Understanding Multilateral Sanctions using a Multi-way Network Approach

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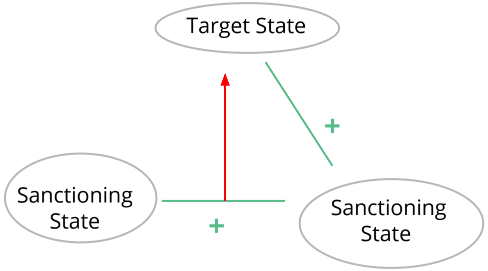
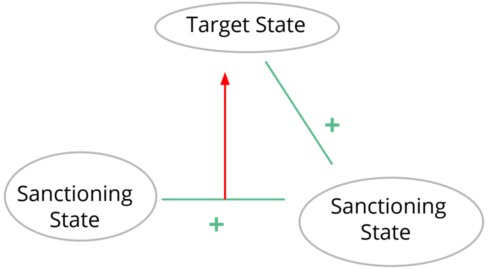
Balance Theory

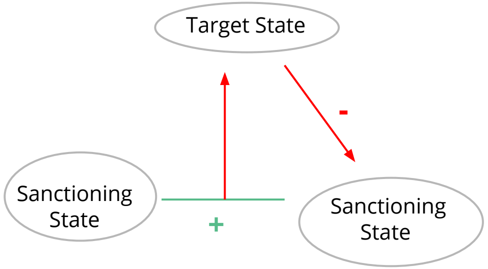
- Balanced Triad: A balanced state offers a stable relational structure for the members in the triad (Heider 1946).
- A balanced triad will not violate any of the following (Holland and Leinhardt 1977):
  - A friend of a friend is a friend.
  - A friend of an enemy is an enemy.
  - An enemy of a friend is an enemy.
  - An enemy of an enemy is a friend.
- And additionally:
  - The lack of a tie is a vacuously positive relationship.
  - An enemy is not a friend.



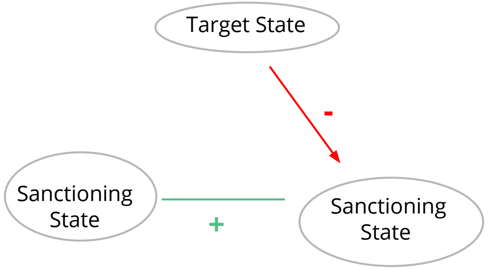
Adapting Balance Theory for Multilateral Sanctions



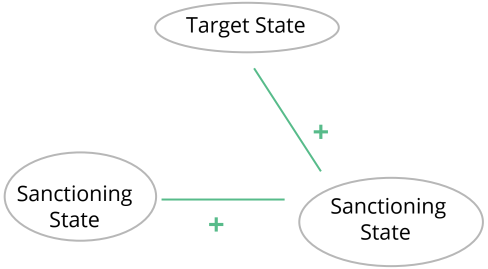
Unbalanced



Balanced



Vacuously Unbalanced



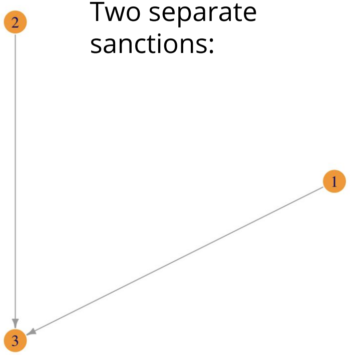
Vacuously Balanced

Question: How does balance theory play a role in collaboration for multilateral sanctions?

