# Changes in the connection networks of MEPs

Marits Márton, Bernát Ádám

Budapesti Műszaki és Gazdaságtudományi Egyetem
**Project Laboratory**

2023

# Introduction

By its plastic nature, human connections change over time, especially when outside effects take place. However, in the case of policy makers, such changes will sooner or later have consequences to our life (As we live in the EU.)

# Motivation

Understanding the network of MEPs might give us a better understanding of the following:

# Motivation

Understanding the network of MEPs might give us a better understanding of the following:

- How smaller networks inbetween MEPs look like, their size and their quantity.

# Motivation

Understanding the network of MEPs might give us a better understanding of the following:

- How smaller networks inbetween MEPs look like, their size and their quantity.
- **Identifying key decision and policy makers.**

# Motivation

Understanding the network of MEPs might give us a better understanding of the following:

- How smaller networks inbetween MEPs look like, their size and their quantity.
- **Identifying key decision and policy makers.**
- **How events and occurrences shape the form and topology of the network.**

# Motivation

Understanding the network of MEPs might give us a better understanding of the following:

- How smaller networks inbetween MEPs look like, their size and their quantity.
- **Identifying key decision and policy makers.**
- **How events and occurrences shape the form and topology of the network.**

All of these are helpful in understanding the processes regarding proposals and how they evolve into enacted laws.

# Our Topic(s)

# Our Topic(s)

- **Our main focus was on the effects of COVID-19 and how it shaped the network of MEPs.**

# Our Topic(s)

- **Our main focus was on the effects of COVID-19 and how it shaped the network of MEPs.**
- A more recent topic of interest might be the Russian-Ukrainian conflict and how it altered connections within the European Parliament.

# Our Topic(s)

- **Our main focus was on the effects of COVID-19 and how it shaped the network of MEPs.**
- A more recent topic of interest might be the Russian-Ukrainian conflict and how it altered connections within the European Parliament.
- For now, we focused on gathering information on **the whole dataset at once**, and we will focus on the changes over time in future research

# Our analysis

We acquired data regarding amendments, for each amendment we know which MEP proposed the amendment, what kind of document it is, etc..

# Our analysis

We acquired data regarding amendments, for each amendment we know which MEP proposed the amendment, what kind of document it is, etc..

Basically, we got a bipartite graph with node groups:

- MEPs
- Documents

# Our analysis

We acquired data regarding amendments, for each amendment we know which MEP proposed the amendment, what kind of document it is, etc..

Basically, we got a bipartite graph with node groups:

- MEPs
- Documents

Edges $\iff$ MEP made amendment to document

# Our analysis

We acquired data regarding amendments, for each amendment we know which MEP proposed the amendment, what kind of document it is, etc..

Basically, we got a bipartite graph with node groups:

- MEPs
- Documents

Edges $\iff$ MEP made amendment to document

A bipartite graph:

BipartiteGraph.png

# Projection

We then created a projection of this bipartite graph:

# Projection

We then created a projection of this bipartite graph:

- Nodes: the nodes of MEPs

# Projection

We then created a projection of this bipartite graph:

- Nodes: the nodes of MEPs
- Edges: 2 MEPs are connected if they amended the same document

# Projection

We then created a projection of this bipartite graph:

- Nodes: the nodes of MEPs
- Edges: 2 MEPs are connected if they amended the same document

We have also considered and implemented weighted projection. We used the so called: "Collaboration weighted projection"(where we reward secluded document matching and punish popular document matching)

# Analysis of activity by country

We are interested in analyzing how many amendments were contributed by each country's MEPs.

# Analysis of activity by country

We are interested in analyzing how many amendments were contributed by each country's MEPs.

| Country | Contributions |
|---|---|
| Germany | 5539 |
| France | 4242 |
| Spain | 3853 |
| Italy | 3550 |
| Poland | 2531 |
| ⋮ | ⋮ |
| Lithuania | 541 |
| Cyprus | 502 |
| Latvia | 426 |
| Estonia | 423 |
| United Kingdom | 268 |

# Analysis of activity by country

We are interested in analyzing how many amendments were contributed by each country's MEPs.

| Country | Contributions |
|---|---|
| Germany | 5539 |
| France | 4242 |
| Spain | 3853 |
| Italy | 3550 |
| Poland | 2531 |
| ⋮ | ⋮ |
| Lithuania | 541 |
| Cyprus | 502 |
| Latvia | 426 |
| Estonia | 423 |
| United Kingdom | 268 |

As one would expect, largest countries on top, small countries on the bottom.

