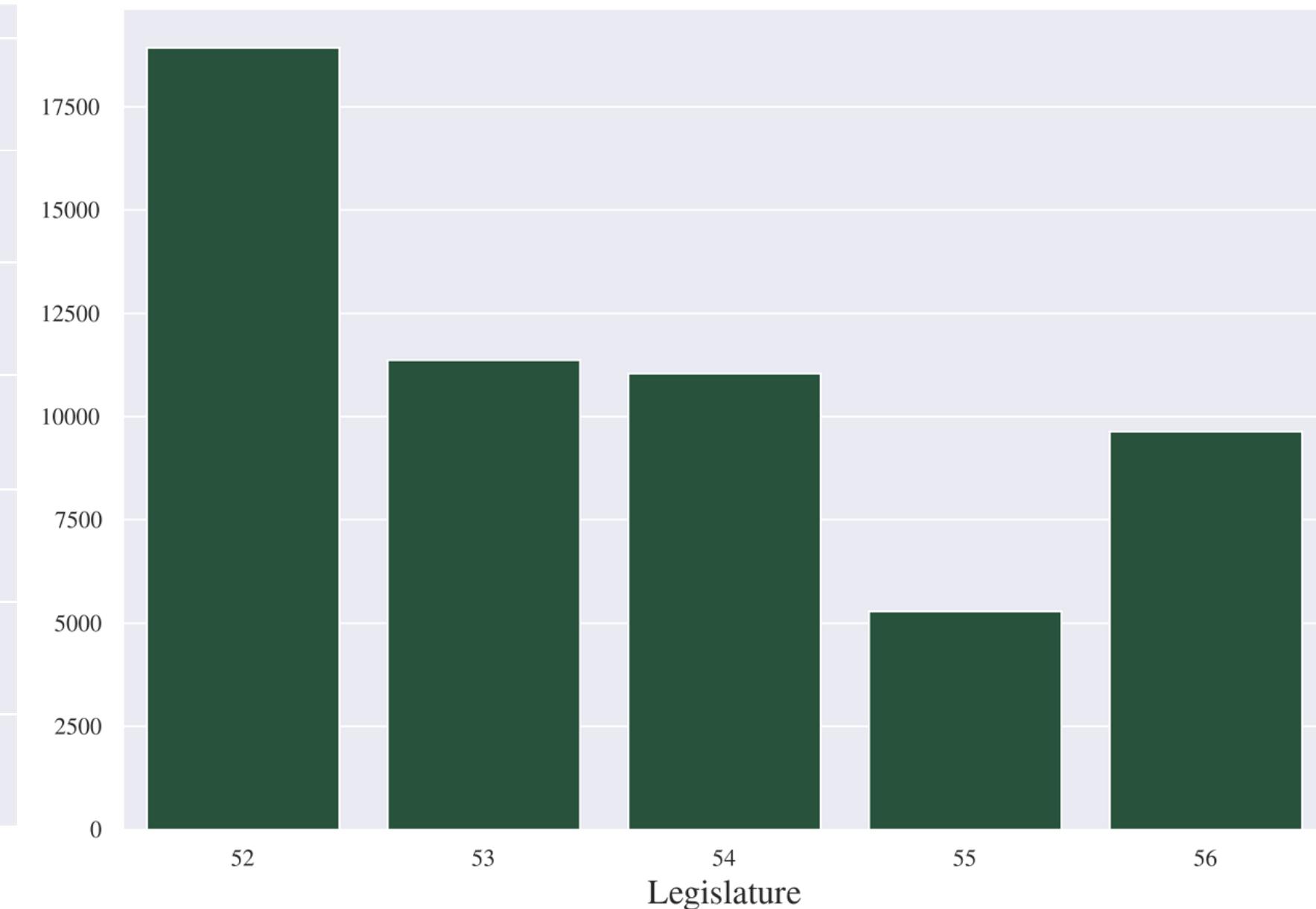
Network node analysis

# Nodes and links

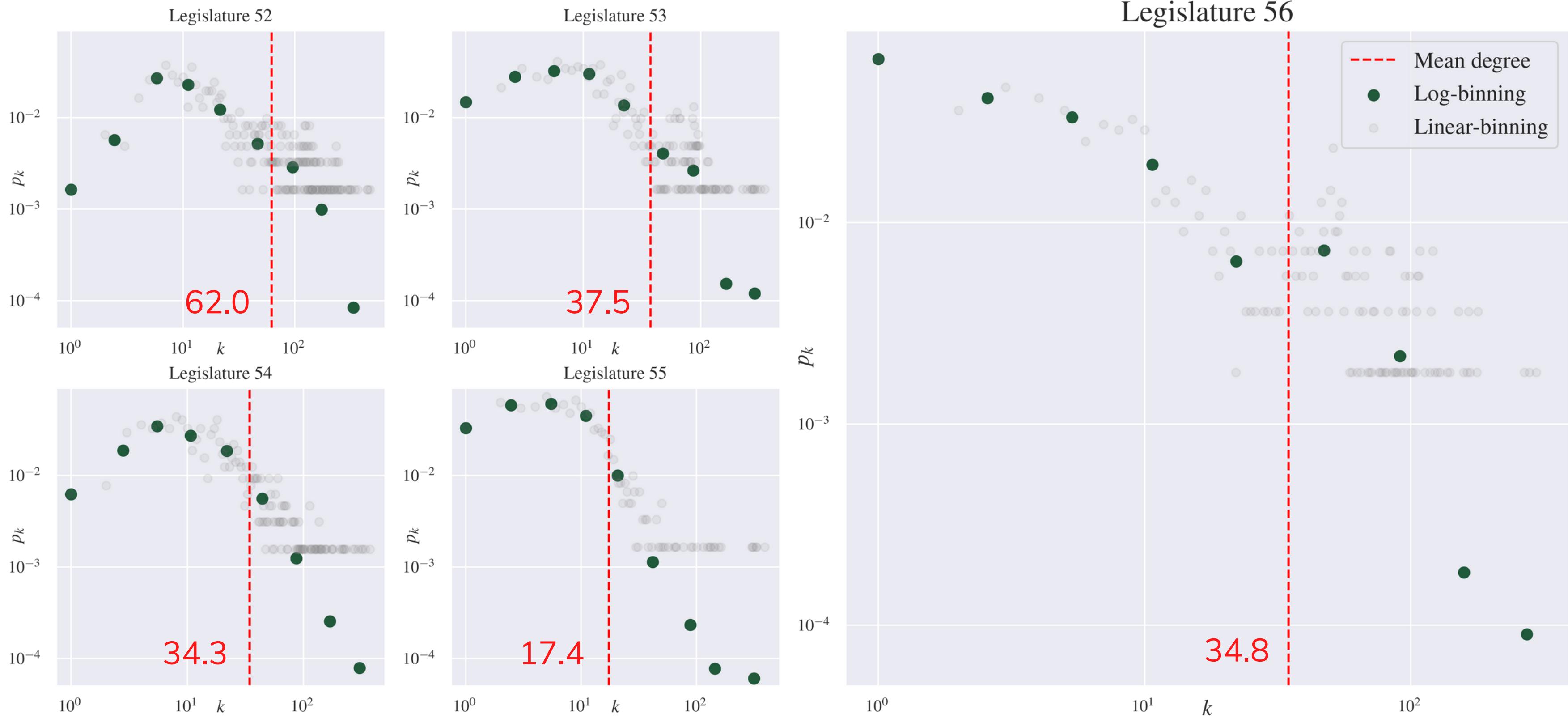
Number of deputies per legislature



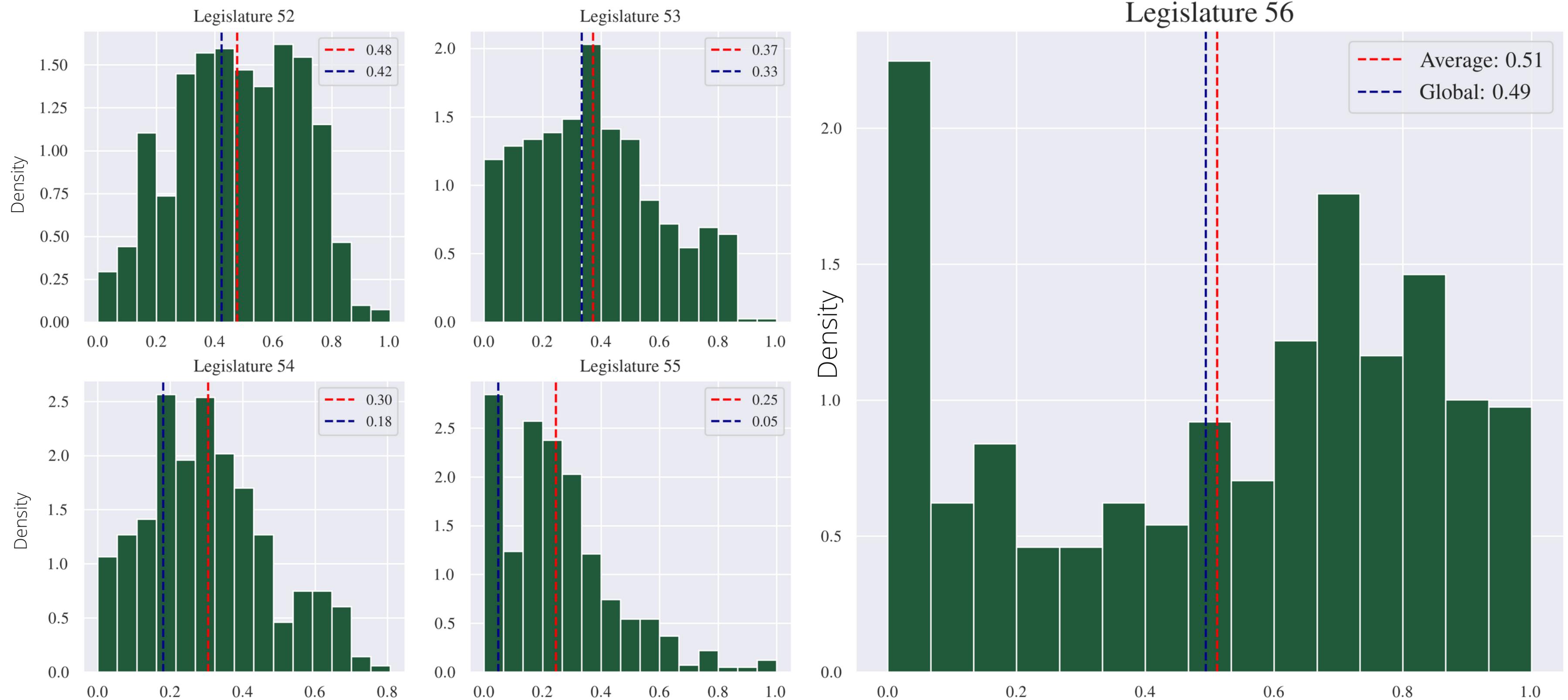
Number of links per legislature



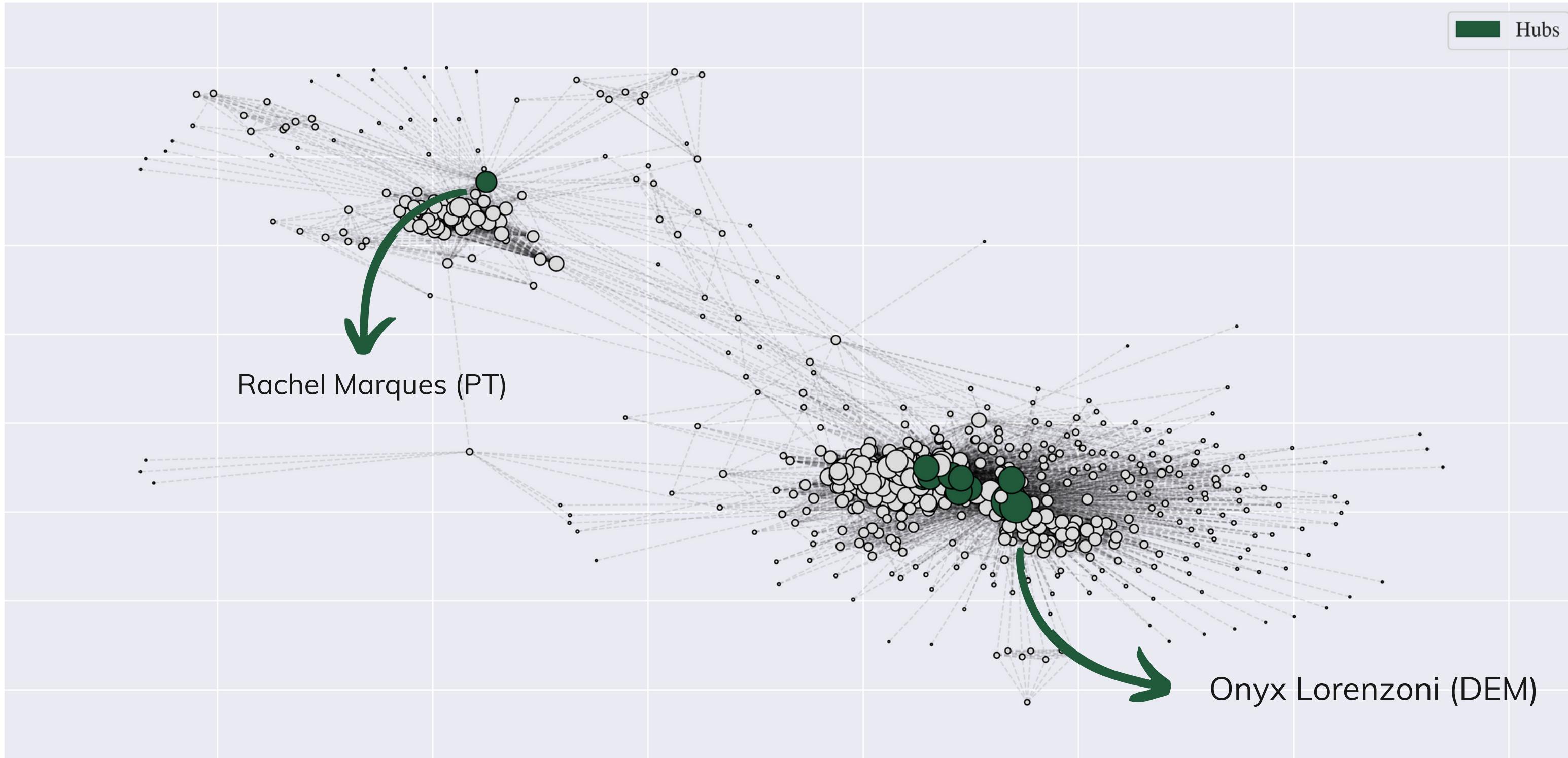
# Degree distribution



# Clustering coefficient



# Who are the most influential deputies?



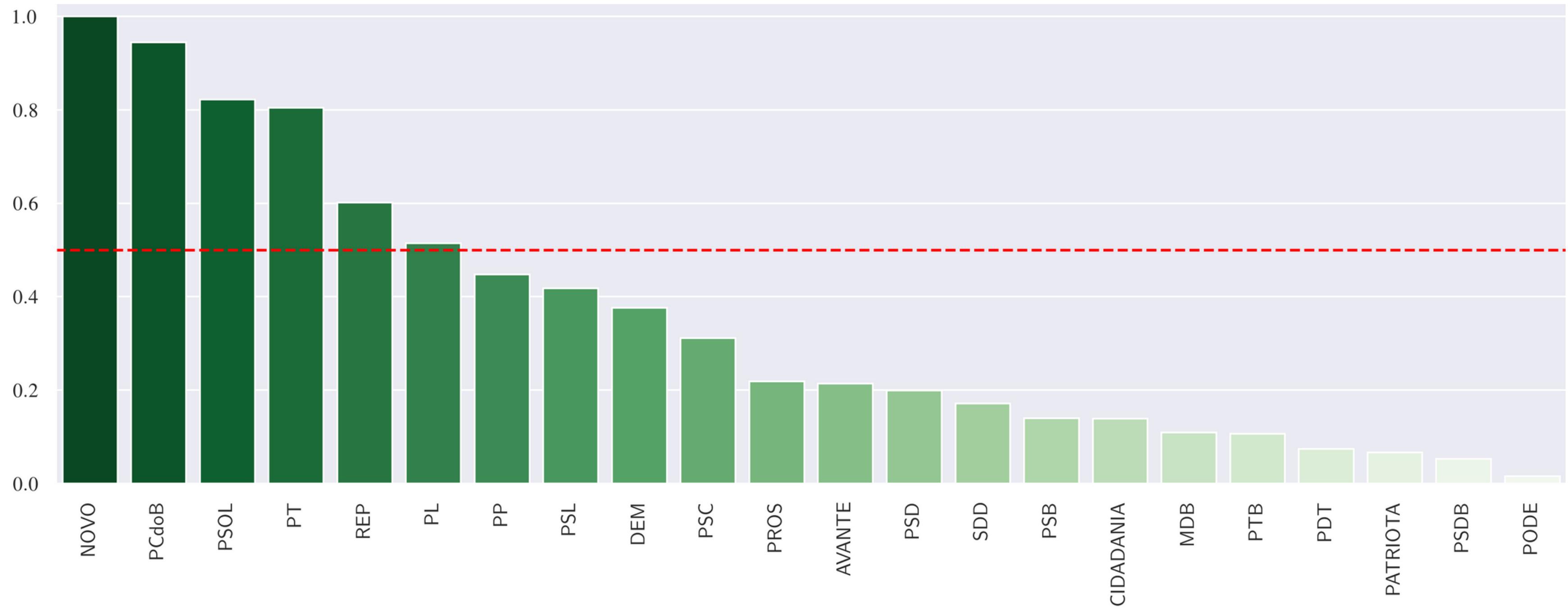
Detection of network hubs



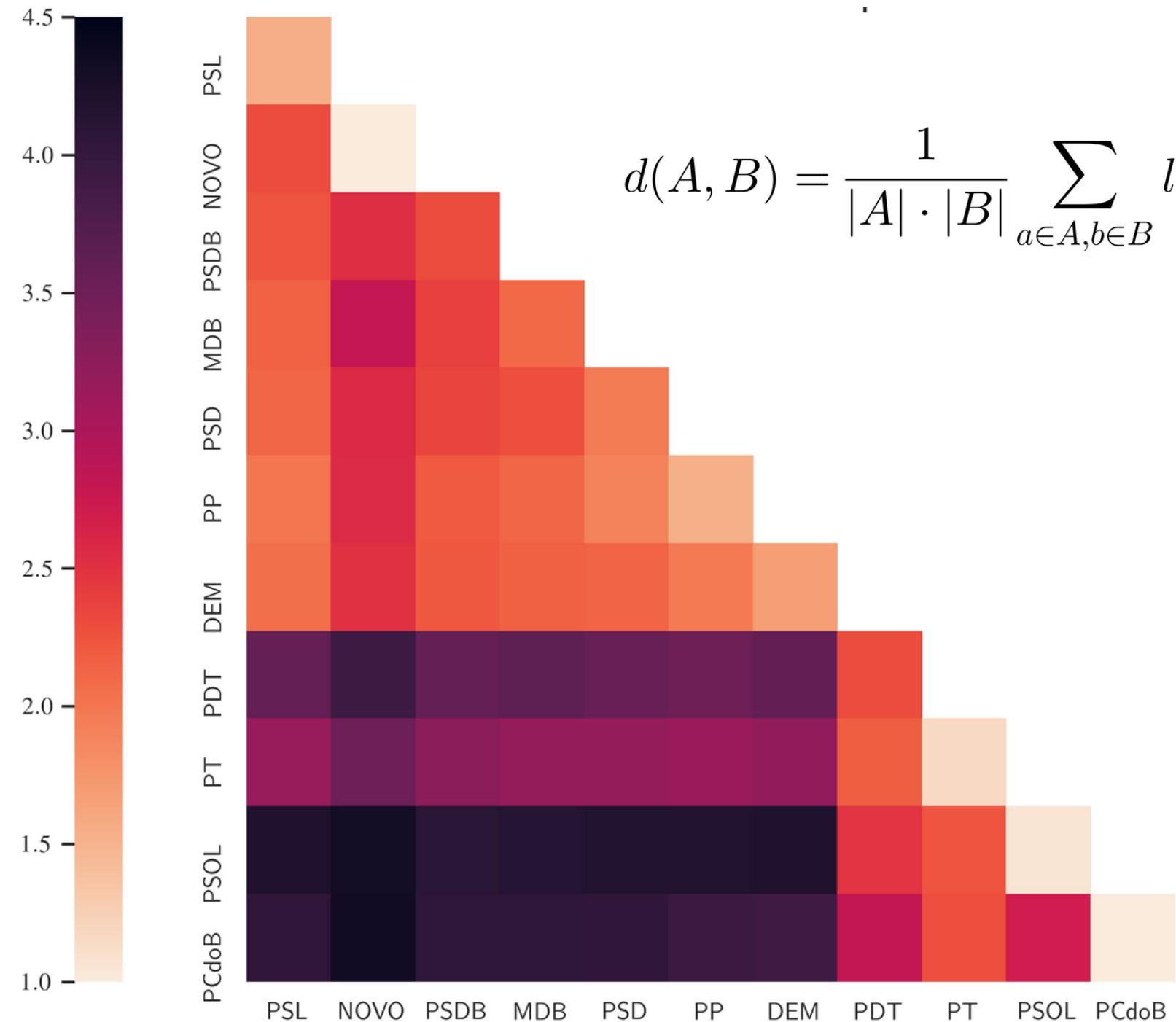
# Party-based questions

Network community analysis