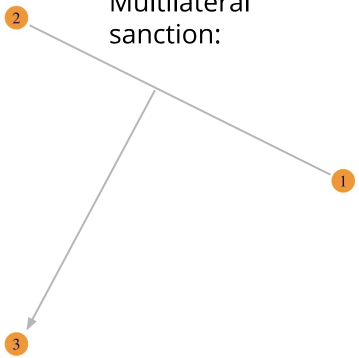
Threat and Imposition of Sanctions (TIES)

- Dataset of 1412 sanction threats and impositions that have been created across 176 countries (1945-2005)
- Rarely examined as a network- even then this assumes independence in collaborations for sanction events

Two separate sanctions:



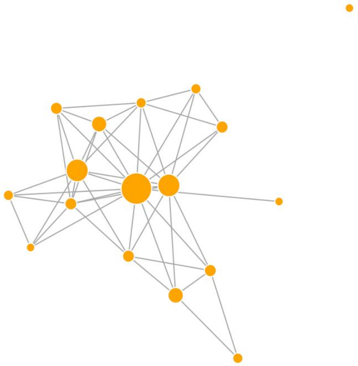
Multilateral sanction:



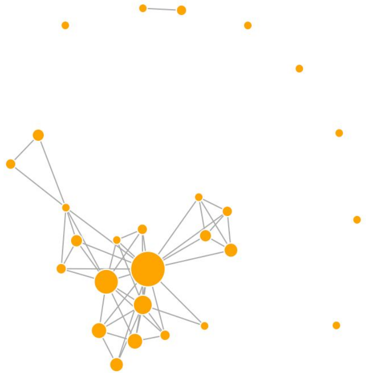
Relational Event Data

Date	Senders	Receiver
