# Financial Exchange Networks Among Political Committees in the 2020 Election Cycle

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# From Data to Networks

# Data Source

- The data used in this research was sourced directly from the **Federal Elections Commission** (**FEC**), an independent government agency created by Congress in 1974.
- The FEC's website http://www.fec.gov/ provides bulk data downloads.
- It also provides developer access to all campaign contribution and spending data through a RESTful API https://api.open.fec.gov/developers/ that is accessible programmatically after signing up for a free developer key.
- The bulk datasets used for the analysis of the 2–year election cycle ending in 2020 include: candidate, committee, receipts, and disbursements.

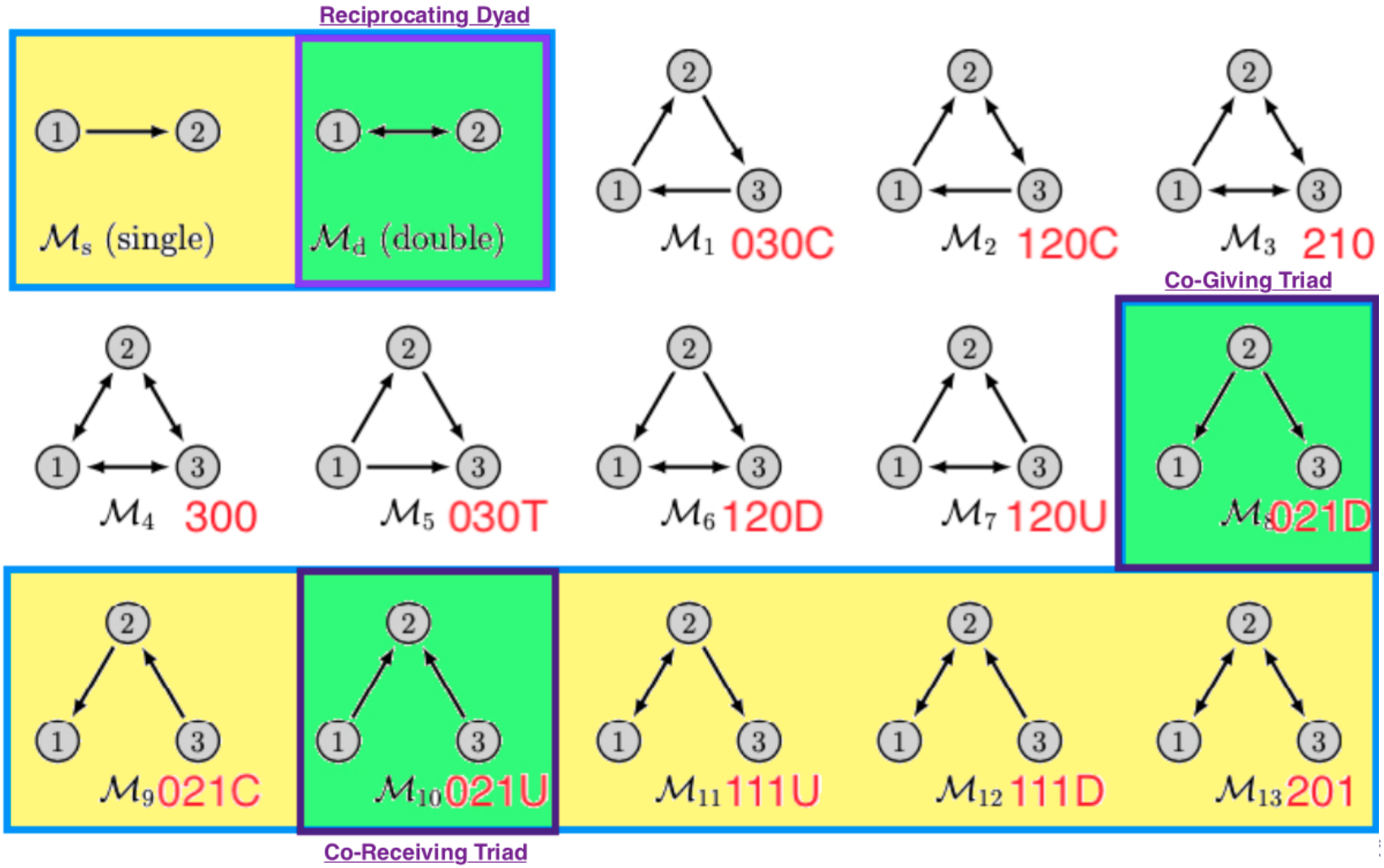
# The Directed Graph of Exchanges among Committees

- After removing committees, for which the FEC dataset does not provide any attributes and which are not involved in any exchanges:
- The **Directed Graph of Exchanges among Committees** $G = (V, E)$ consists of:
- 10,603 nodes/vertices (Committees) and 236,941 edges/links (exchanges)
- $G$ is a weighted graph (where the amount in US dollars of an exchange or expenditure is the weight of the corresponding edge). The minimum weight is 1, and the maximum weight is 237,500,000.
- $G$ is not strongly connected and it contains 4,678 strongly connected components. The largest strongly connected component of $G$ includes 5,838 nodes and 224,602 edges.
- $G$ is not weakly connected and it contains 1,812 weakly connected components. The largest weakly connected component of $G$ includes 8,708 nodes and 236,835 edges.
- $G$ includes 1,740 isolates (which are Committees not participating in any exchanges with other Committees).
- The density of $G$ is 0.002.
- The transitivity of $G$ is 0.042.
- The reciprocity of $G$ is 0.318.
- The attribute assortativity coeefficient of $G$ wrt the attribute of political affiliation of committees is -0.0139.

# Dyadic & Triadic Methods

# Dyads & Triads

**M–A–N notation (Davis, Holland & Leinhardt):** Three digits possibly followed by a letter. The first digit indicates the number reciprocating (mutual) dyads (**M**), the second digit is the number of assymmetric dyads (**A**), and the third digit is the number of null dyads (**N**). Sometimes a letter is added to distinguish between triads of the same M–A–N digits: **D** for down, **U** for up, **C** for cyclic, and **T** for transitive.



# Reciprocating Dyads & Co–Giving or Co–Receiving Triads

- Let $G = (V, E)$ be a **directed** graph. For any node/vertex $i \in V$, $\deg^+(i)$ denotes the **out–degree** of $i$ and $\deg^-(i)$ denotes the **in–degree** of $i$. In what follows below, $i, j, k \in V$.
- A **dyad** in $G$ is another name for an edge $e \in E$. If $e = (i, j)$, the dyad $(i, j)$ is directed from $i$ to $j$. This is why dyad $(i, j)$ is denoted as "$i \to j$."
- A **reciprocated dyad** is a dyad $e = (i, j)$ such that $(j, i)$ is a dyad too. Another way to denote the reciprocated dyad $(i, j)$ is as "$i \leftrightarrow j$." The set of reciprocated dyads in $G$ is denoted as Recip.
- Let $G$[Recip] the (induced) subgraph of Recip, i.e., what remains in $G$, after the removal of all non–reciprocated dyads.
- A (non–null) **triad** in $G$ is any walk $(i, j, k)$ of length 3.
- A **co–giving triad** is a triad $(i, j, k)$ such that $(j, i), (j, k) \in E$. Another way to denote the co–giving triad $(i, j, k)$ is as "$i \leftarrow j \to k$." The set of co–giving triads is denoted as Co–Giv.
- Let $G$[Co–Giv] the (induced) subgraph of Co–Giv, i.e., what remains in $G$, after the removal of all nodes havig out–degree equal to 1 or 0.
- A **co–receiving triad** is a triad $(i, j, k)$ such that $(i, j), (k, j) \in E$. Another way to denote the co–receiving triad $(i, j, k)$ is as "$i \to j \leftarrow k$." The set of co–receiving triads is denoted as Co–Rec.
- Let $G$[Co–Rec] the (induced) subgraph of Co–Rec, i.e., what remains in $G$, after the removal of all nodes havig in–degree equal to 1 or 0.