# Density within the parties



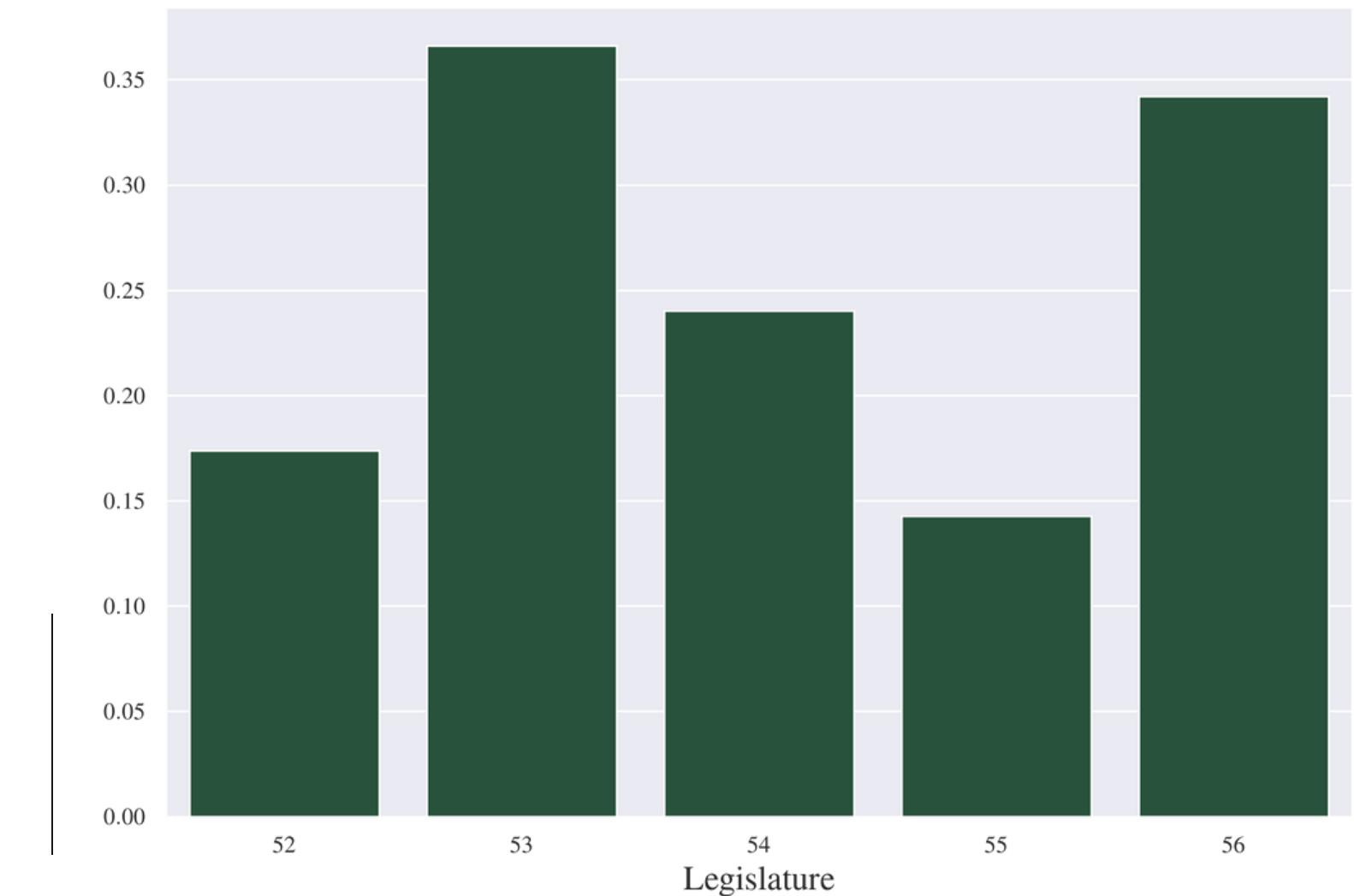
# Parties as communities



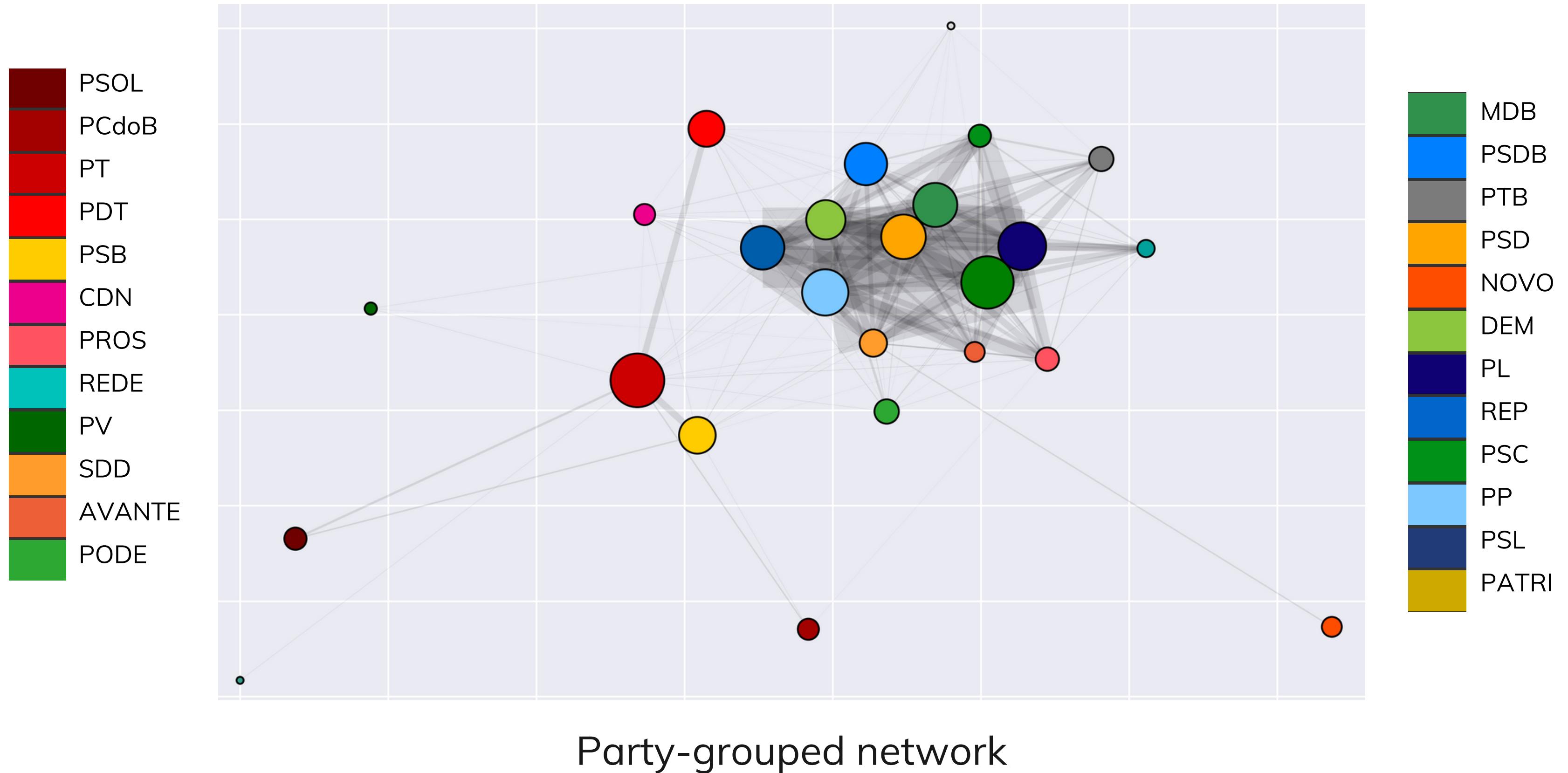
Distance between parties

$$d(A, B) = \frac{1}{|A| \cdot |B|} \sum_{a \in A, b \in B} l(a, b)$$

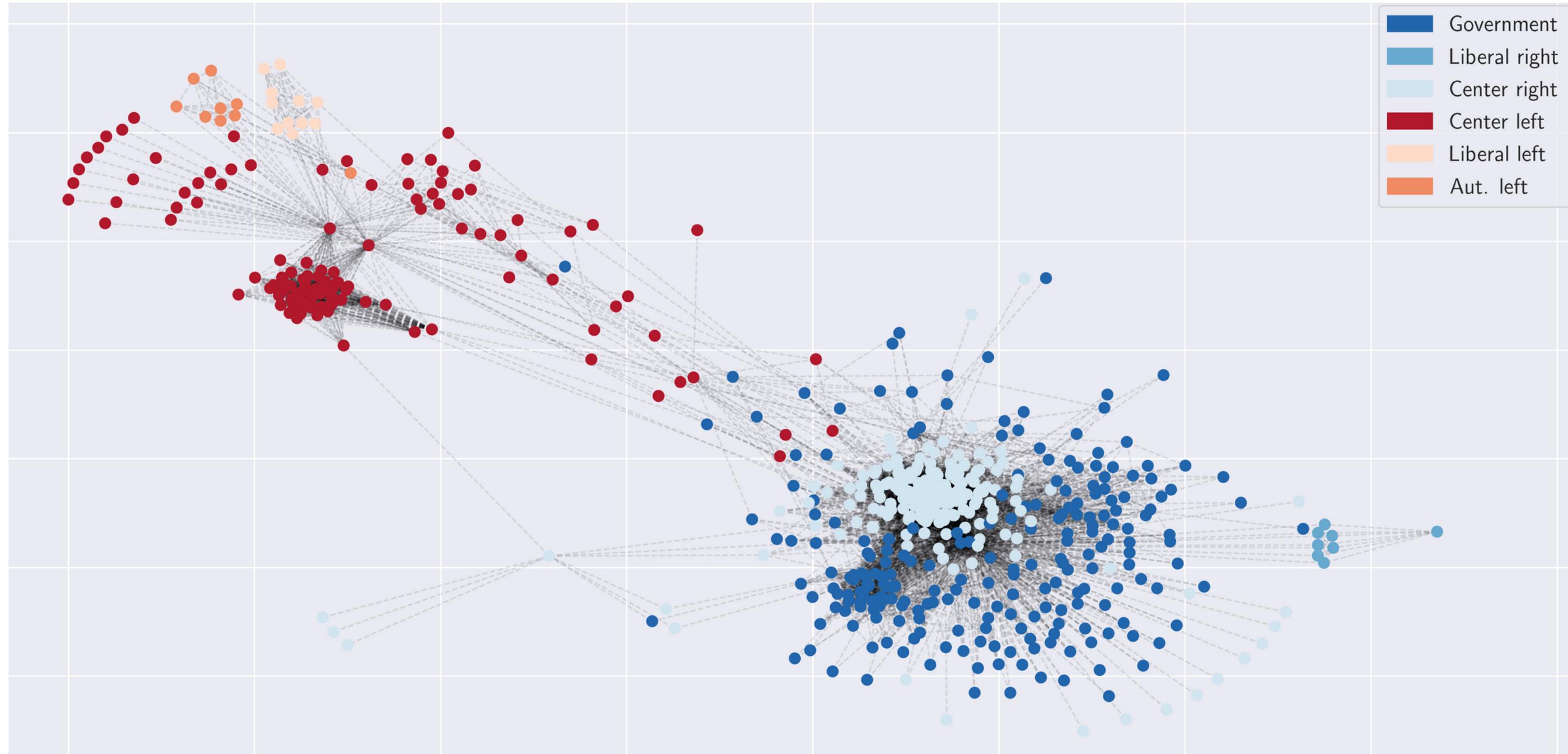
Party assortativity coefficient



# How do the parties interact?



# Do we need so many parties?



Deputies community detection based on modularity

# Are the parties consistent?

Community	Party																			Total				
	PSL	MDB	PSDB	DEM	PSD	SOLIDARIEDADE	PROS	REPUBLICANOS	PL	PTB	PSB	PV	PDT	PP	PSC	PODE	CIDADANIA	PATRIOTA	AVANTE	PT	REDE	PSOL	PCdoB	NOVO