# Analysis of activity by country

We are interested in analyzing how many amendments were contributed by each country's MEPs.

| Country | Contributions |
|---|---|
| Germany | 5539 |
| France | 4242 |
| Spain | 3853 |
| Italy | 3550 |
| Poland | 2531 |
| ⋮ | ⋮ |
| Lithuania | 541 |
| Cyprus | 502 |
| Latvia | 426 |
| Estonia | 423 |
| United Kingdom | 268 |

As one would expect, largest countries on top, small countries on the bottom.
The UK is an outlier because of Brexit, as one would expect.

# Analysis of activity by country

We are interested in analyzing how many amendments were contributed by each country's MEPs.

| Country | Contributions |
|---|---|
| Germany | 5539 |
| France | 4242 |
| Spain | 3853 |
| Italy | 3550 |
| Poland | 2531 |
| ⋮ | ⋮ |
| Lithuania | 541 |
| Cyprus | 502 |
| Latvia | 426 |
| Estonia | 423 |
| United Kingdom | 268 |

As one would expect, largest countries on top, small countries on the bottom.
The UK is an outlier because of Brexit, as one would expect. (They left the European Parliament in January 2020)

# Analysis of activity by country

Okay, so what if we normalize for population?

# Analysis of activity by country

Okay, so what if we normalize for population?

| Country | Contributions per million people |
|---|---|
| Malta | 1181.76 |
| Luxembourg | 965.30 |
| Cyprus | 546.78 |
| Slovenia | 360.67 |
| Estonia | 317.61 |
| ⋮ | ⋮ |
| Germany | 66.54 |
| Poland | 66.54 |
| France | 65.01 |
| Italy | 60.32 |
| United Kingdom | 4.00 |

# Analysis of activity by country

Okay, so what if we normalize for population?

| Country | Contributions per million people |
|---|---|
| Malta | 1181.76 |
| Luxembourg | 965.30 |
| Cyprus | 546.78 |
| Slovenia | 360.67 |
| Estonia | 317.61 |
| ⋮ | ⋮ |
| Germany | 66.54 |
| Poland | 66.54 |
| France | 65.01 |
| Italy | 60.32 |
| United Kingdom | 4.00 |

Here we see the smaller countries dominate the scene

# Analysis of activity by country

Okay, so what if we normalize for population?

| Country | Contributions per million people |
|---|---|
| Malta | 1181.76 |
| Luxembourg | 965.30 |
| Cyprus | 546.78 |
| Slovenia | 360.67 |
| Estonia | 317.61 |
| ⋮ | ⋮ |
| Germany | 66.54 |
| Poland | 66.54 |
| France | 65.01 |
| Italy | 60.32 |
| United Kingdom | 4.00 |

Here we see the smaller countries dominate the scene
This is because EP seats are not distributed according to population

# Analysis of activity by country

Okay, so what if we normalize for population?

| Country | Contributions per million people |
|---|---|
| Malta | 1181.76 |
| Luxembourg | 965.30 |
| Cyprus | 546.78 |
| Slovenia | 360.67 |
| Estonia | 317.61 |
| ⋮ | ⋮ |
| Germany | 66.54 |
| Poland | 66.54 |
| France | 65.01 |
| Italy | 60.32 |
| United Kingdom | 4.00 |

Here we see the smaller countries dominate the scene

This is because EP seats are not distributed according to population

More seats are given to smaller countries to boost their influence in the EP

# Analysis of activity by country

So we should normalize for number of MEPs

# Analysis of activity by country

So we should normalize for number of MEPs

| Country | Contributions per MEP |
|---|---|
| Luxembourg | 103.83 |
| Malta | 102.33 |
| Slovenia | 95.00 |
| Slovakia | 92.38 |
| Cyprus | 83.67 |
| ⋮ | ⋮ |
| Poland | 49.63 |
| Lithuania | 49.18 |
| Italy | 48.63 |
| Czechia | 48.57 |
| United Kingdom | 3.67 |

# Analysis of activity by country

So we should normalize for number of MEPs

| Country | Contributions per MEP |
|---|---|
| Luxembourg | 103.83 |
| Malta | 102.33 |
| Slovenia | 95.00 |
| Slovakia | 92.38 |
| Cyprus | 83.67 |
| ⋮ | ⋮ |
| Poland | 49.63 |
| Lithuania | 49.18 |
| Italy | 48.63 |
| Czechia | 48.57 |
| United Kingdom | 3.67 |

The smaller countries do more, even in this chart

# Analysis of activity by country

So we should normalize for number of MEPs

| Country | Contributions per MEP |
|---|---|
| Luxembourg | 103.83 |
| Malta | 102.33 |
| Slovenia | 95.00 |
| Slovakia | 92.38 |
| Cyprus | 83.67 |
| ⋮ | ⋮ |
| Poland | 49.63 |
| Lithuania | 49.18 |
| Italy | 48.63 |
| Czechia | 48.57 |
| United Kingdom | 3.67 |

The smaller countries do more, even in this chart

So the **MEPs of smaller countries contribute more** on average

# Analysis of activity by EP Group

Which EP Groups were the most active?