# Motivation from Citation Graphs

- In bibliometrics, a **citation graph** $G = (V, E)$ is a directed acyclic graph (DAG), in which nodes represent documents (or publications) and edges correspond to citations (or references) among them.
- Since $G$ is a DAG, Recip $= \varnothing$, i.e., no reciprocation can occur in a citation graph!
- However, from a citation graph, two weighted undirected graphs are typically induced through the mechanism of triadic closure (or completion):
  - The **co–citation graph** is induced by the triadic closure of the subgraph of co–giving triads of $G$.
  - The **bibliometric coupling graph** is induced by the triadic closure of the subgraph of co–receiving triads of $G$.

# Counts for the Graph of Exchanges among Committies

$$|\text{Recip}| = |\{e \in E : e = (i,j) \text{ and } (j,i) \in E\}|$$

$$|\text{Co–Giv}| = \sum_{j \in V : \deg^+(j) \geq 2} \binom{\deg^+(j)}{2}$$

$$|\text{Co–Rec}| = \sum_{j \in V : \deg^-(j) \geq 2} \binom{\deg^-(j)}{2}$$

| **Motif** | **Count** |
|---|---|
| Reciprocated Dyads | 37,658 |
| Co-Giving Triads | 20,823,544 |
| Co-Receiving Triads | 27,648,251 |

# Counts of Nodes and Edges for Subgraphs

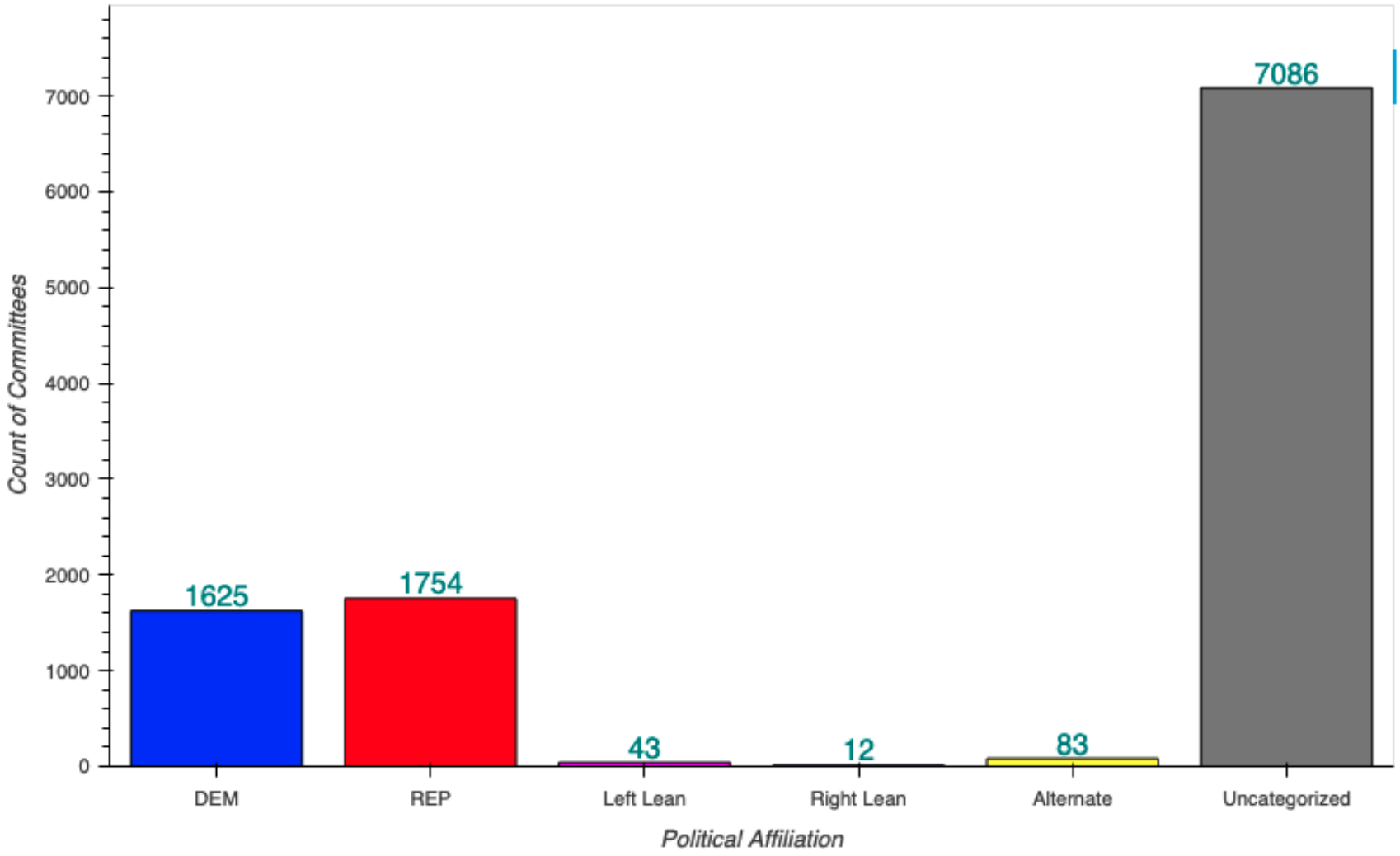
| **Subgraph** | **No. of nodes** | **No. of edges** |
|---|---|---|
| Reciprocated Dyads | 5,589 | 37,658 |
| Co-Giving Triads | 8,013 | 231,698 |
| Co-Receiving Triads | 8,109 | 119,584 |

# Graphs of Dyads & Triads of Committees Labelled in Political Affiliation

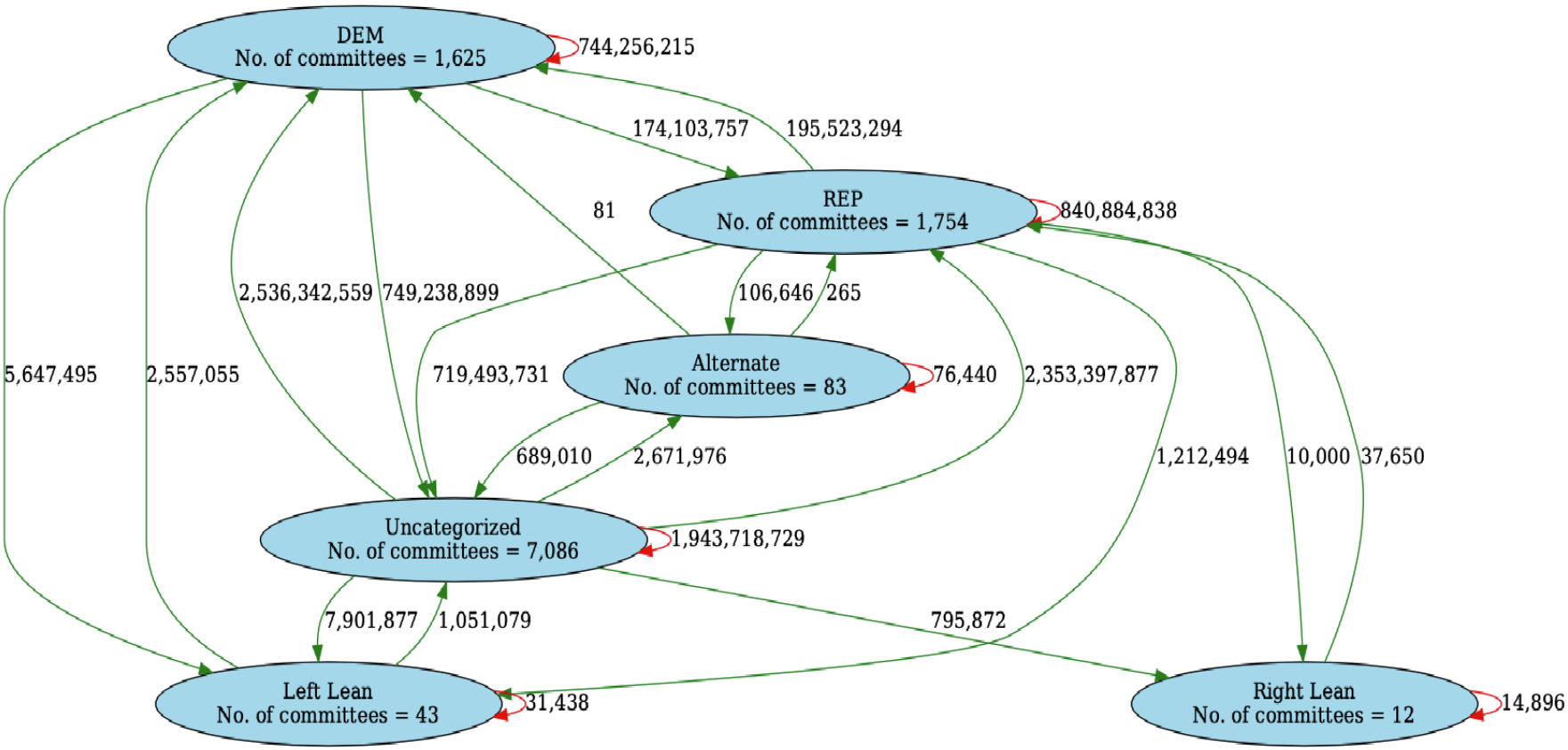
# Six Types of Political Affiliation of Committees