Government	54	37	26	23	13	9	7	6	4	6	2	2	2	8	2	8	3	4	3	-	-	-	-	220
Liberal right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	
Center-right	1	-	6	6	26	5	4	32	42	6	2	-	-	35	8	3	6	2	4	-	-	-	-	188
Center-left	-	2	4	2	1	1	-	-	-	22	1	24	-	-	1	-	-	1	58	1	-	-	-	118
Liberal left	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	10	-	-	-	11	
Aut. left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	9

# Are the parties consistent?

Some are very consistent

Community	Party																			Total					
	PSL	MDB	PSDB	DEM	PSD	SOLIDARIEDADE	PROS	REPUBLICANOS	PL	PTB	PSB	PV	PDT	PP	PSC	PODE	CIDADANIA	PATRIOTA	AVANTE	PT	REDE	PSOL	PCdOB	NOVO	
Government	54	37	26	23	13	9	7	6	4	6	2	2	2	8	2	8	3	4	3	-	-	-	-	220	
Liberal right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8		
Center-right	1	-	6	6	26	5	4	32	42	6	2	-	-	35	8	3	6	2	4	-	-	-	-	188	
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Liberal left	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	10	-	-	11	
Aut. left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	9	

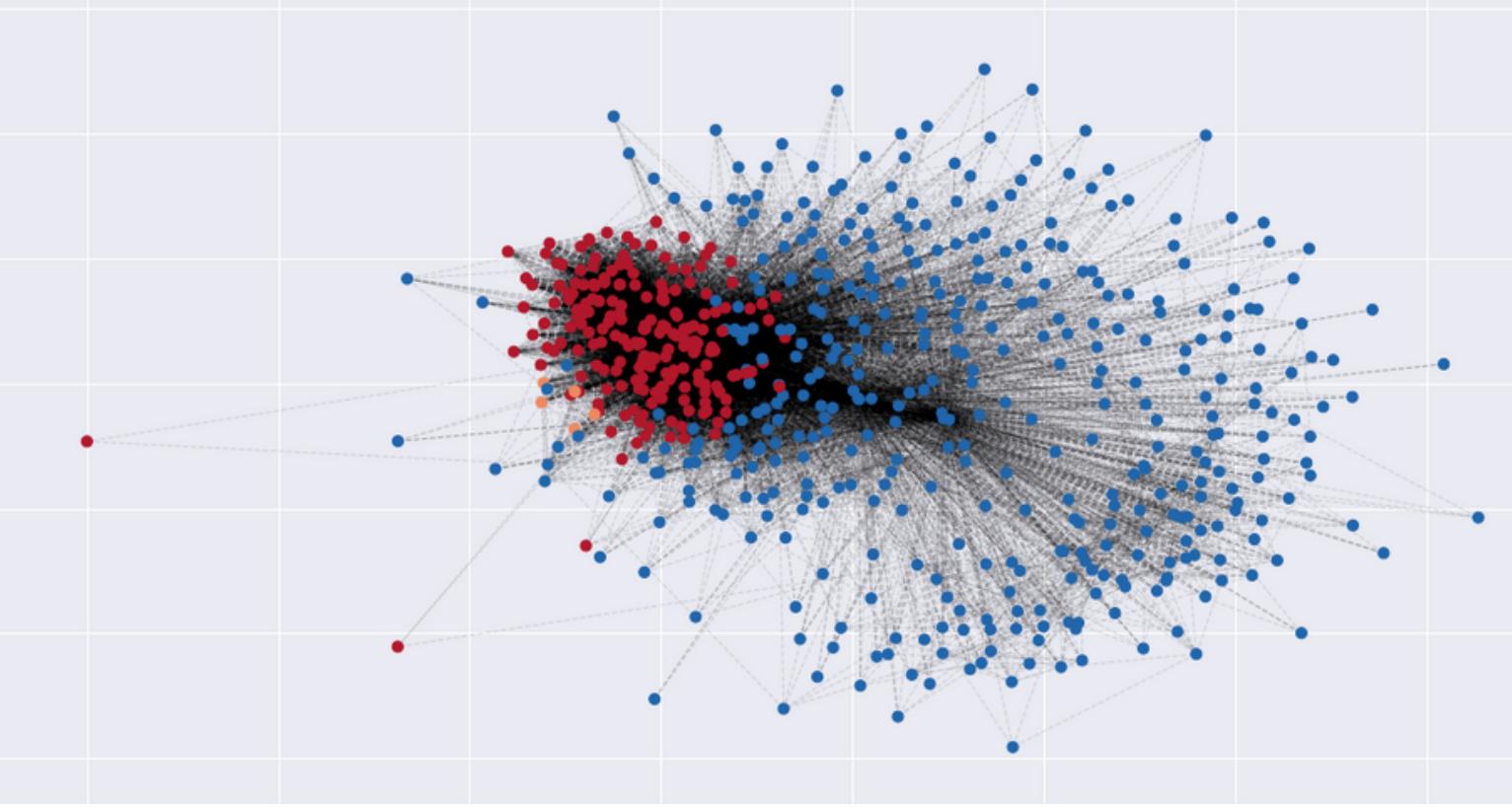
# Are the parties consistent?