03/11/1946	IND	PAK
03/11/1946	IND	JAM
03/11/1946	PAK	JAM

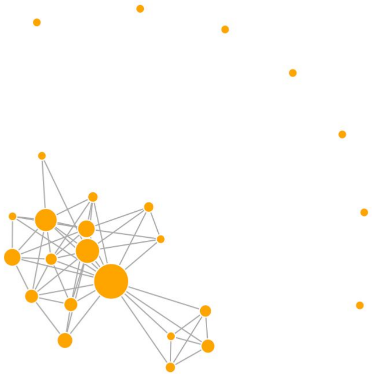
Collaboration Network in 1990



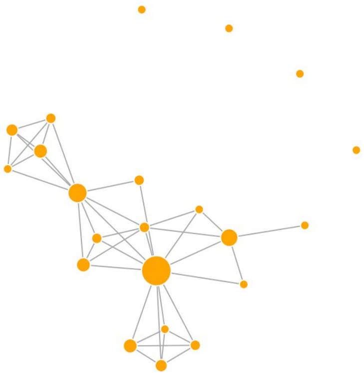
Collaboration Network in 1995



Collaboration Network in 2000

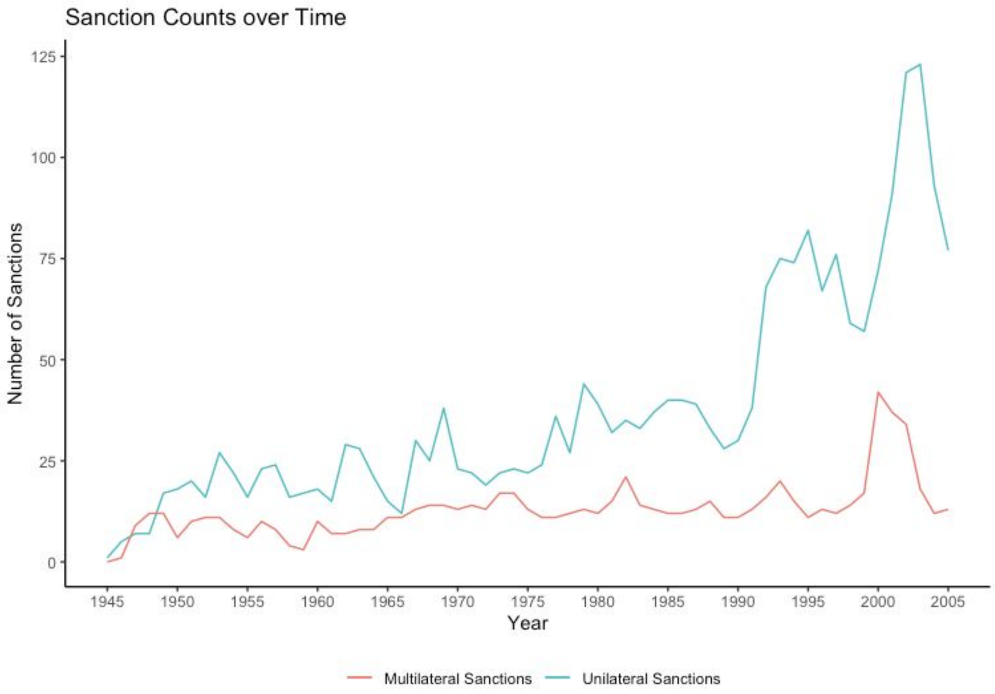


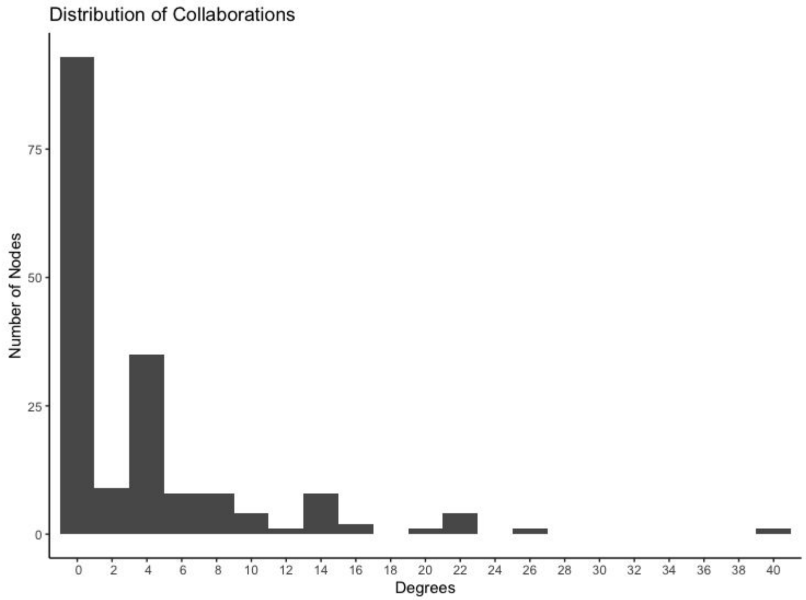
Collaboration Network in 2005

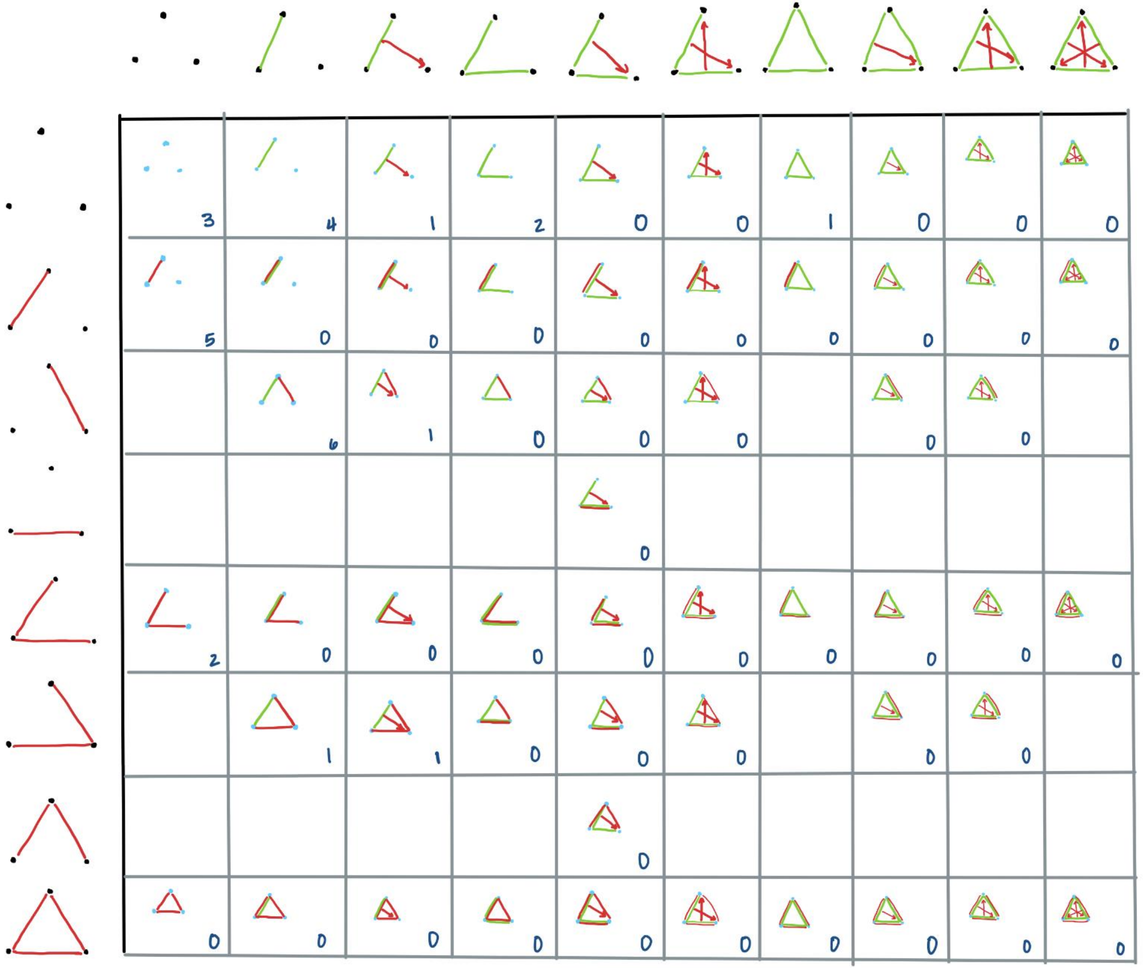


Node sizes have been scaled by number of collaborators

Exploratory Data Analysis