- DEM
- REP
- Left Lean
  - SEP (Socialist Equality Party)
  - SWP (Socialist Workers Party)
  - PPY (People's Party)
  - DFL (Democratic-Farmer-Labor)
  - GRE (Green Party)
- Right Lean
  - CON (Constitution Party)
  - CRV (Conservative Party)
  - IAP (Independent American Party)
- Alternate
  - NPP (New Progressive Party)
  - IDP (Independence Party)
  - LIB (Libertarian Party)
  - NAP (Prohibition Party)
  - UNI (United Party)
  - VET (Veterans Party)
  - W (Write–In)

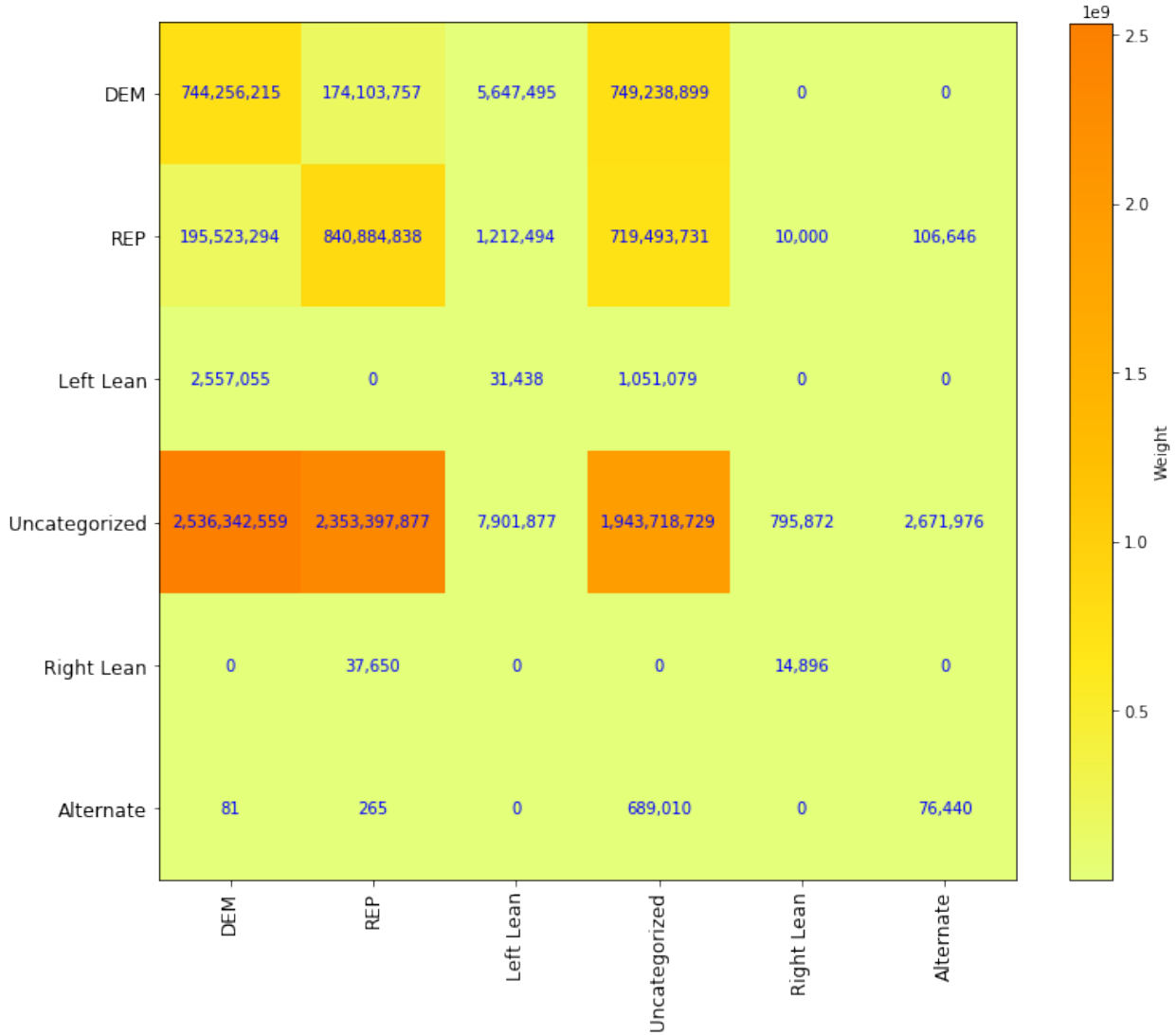
# Political Affiliation of Committees



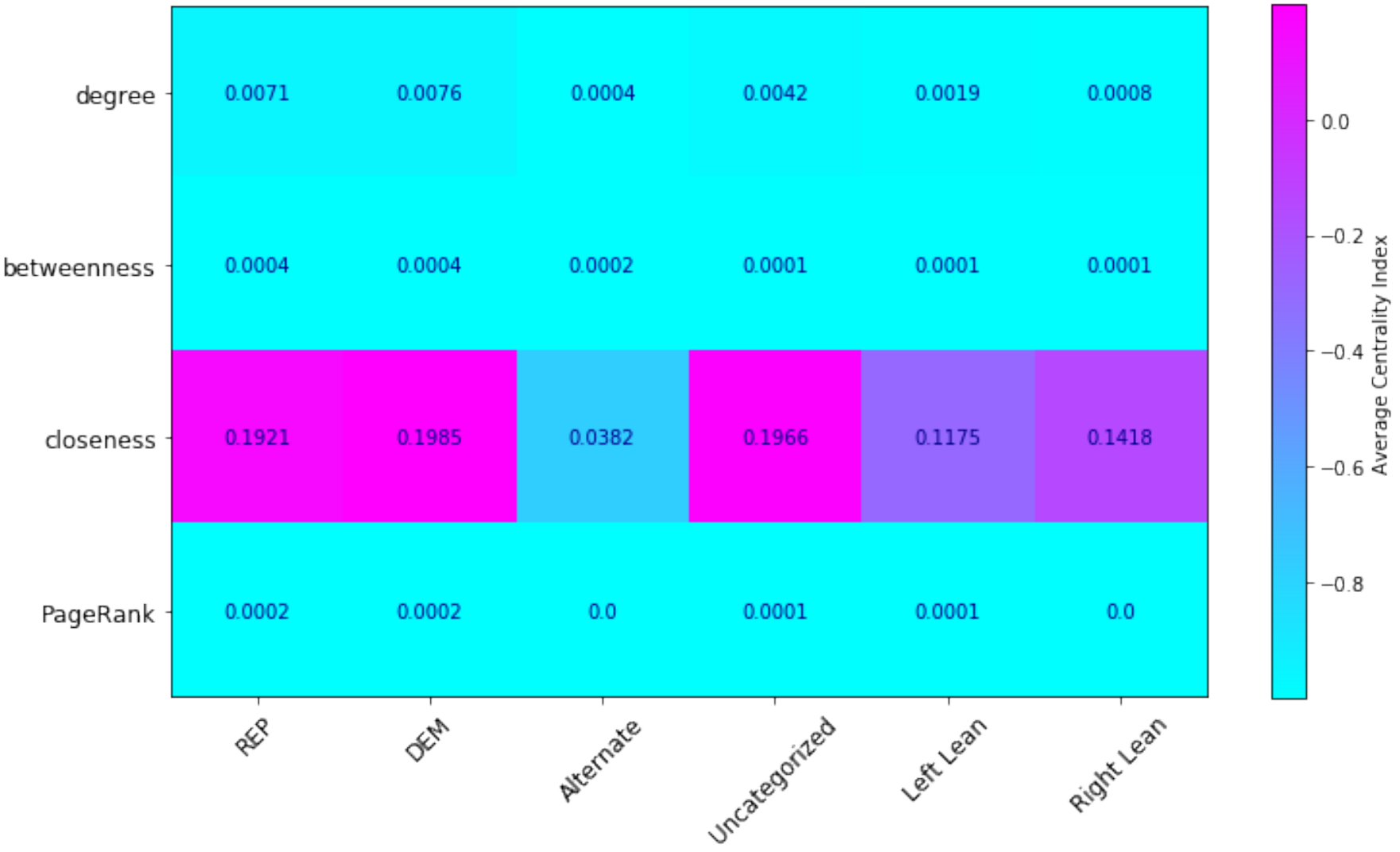
# The Graph of Aggregated Exchanges in Political Affiliation



# The Heatmap of Aggregated Exchanges in Political Affiliation



# Average Centralities of Aggregated Committees in Political Affiliation



# Counts of Labeled Reciprocating Dyads

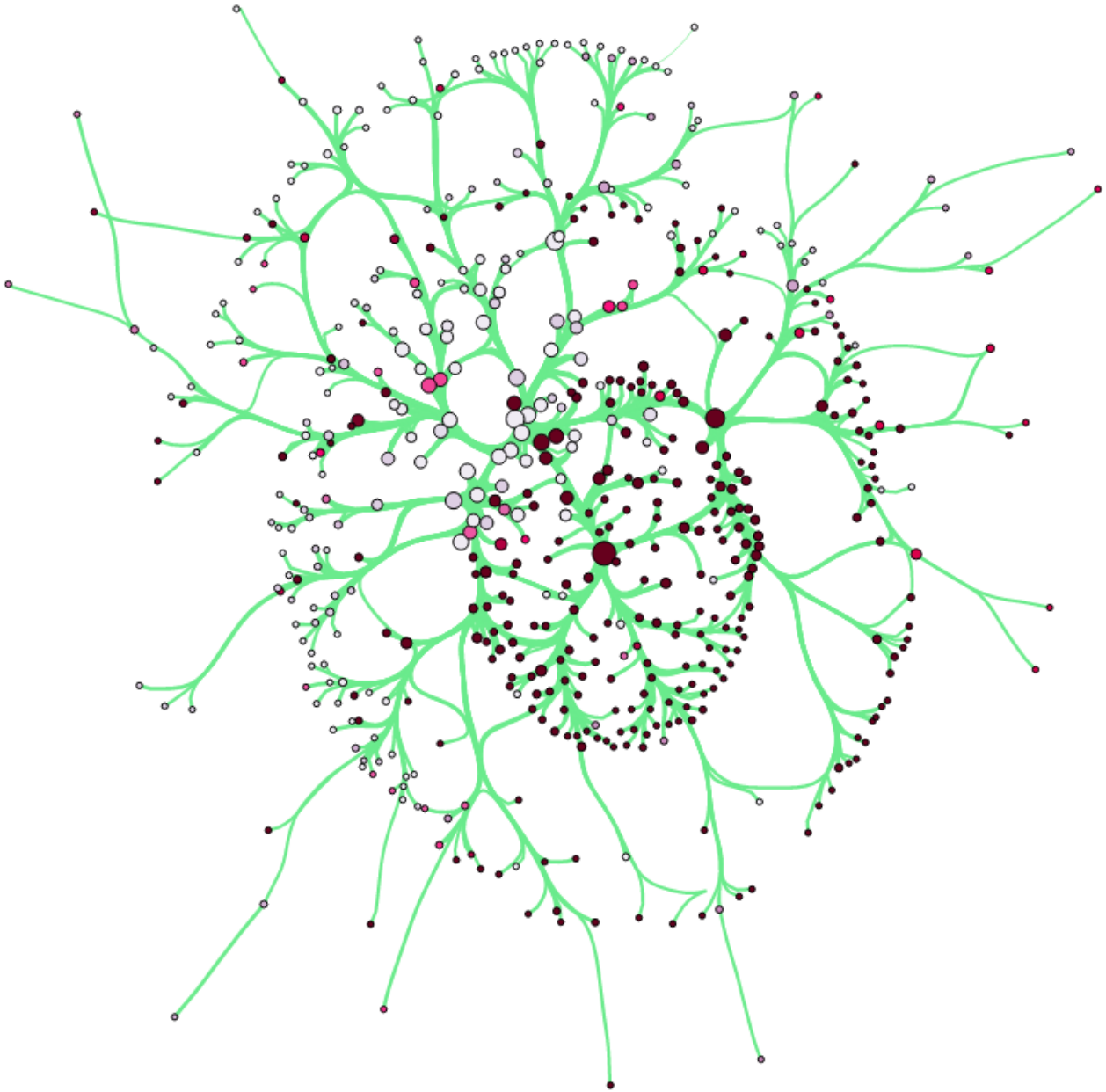
| **Labelled Dyad** | **Count** |
|---|---|
| Uncategorized $\leftrightarrow$ Uncategorized | 23,652 |
| REP $\leftrightarrow$ Uncategorized | 6,690 |
| DEM $\leftrightarrow$ Uncategorized | 5,200 |
| DEM $\leftrightarrow$ DEM | 1,229 |
| REP $\leftrightarrow$ REP | 815 |
| Left Lean $\leftrightarrow$ Uncategorized | 44 |
| Alternate $\leftrightarrow$ Alternate | 9 |
| DEM $\leftrightarrow$ Left Lean | 8 |
| Alternate $\leftrightarrow$ Uncategorized | 6 |
| REP $\leftrightarrow$ Right Lean | 3 |
| Left Lean $\leftrightarrow$ Left Lean | 2 |

# Graphs of Labelled Reciprocating Dyads

- DEM $\leftrightarrow$ DEM
- REP $\leftrightarrow$ REP
- $\{$DEM, REP, Left Lean, Right Lean$\}$ $\leftrightarrow$ $\{$DEM, REP, Left Lean, Right Lean$\}$