Others aren't very consistent

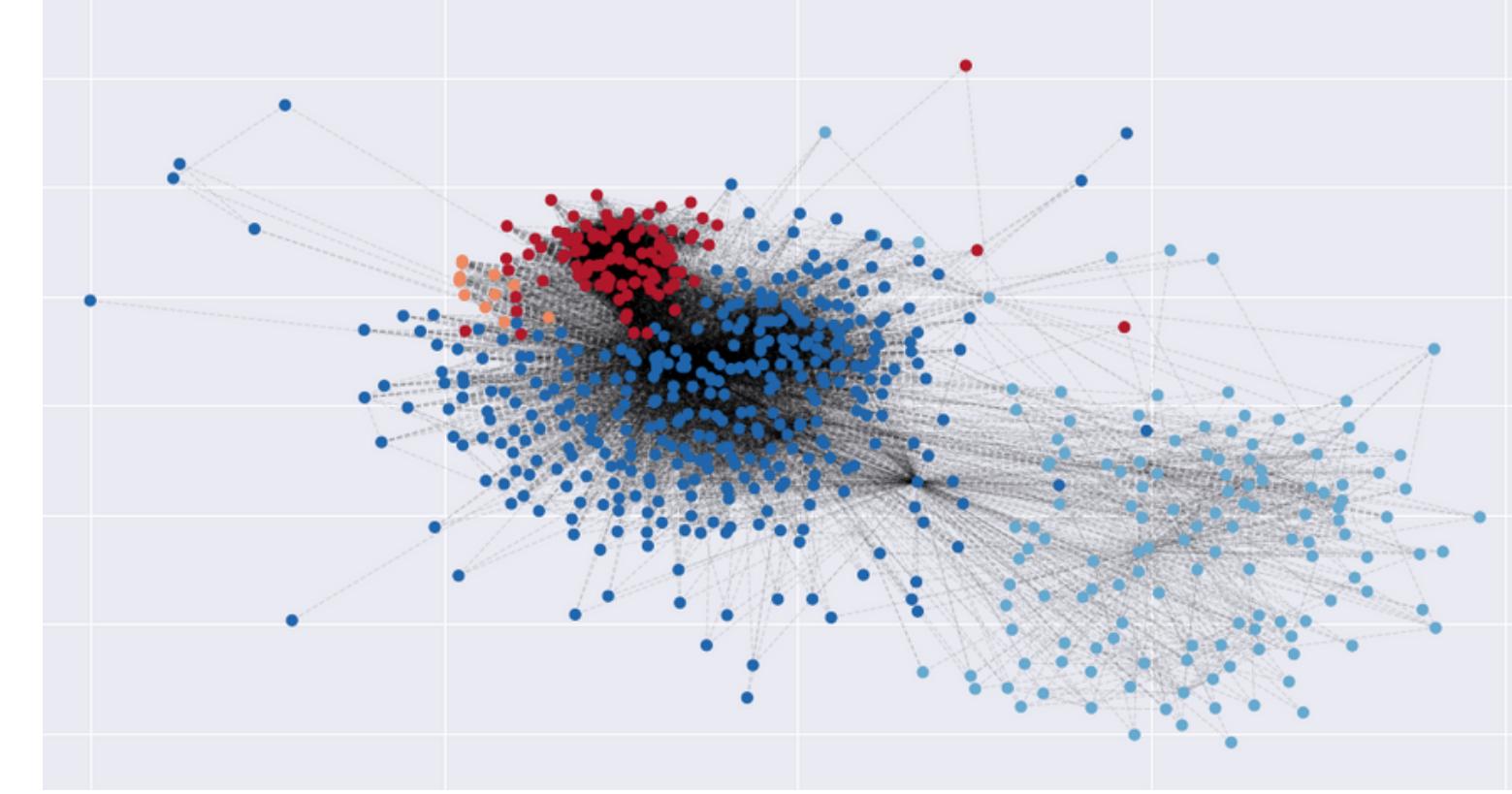
Community	Party																			Total				
	PSL	MDB	PSDB	DEM	PSD	SOLIDARIEDADE	PROS	REPUBLICANOS	PL	PTB	PSB	PV	PDT	PP	PSC	PODE	CIDADANIA	PATRIOTA	AVANTE	PT	REDE	PSOL	PcdoB	NOVO
Government	54	37	26	23	13	9	7	6	4	6	2	2	2	8	2	8	3	4	3	-	-	-	-	220
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Center-right	1	-	6	6	26	5	4	32	42	6	2	-	-	35	8	3	6	2	4	-	-	-	-	188
Center-left	-	2	4	2	1	1	-	-	-	-	22	1	24	-	-	1	-	-	1	58	1	-	-	118
Liberal left	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	10	-	-	11	
Aut. left	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	9	