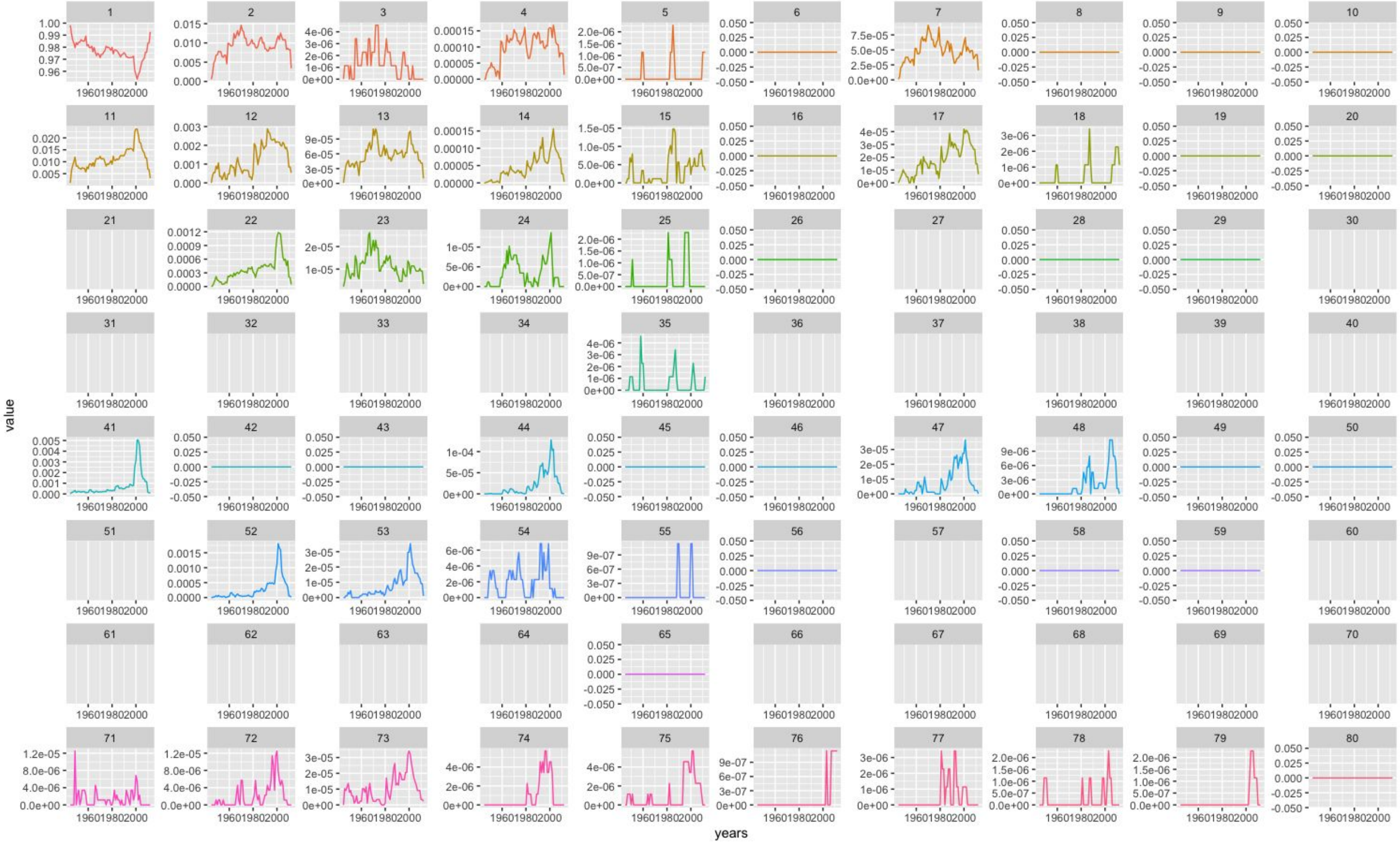


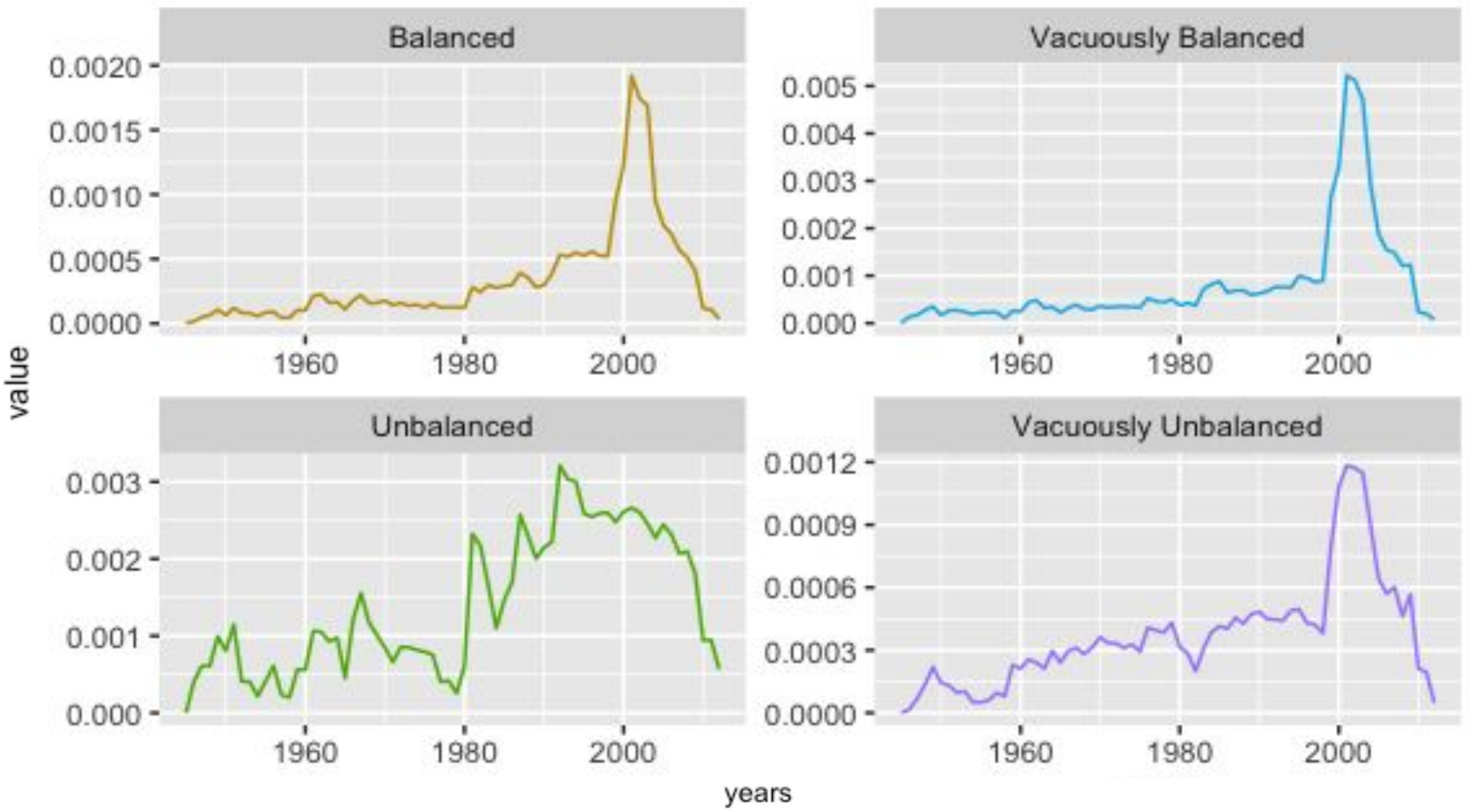




0 - Unbalanced
1 - Balanced
2 - Vacuously Balanced
3 - Empty
4 - One Positive Tie
5 - One Negative Tie
6 - Vacuously Unbalanced

Blank tiles are isomorphisms.


value
years
1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
196019802000


Balanced
Vacuously Balanced
Unbalanced
Vacuously Unbalanced
value
years
0.0000
0.0005
0.0010
0.0015
0.0020
0.000
0.001
0.002
0.003
0.004
0.005
0.0003
0.0006
0.0009
0.0012
1960
1980
2000

The Dynamic Network Actor Model (DyNAM)

- Created by Stadtfield et al. (2017)
- Goal:
  - Model undirected collaborations over time, taking into account axioms of balance
- Model Specifications:
  - Limit collaborations to two nodes (only 28% of multilateral sanctions are bilateral)
  - Only model the creation of ties, not their dissolution
  - Only model choice coordination, not the rate

Definitions

$x^{i \leftrightarrow j}$	The network x, plus an added edge from i to j
$s(\ i,\ x^{i \leftrightarrow j})$	The measure for an attribute s for node i if there was an added edge from i to j
β	The set of parameters corresponding to s
A	All actors in the graph

Model Definition

Multinomial choice probability for how actors propose and accept new ties:

$$p_{i \to j}(x, \beta) = \frac{exp\left(\beta^T s\left(i,\ x^{i \leftrightarrow j}\right)\right)}{\sum_{a \in A} exp\left(\beta^T s\left(i,\ x^{i \leftrightarrow a}\right)\right)}$$