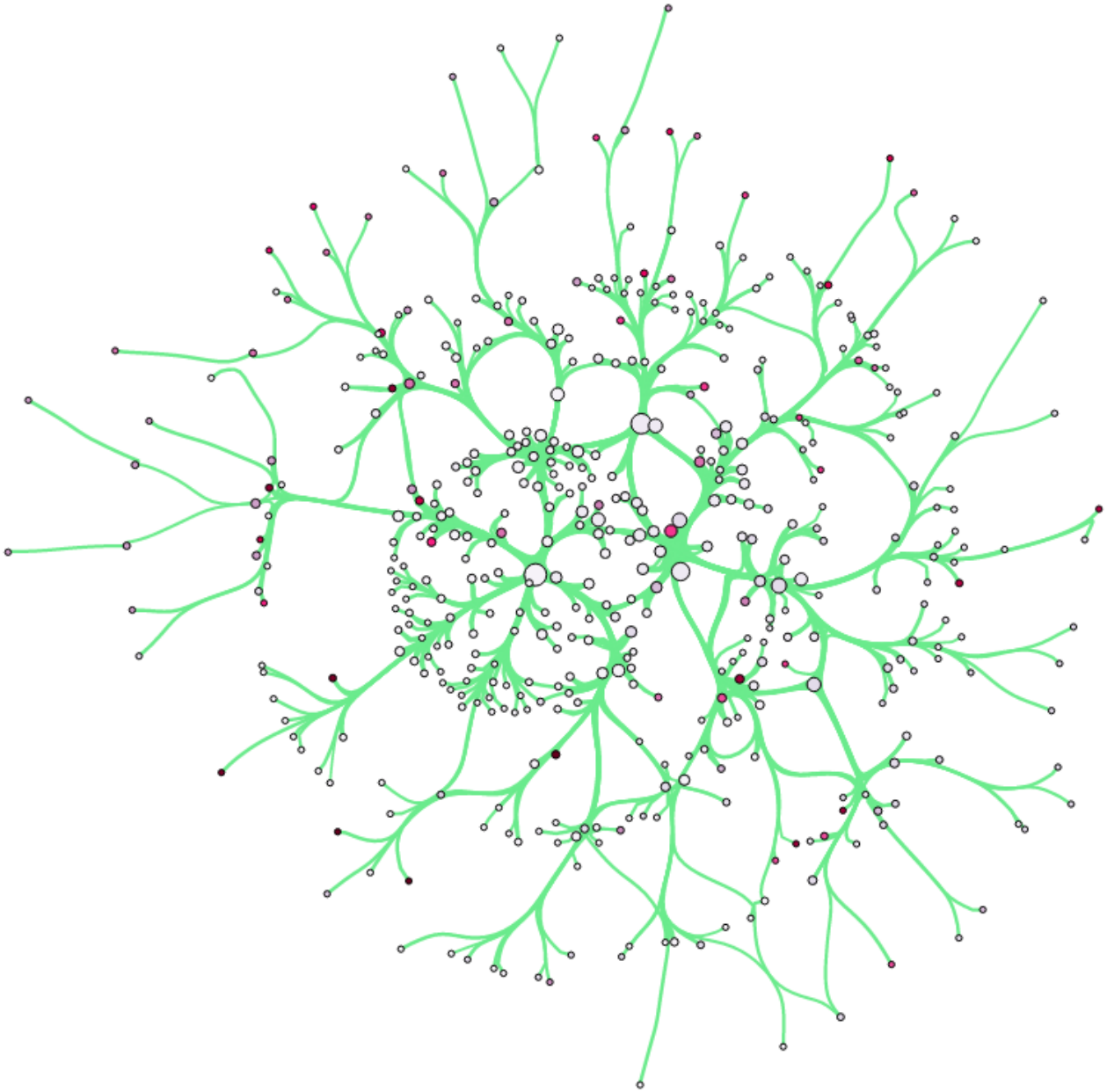
# DEM $\leftrightarrow$ DEM

Link



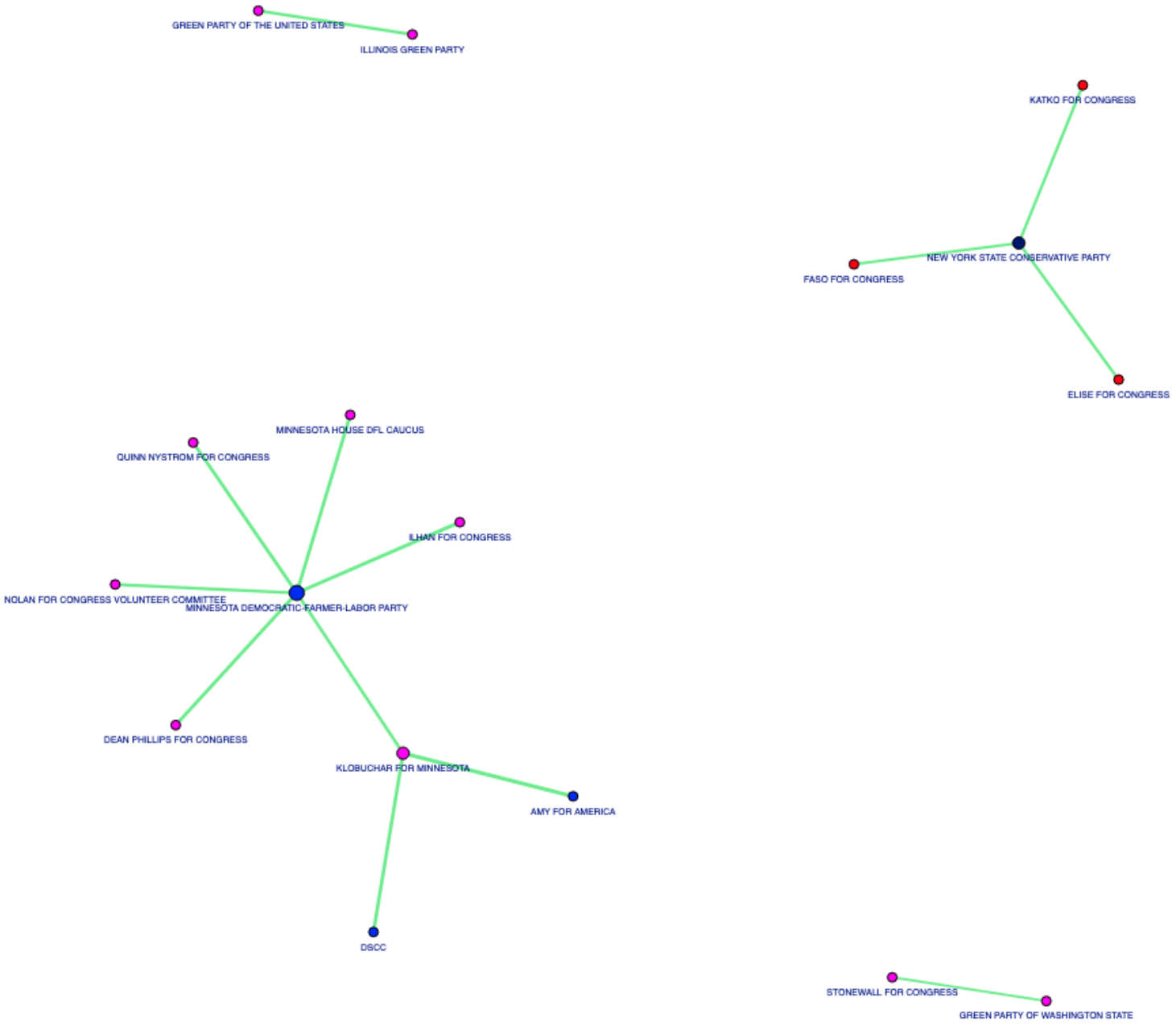
# REP $\leftrightarrow$ REP

Link



# {DEM, REP, Left Lean, Right Lean} ↔ {DEM, REP, Left Lean, Right Lean}

Link



# Counts of Labelled Co–Giving Triads

Top 5 Labelled Co–Giving Triads

| **Labelled Co–Giving Triad** | **Count** | **Unique Givers** |
|---|---|---|
| DEM ← Uncategorized → REP | 3,744,544 | 2,424 |
| DEM ← Uncategorized → DEM | 3,368,273 | 3,155 |
| DEM ← Uncategorized → Uncategorized | 2,941,656 | 2,712 |
| REP ← Uncategorized → REP | 2,786,801 | 3,117 |
| REP ← Uncategorized → Uncategorized | 2,742,683 | 2,771 |