# How about the other legislatures?

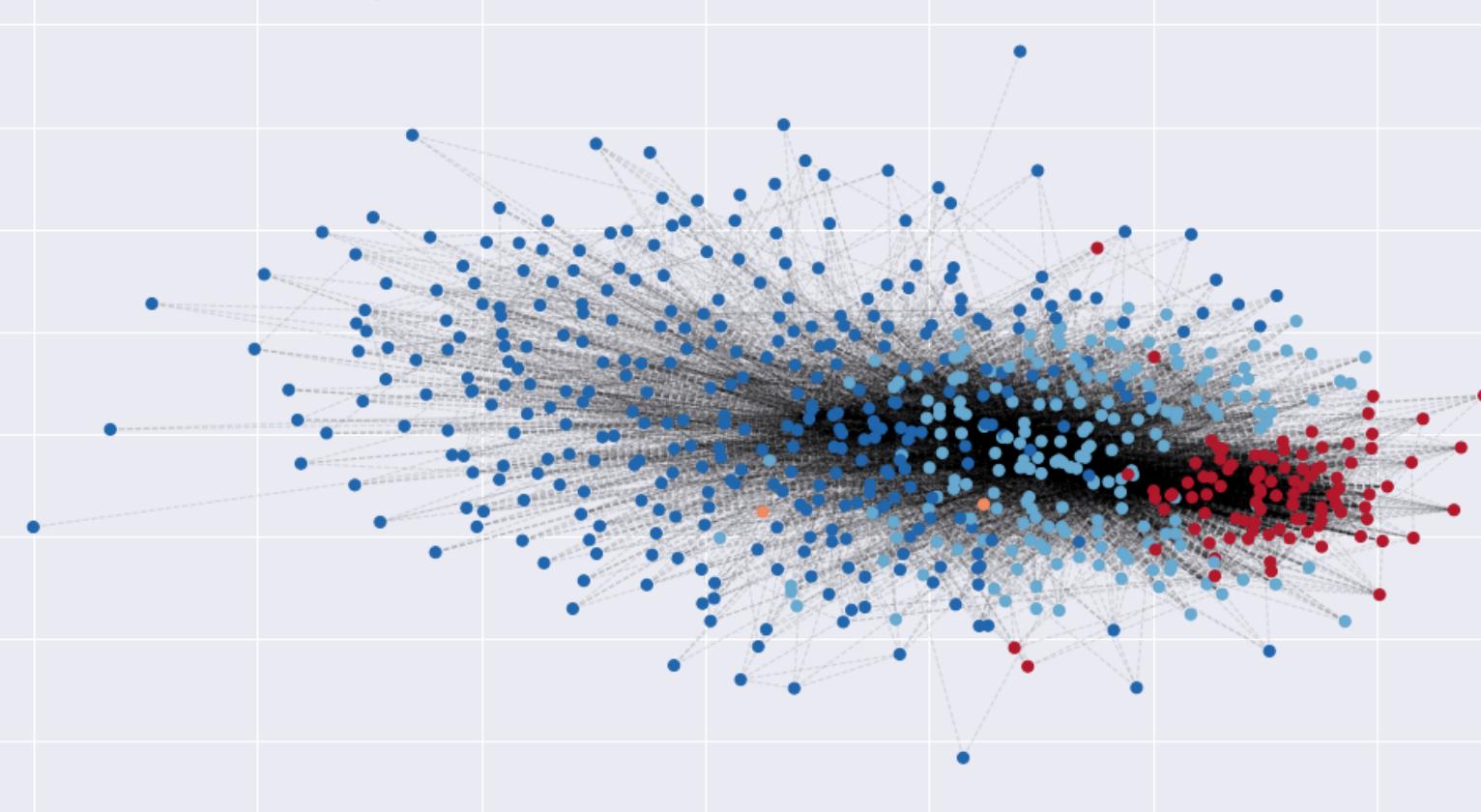
Legislature 52 - 3 communities



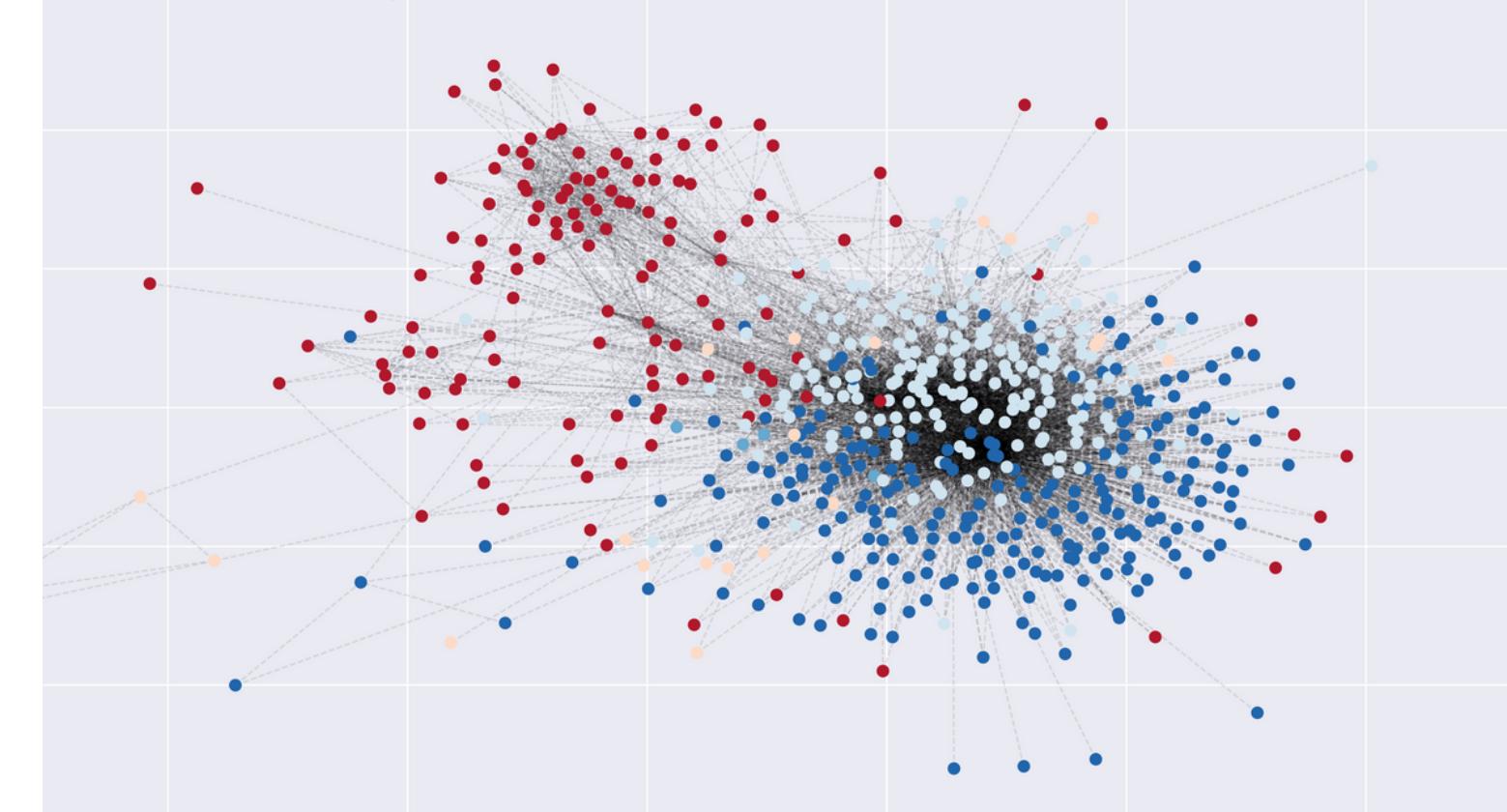
Legislature 53 - 4 communities



Legislature 54 - 4 communities



Legislature 55 - 5 communities



# A QUICK RECAP

## PARTY COHESION

Deputies from the same party are becoming more similar



## DEPUTY DIVERSITY

The ideological diversity of deputies is increasing



## 6 COALITIONS

Is the optimum division for the deputies of the current legislature



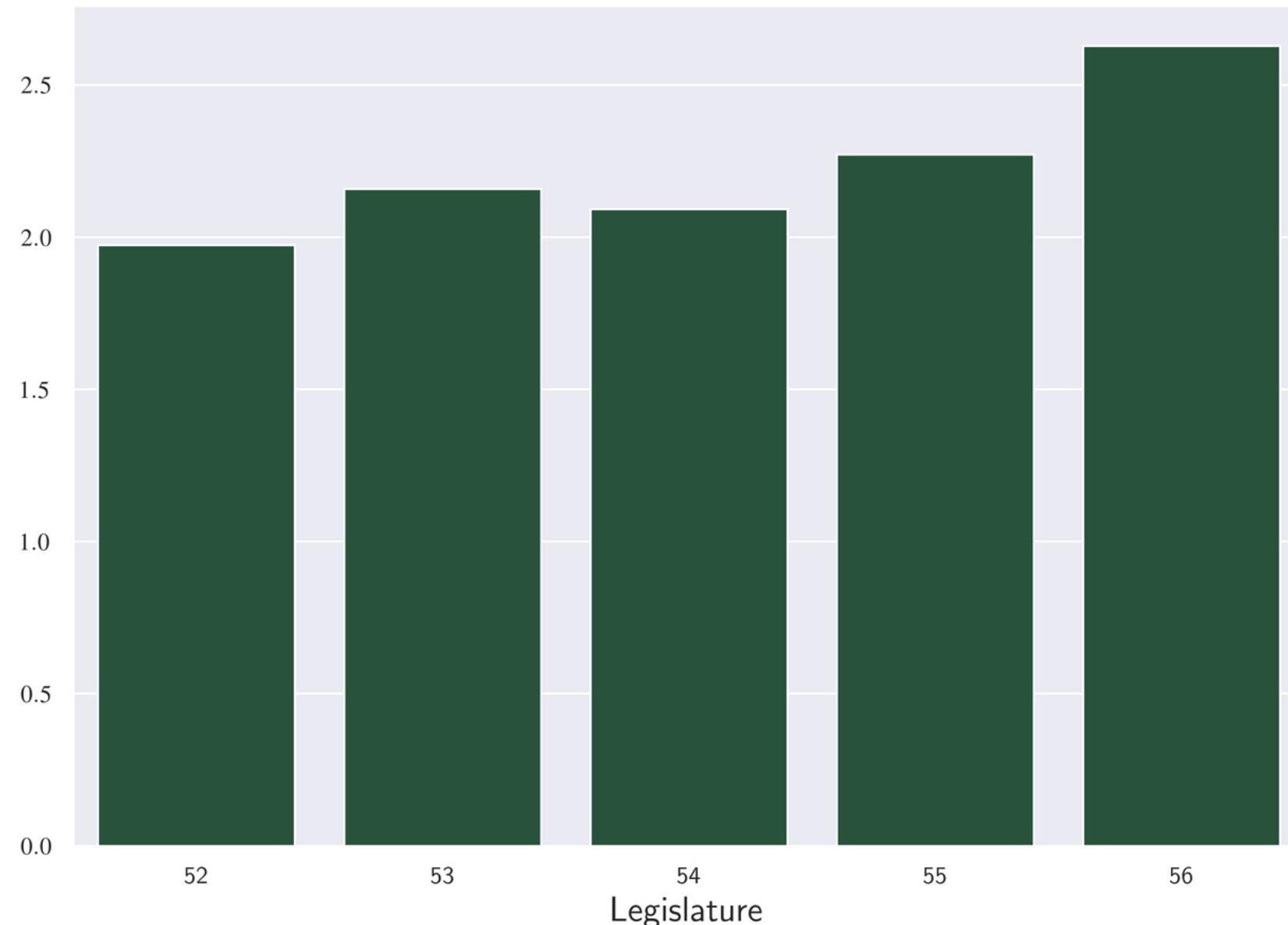
<https://github.com/lucasmoschen/project-network-science>



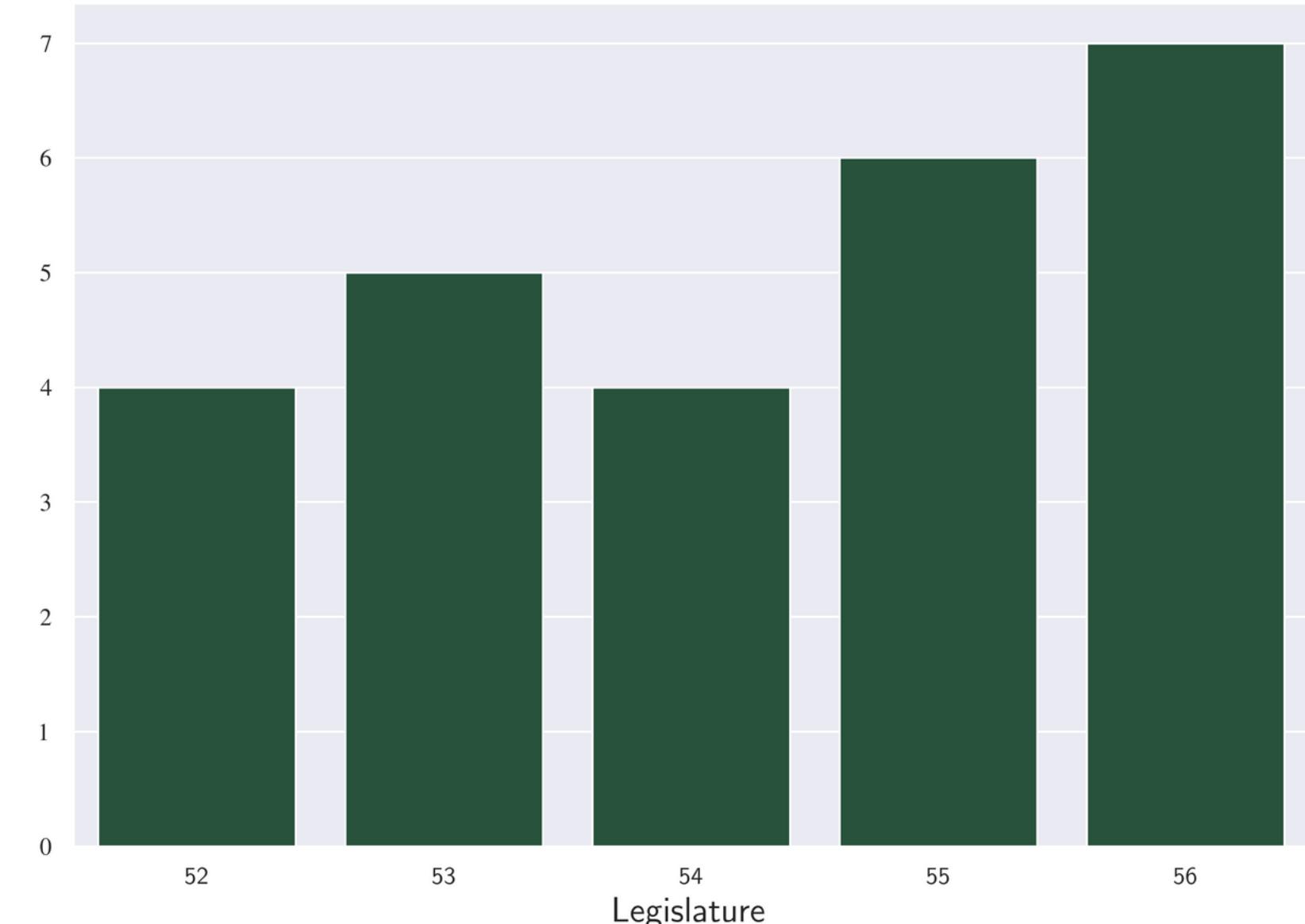
What else can  
we analyze?