Since each collaboration is assumed to be two actors choosing each other:

$$p_{i \leftrightarrow j}(x, \beta) = \frac{p_{i \to j}(x, \beta)\, p_{j \to i}(x, \beta)}{\sum_{k, l \in A,\ k \le l} p_{k \to l}(x, \beta)\, p_{l \to k}(x, \beta)}$$

Log-likelihood

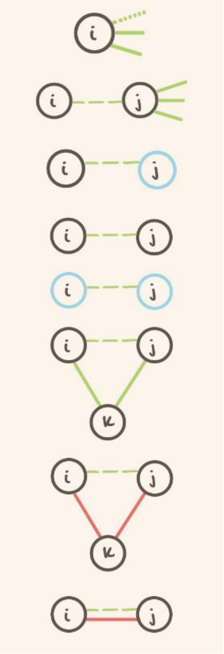
We estimate the parameters of the model with maximum likelihood estimation:

$$\sum_{\omega} \log(L_{\omega}(x_{\omega}, \beta, i_{\omega} \leftrightarrow j_{\omega})) = \sum_{\omega} \left[\log(p_{i_{\omega} \to j_{\omega}}(x_{\omega}, \beta)) + \log(p_{j_{\omega} \to i_{\omega}}(x_{\omega}, \beta)) - \log \left(\sum_{k,l \in N, k \leq l} p_{k \to l}(x_{\omega}, \beta) p_{l \to k}(x_{\omega}, \beta) \right) \right]$$

Here, ω denotes each collaboration event.

Statistic Functions

	Effect name	Effect $s_i(x, z)$	Network representation
1	Degree ego	$\dot{x}_{i+}^{(1)}$	
2	Degree alter	$\sum_j x_{ij}^{(1)} \dot{x}_{j+}^{(1)}$	
3	Covariate alter	$\sum_j x_{ij}^{(1)} v_j$	
4	Covariate similarity	$\sum_j x_{ij}^{(1)} \mathrm{sim}(v_i, v_j)$	
5	Transitivity	$\sum_{j,h} x_{ij}^{(1)} \dot{x}_{ik}^{(1)} \dot{x}_{jk}^{(1)}$	
6	Mixed transitivity	$\sum_{j,h} x_{ij}^{(1)} \dot{x}_{ik}^{(2)} \dot{x}_{jk}^{(2)}$	
7	Simultaneous tie	$\sum_j x_{ij}^{(1)} \dot{x}_{ij}^{(2)}$	



: at least one existing sanction

: a green edge is at least one existing collaboration

: a potential new ally ($\dot{x}_{ij}^{(1)}$ increases by 1)

: a potential new collaboration ($x_{ij}^{(1)}$ increases by 1)

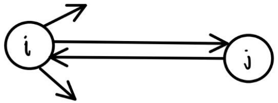
Results

	Model 1		Model 2	
	par.	s.e.	par.	s.e.
Unweighted degree (ego)	-0.570^{***}	0.022	-0.568^{***}	0.022
Weighted popularity	0.081^{***}	0.004	0.085^{***}	0.004
Transitivity	0.139^{***}	0.008	0.134^{***}	0.010
Regime (alter)	0.013^{***}	0.004	0.014^{***}	0.004
Similar regime	0.001	0.004	0.001	0.004
Mixed transitivity			0.001	0.004
Tie in sanction network			-0.150^{*}	0.059
AIC	*14105*		*14101*	

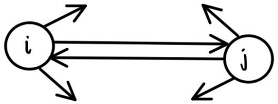
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Next Steps

- Adapt the DyNAM approach for collaborations, ie:



Instead of:



- Adapt the DyNAM approach for three-way relations
  - Model collaboration over more than two actors
  - Condition this on a proposed sanction target from the primary sanction sender

Thanks for watching!