Bottom 5 Labelled Co–Giving Triads

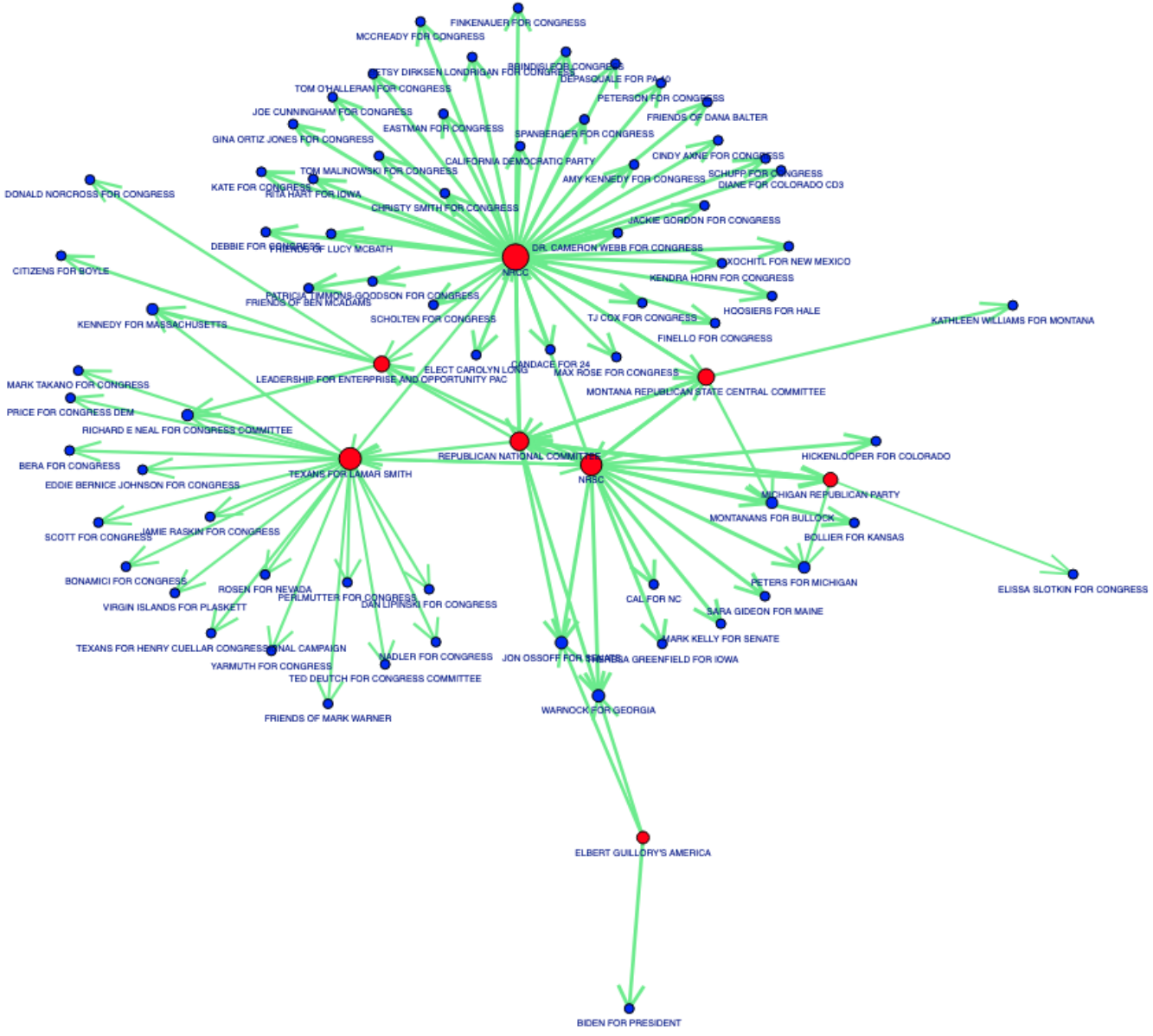
| **Labelled Co–Giving Triad** | **Count** | **Unique Givers** |
|---|---|---|
| Left Lean ← Uncategorized → Alternate | 7 | 5 |
| Alternate ← Uncategorized → Alternate | 6 | 2 |
| DEM ← REP → Alternate | 5 | 3 |
| Left Lean ← Left Lean → Left Lean | 5 | 3 |
| DEM ← Uncategorized → Right Lean | 5 | 1 |

# Graphs of Labelled Co-Giving Triads

- DEM $\leftarrow$ REP $\rightarrow$ DEM
- REP $\leftarrow$ DEM $\rightarrow$ REP
- $\{$DEM, REP$\}$ $\leftarrow$ $\{$Left Lean, Right Lean,Alternate$\}$ $\rightarrow$ $\{$DEM, REP$\}$