# Polarization on the rise in Brazil

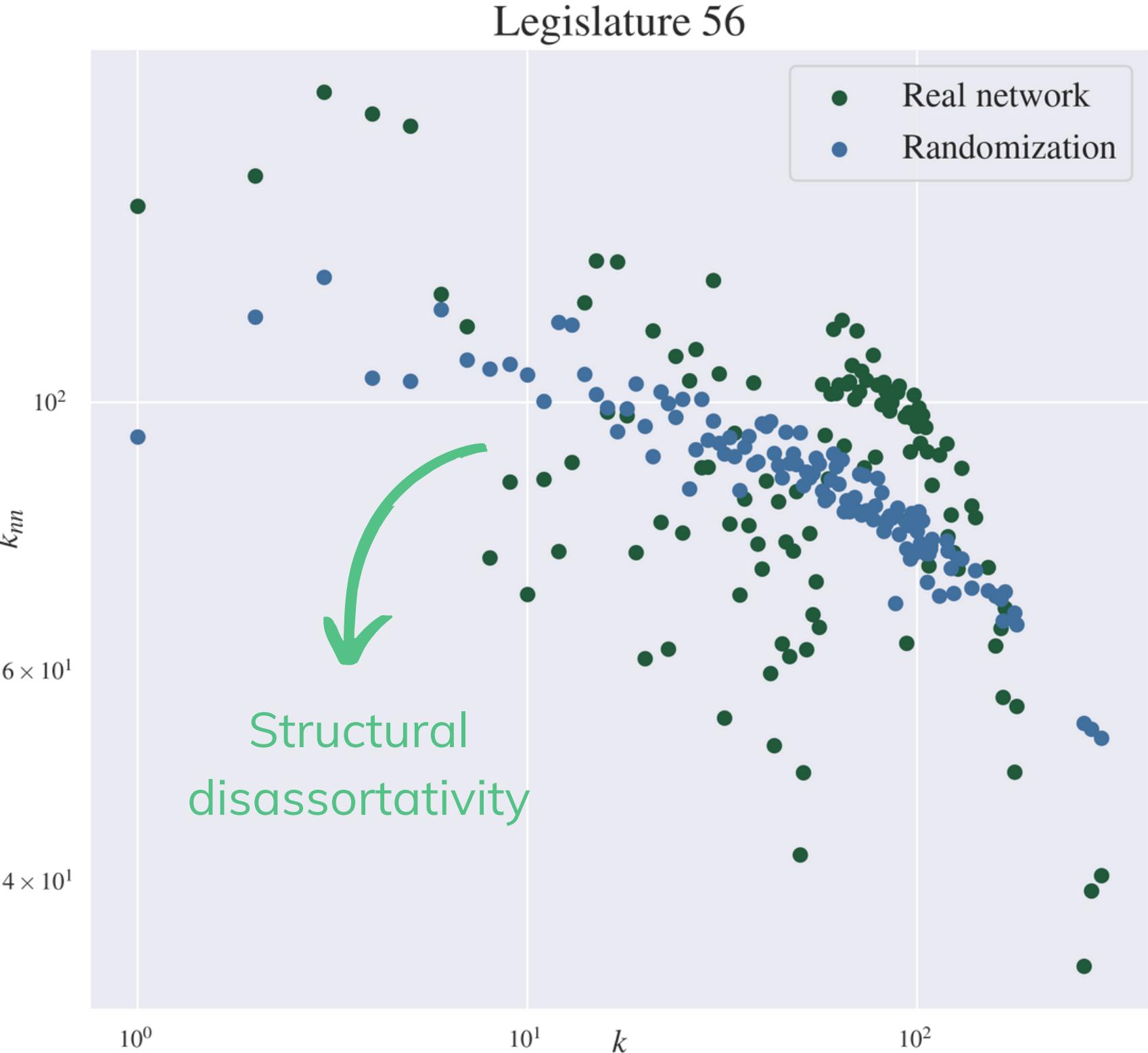
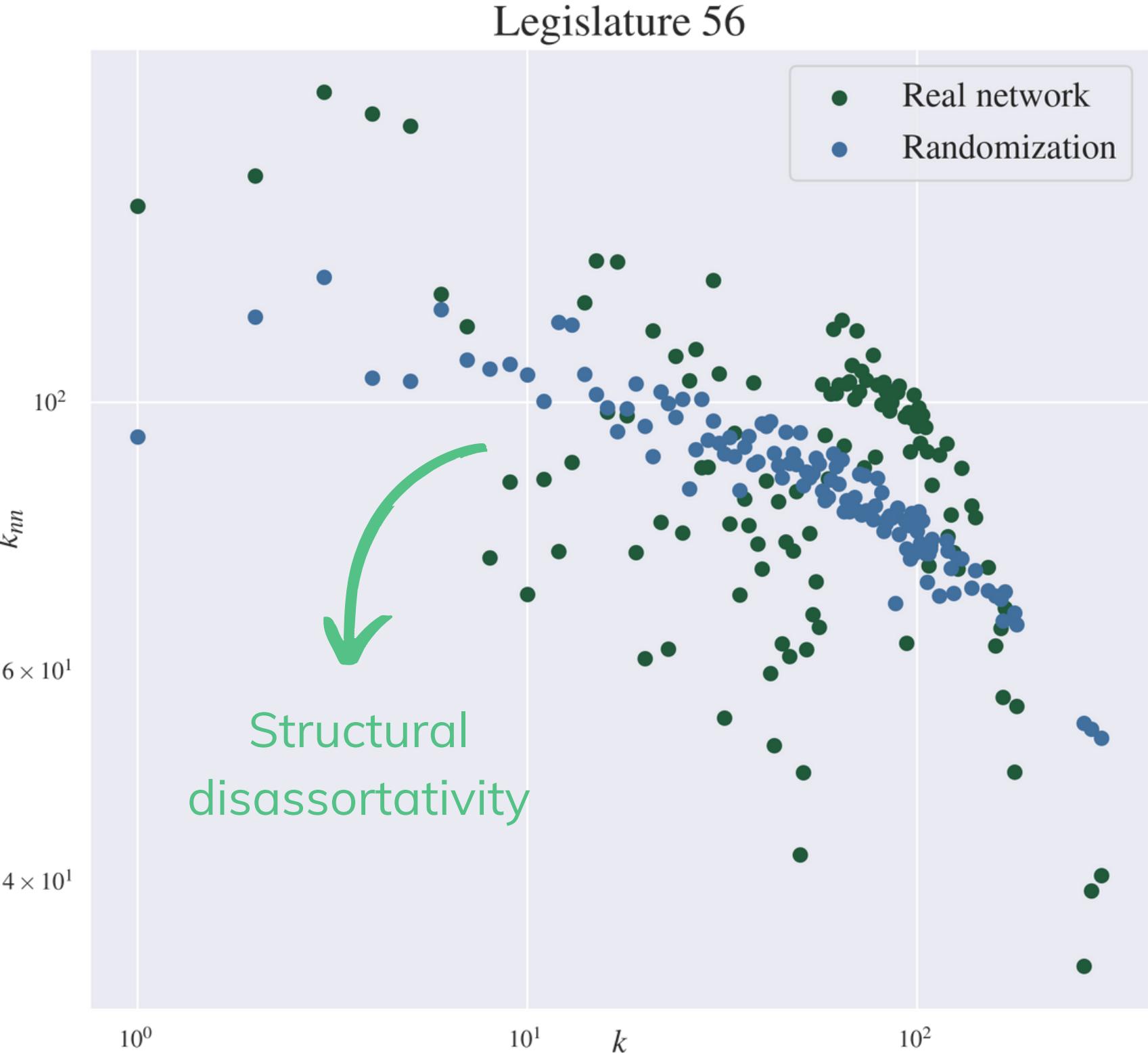
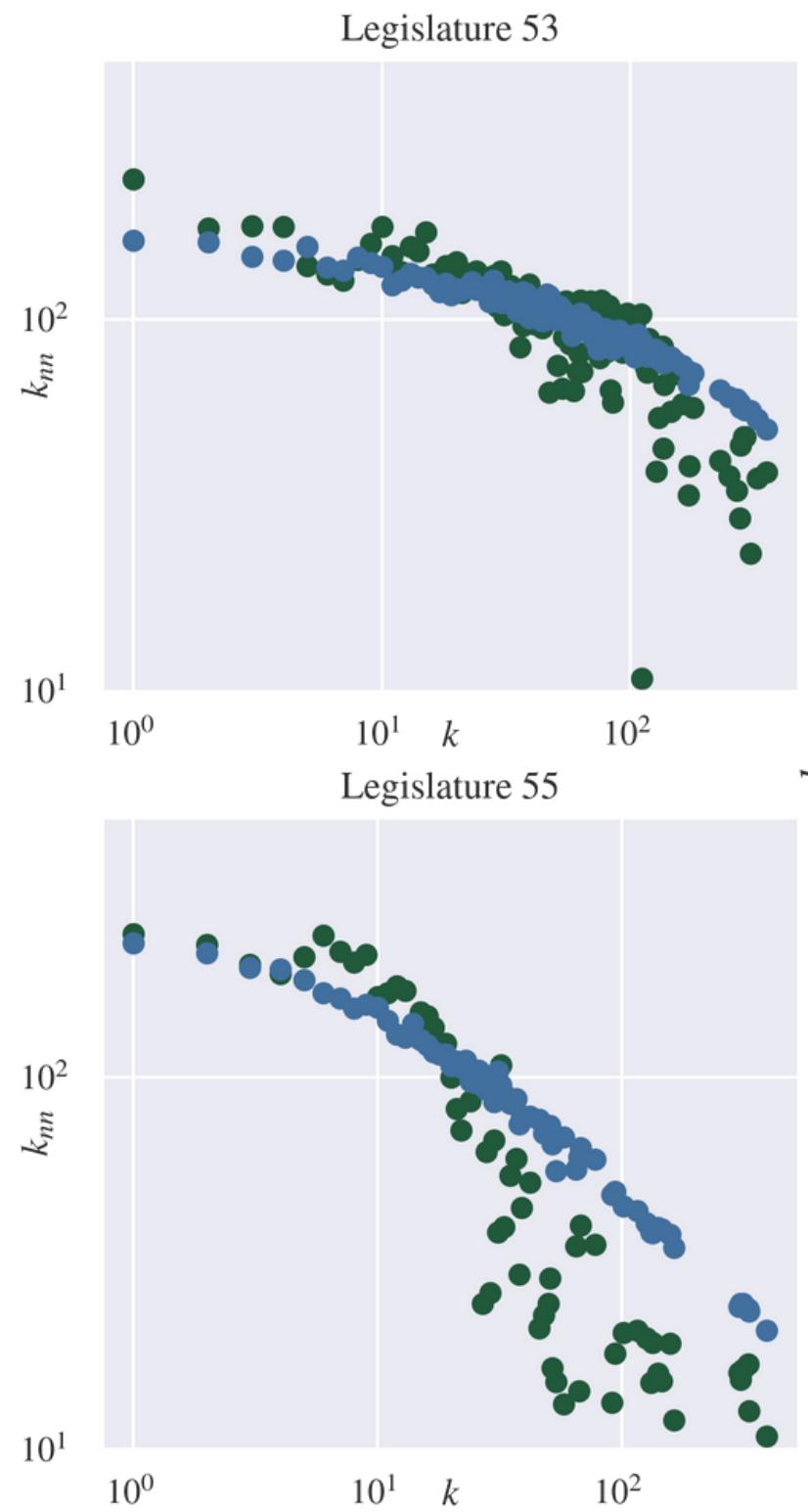
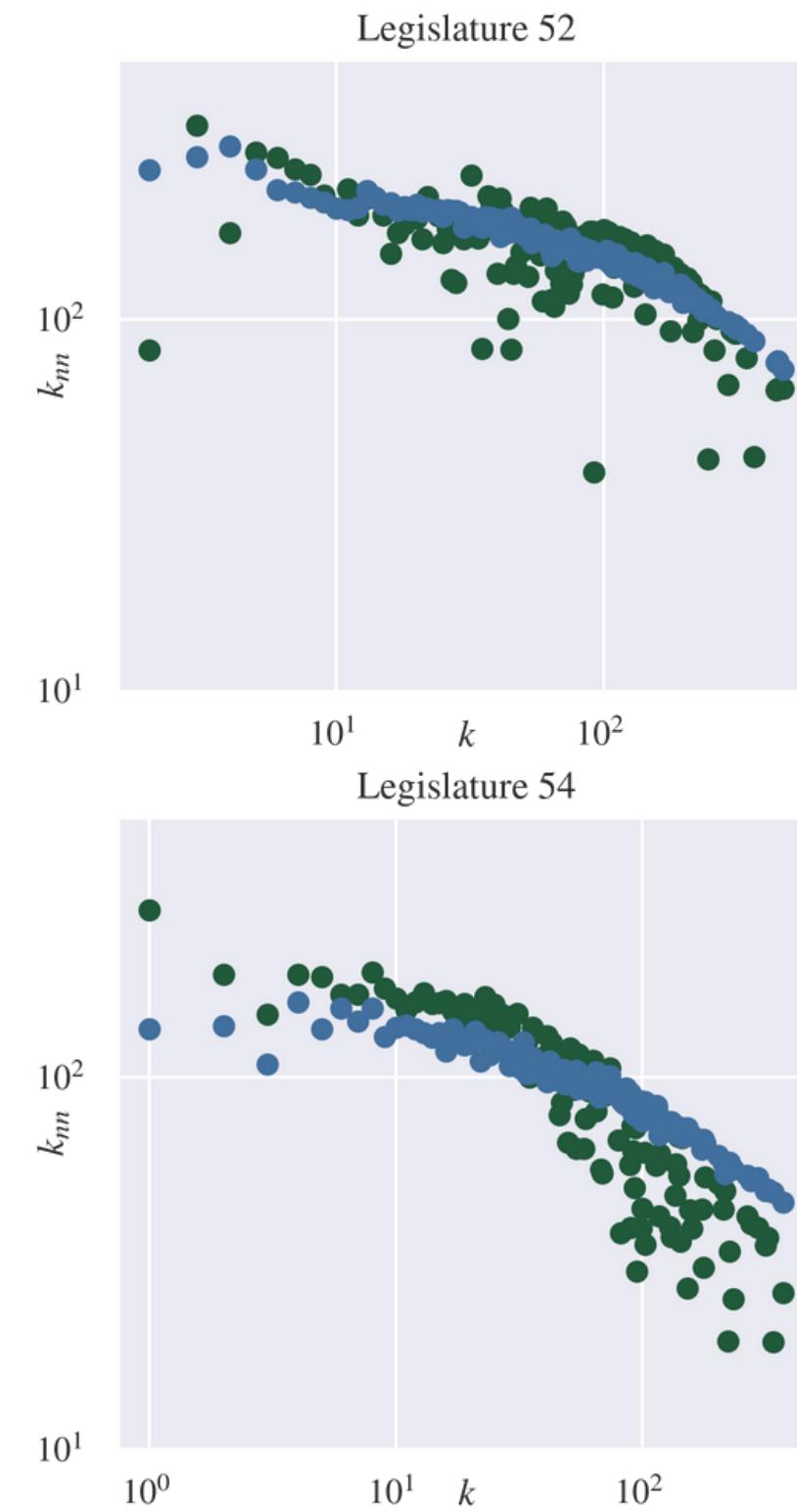
Average shortest path