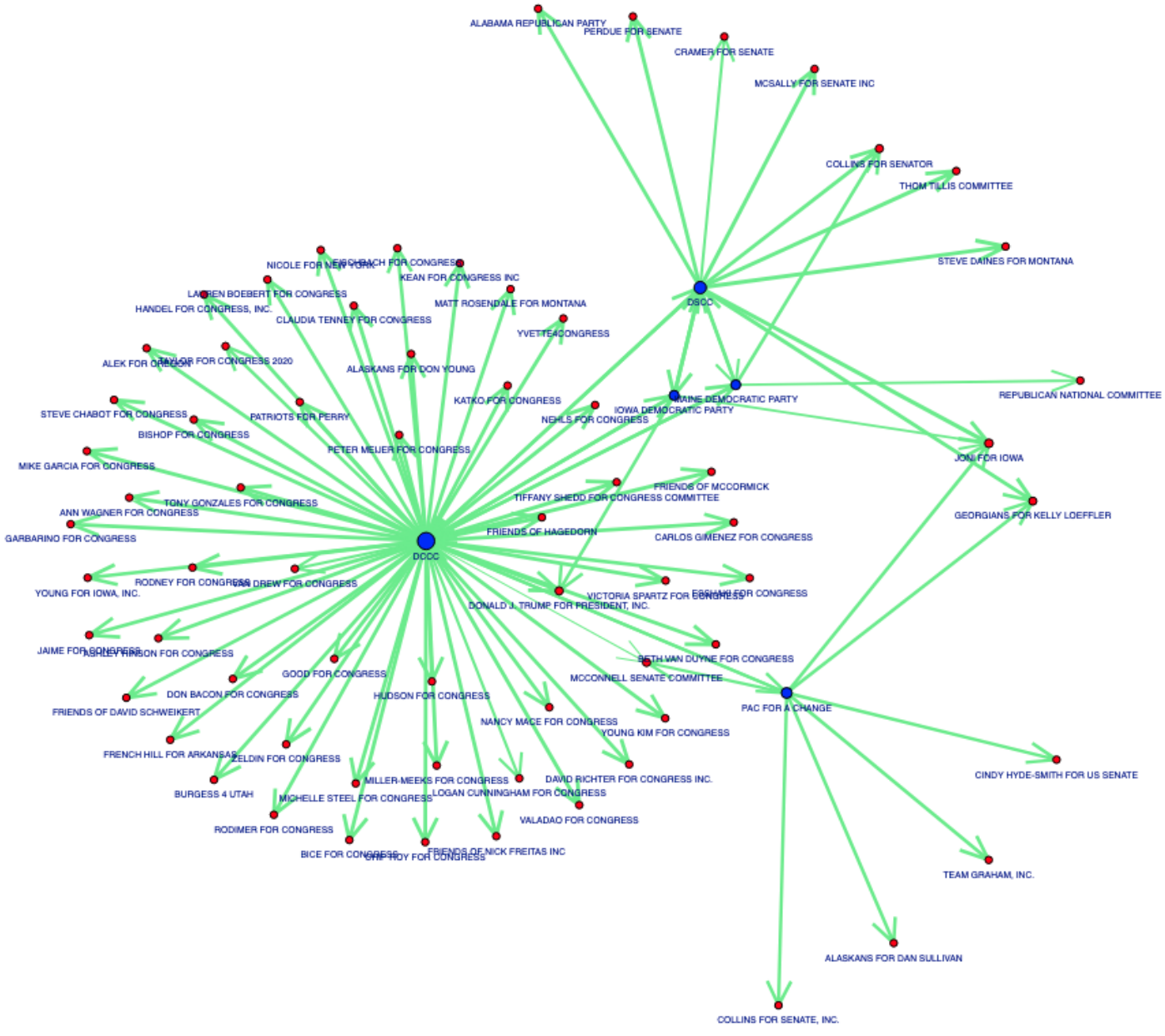
# DEM ← REP → DEM

Link



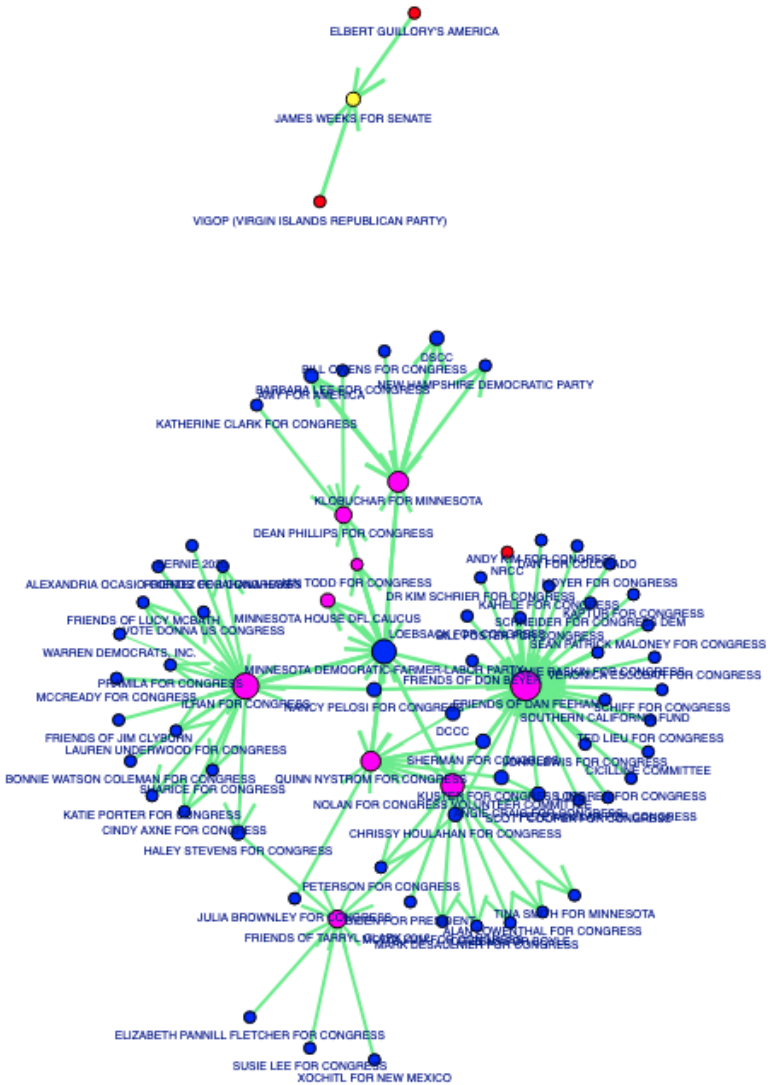
# REP ← DEM → REP

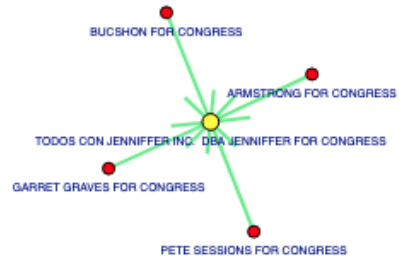
Link



# {DEM, REP} ← {Left Lean, Right Lean,Alternate} → {DEM, REP} → DEM

Link




# Counts of Labelled Co–Receiving Triads

Top 5 Labelled Co–Giving Triads

| Labelled Co–Receiving Triad | Count | Unique Receivers |
|---|---|---|
| Uncategorized → REP ← Uncategorized | 11,517,614 | 798 |
| Uncategorized → DEM ← Uncategorized | 9,760,559 | 744 |
| Uncategorized → Uncategorized ← Uncategorized | 2,121,018 | 2963 |
| DEM → DEM ← Uncategorized | 1,664,159 | 709 |
| REP → REP ← Uncategorized | 1,453,265 | 731 |

Bottom 5 Labelled Co–Giving Triads

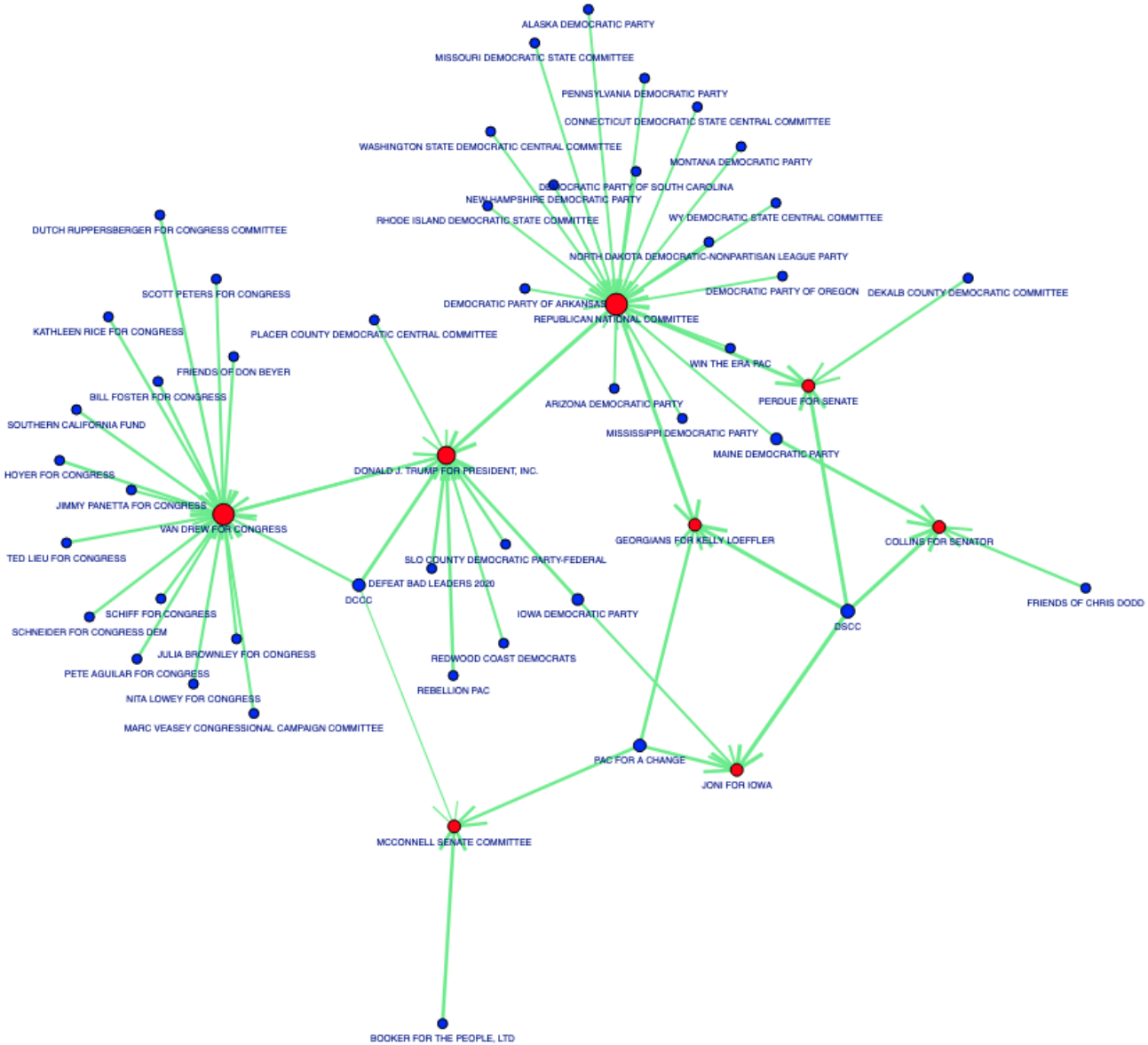
| Labelled Co–Receiving Triad | Count | Unique Receivers |
|---|---|---|
| REP → Alternate ← REP | 7 | 2 |
| REP → Uncategorized ← Alternate | 7 | 2 |
| REP → DEM ← Left Lean | 4 | 4 |
| Left Lean → Left Lean ← Left Lean | 3 | 1 |
| REP → Left Lean ← Left Lean | 1 | 1 |

# Graphs of Labelled Co–Receiving Triads

- DEM $\rightarrow$ REP $\leftarrow$ DEM
- REP $\rightarrow$ DEM $\leftarrow$ REP
- $\{$DEM, REP,Left Lean$\}$ $\rightarrow$ $\{$Left Lean, Right Lean$\}$ $\leftarrow$ $\{$DEM, REP,Left Lean$\}$

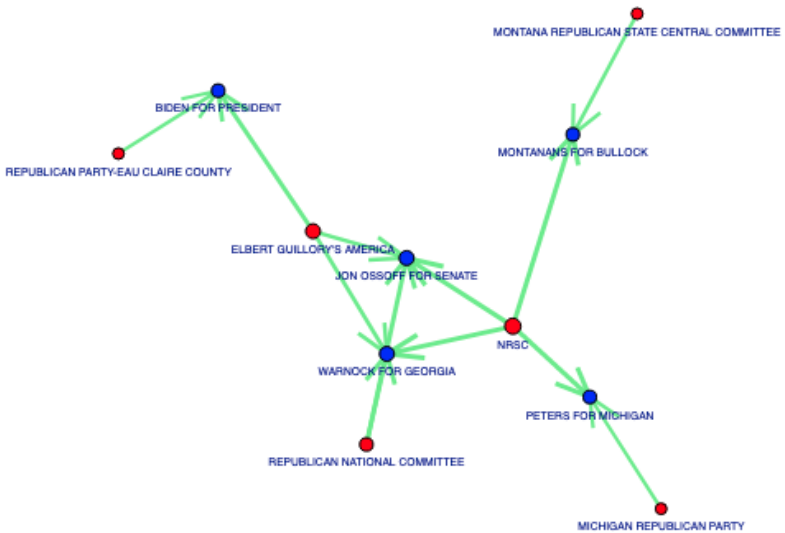
# DEM → REP ← DEM

Link



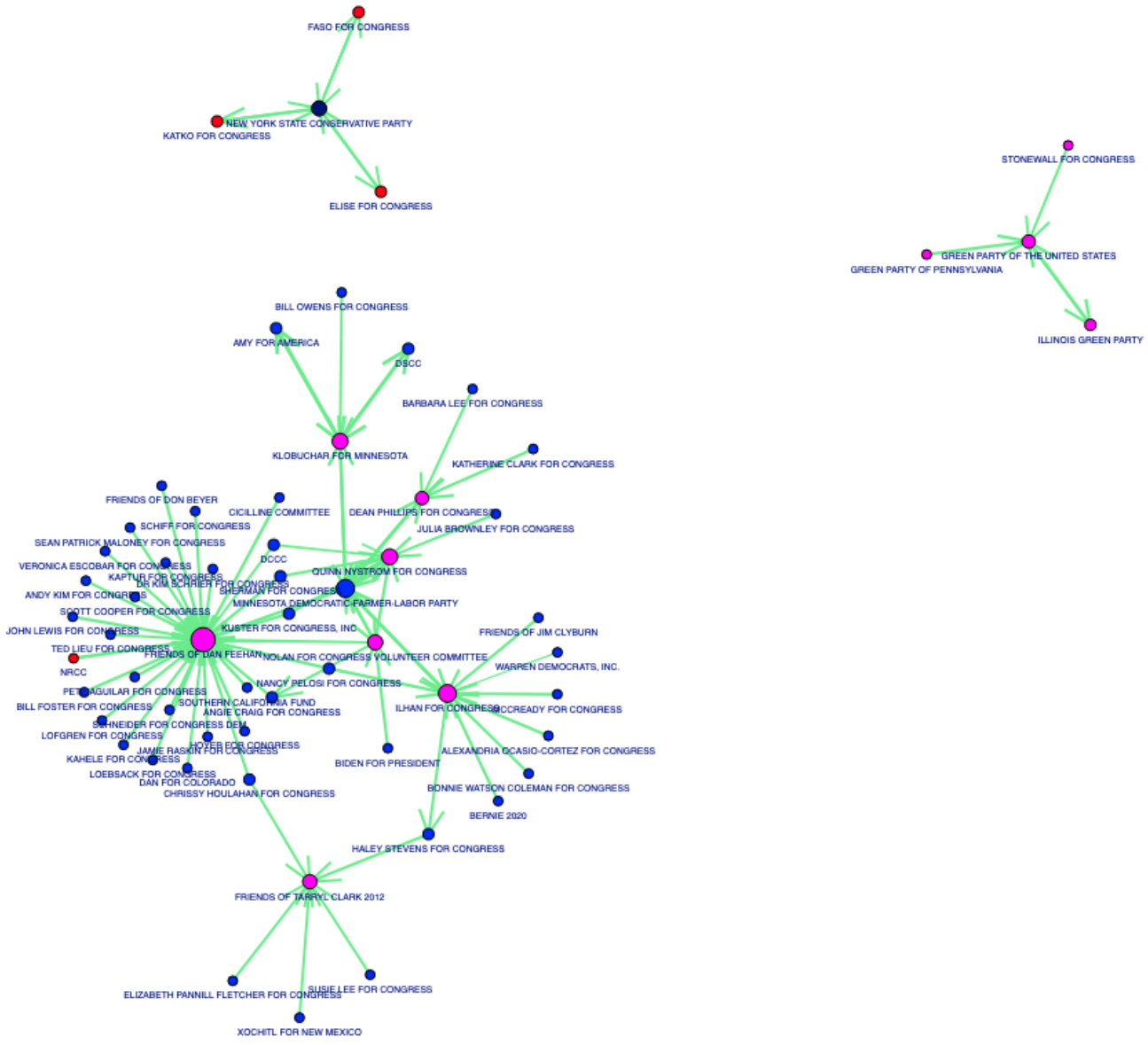
# REP → DEM ← REP

Link

# {DEM, REP,Left Lean} → {Left Lean, Right Lean} ← {DEM, REP,Left Lean}

Link



# Conclusions

# Conclusions

- Within party financial exchanges dominate the overall FEC network.
- However, we observed a number of some significant across–party financial exchanges, despite some of the parties being in political opposition to each other.
- The committees that are uncategorized (or unaffiliated) have the largest share among those exchanges that are not within a single party.
- In upcoming and future elections it will be interesting to explore whether patterns observed here continue to hold.
- We plan to further develop this data & network analysis, particularly expanded statistical analyses, and welcome possible collaboration from the audience here among those interested.