Diameter of the network

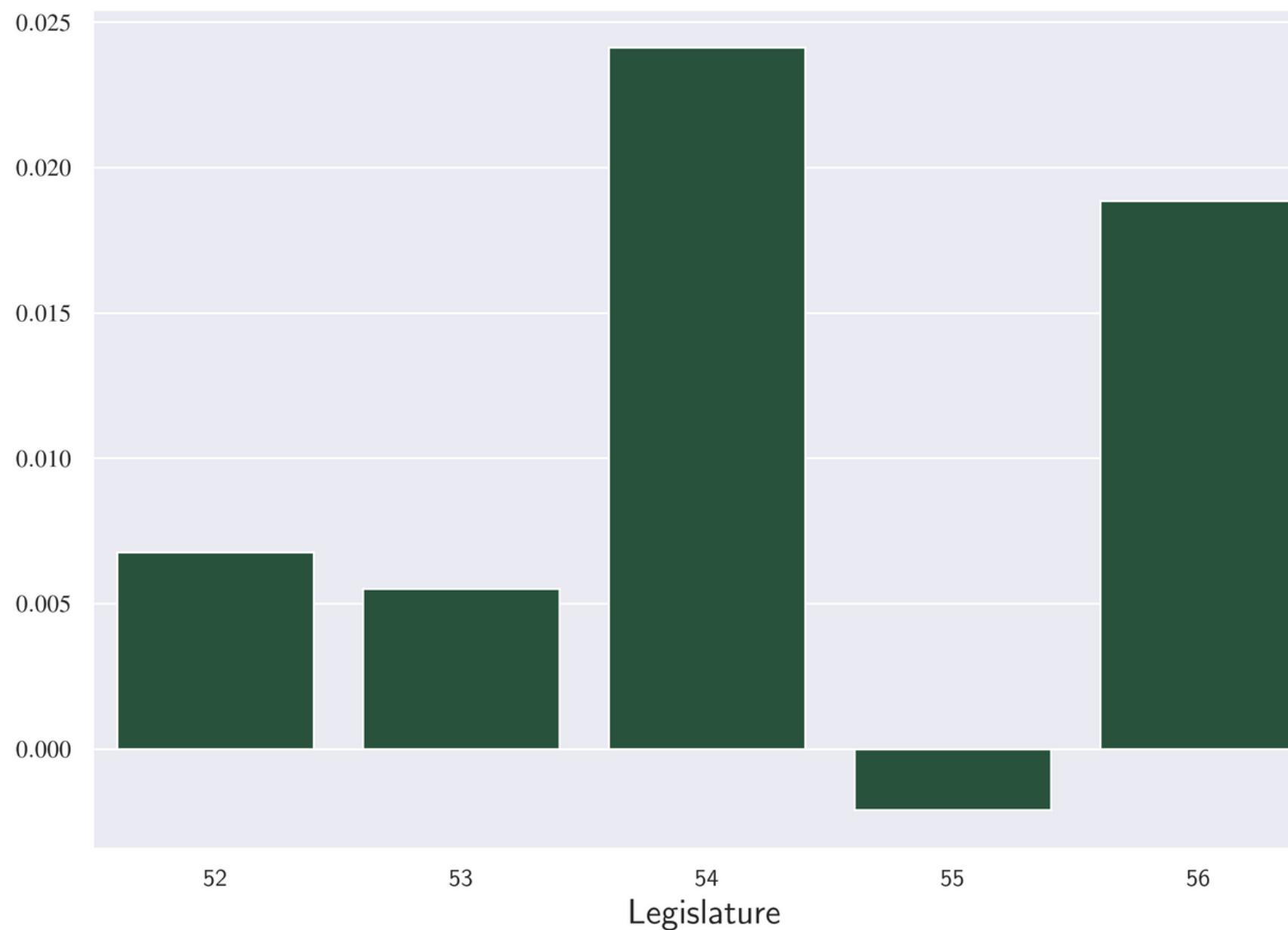


# Assortativity



# Do the regions affect the voting pattern?

Region assortative coefficient



The coefficient is almost zero, then it behaves randomly.

# Comparing the Modularities

Modularity per legislature