# Analysis of activity by EP Group

Which EP Groups were the most active?

EP groups are coalitions of parties from different countries

# Analysis of activity by EP Group

Which EP Groups were the most active?
EP groups are coalitions of parties from different countries
The current EP groups are the following:

# Analysis of activity by EP Group

Which EP Groups were the most active?

EP groups are coalitions of parties from different countries

The current EP groups are the following:

| EP Group | Ideology | MEPs (pre-Brexit) |
|---|---|---|
| European People's Party (EPP) | center-right, conservative | 176 (182) |
| Socialists and Democrats (S&D) | social democrat, progressive | 144 (154) |
| Renew Europe (RE) | liberal, pro-Europe | 101 (108) |
| Greens-European Free Alliance (Greens/EFA) | green, regionalist, pro-Europe | 73 (72) |
| European Conservatives and Reformists (ECR) | conservative | 66 (62) |
| Identity and Democracy (ID) | nationalist, euroskeptic | 62 (73) |
| European United Left/Nordic Green Left (GUE-NGL) | socialist, euroskeptic | 37 (41) |
| Non-inscrits (NI) | various | 46 (57) |

# Analysis of activity by EP Group

Which EP Groups were the most active?

EP groups are coalitions of parties from different countries

The current EP groups are the following:

| EP Group | Ideology | MEPs (pre-Brexit) |
|---|---|---|
| European People's Party (EPP) | center-right, conservative | 176 (182) |
| Socialists and Democrats (S&D) | social democrat, progressive | 144 (154) |
| Renew Europe (RE) | liberal, pro-Europe | 101 (108) |
| Greens-European Free Alliance (Greens/EFA) | green, regionalist, pro-Europe | 73 (72) |
| European Conservatives and Reformists (ECR) | conservative | 66 (62) |
| Identity and Democracy (ID) | nationalist, euroskeptic | 62 (73) |
| European United Left/Nordic Green Left (GUE-NGL) | socialist, euroskeptic | 37 (41) |
| Non-inscrits (NI) | various | 46 (57) |

"Non-inscrits" is a French term for "non-aligned"

# Analysis of activity by EP Group

Which EP Groups were the most active?

# Analysis of activity by EP Group

Which EP Groups were the most active?
We gathered the following data on activity by EP Group:

# Analysis of activity by EP Group

Which EP Groups were the most active?
We gathered the following data on activity by EP Group:

| EP Group | #MEPs | Contribs/MEP |
|---|---|---|
| RE | 108 | 83.29 |
| S&D | 154 | 75.79 |
| EPP | 182 | 73.54 |
| GUE/NGL | 41 | 44.29 |
| ECR | 62 | 34.16 |
| Greens/EFA | 74 | 30.92 |
| ID | 73 | 28.63 |
| NI | 54 | 11.37 |

# Analysis of activity by EP Group

Which EP Groups were the most active?
We gathered the following data on activity by EP Group:

| EP Group | #MEPs | Contribs/MEP |
|---|---|---|
| RE | 108 | 83.29 |
| S&D | 154 | 75.79 |
| EPP | 182 | 73.54 |
| GUE/NGL | 41 | 44.29 |
| ECR | 62 | 34.16 |
| Greens/EFA | 74 | 30.92 |
| ID | 73 | 28.63 |
| NI | 54 | 11.37 |

We see that MEPs from the **left-wing and liberal parties** contribute the most amendments.

# Analysis of activity by EP Group

Which EP Groups were the most active?
We gathered the following data on activity by EP Group:

| EP Group | #MEPs | Contribs/MEP |
|---|---|---|
| RE | 108 | 83.29 |
| S&D | 154 | 75.79 |
| EPP | 182 | 73.54 |
| GUE/NGL | 41 | 44.29 |
| ECR | 62 | 34.16 |
| Greens/EFA | 74 | 30.92 |
| ID | 73 | 28.63 |
| NI | 54 | 11.37 |

We see that MEPs from the **left-wing and liberal parties** contribute the most amendments.
There is also a tendency for larger EP groups to contribute more.

# Centrality of MEPs

Which MEPs are the most central?

# Centrality of MEPs

Which MEPs are the most central?
We analyze the ‘degree centrality’ of each MEP in the social network graph

# Centrality of MEPs

Which MEPs are the most central?
We analyze the ‘degree centrality’ of each MEP in the social network graph
How many different co-contributors does each MEP have?

# Centrality of MEPs

Which MEPs are the most central?

We analyze the 'degree centrality' of each MEP in the social network graph

How many different co-contributors does each MEP have?

| MEP | EP Group | Degree centrality |
|---|---|---|
| Hilde Vautmans | RE | 183 |
| Karen Melchior | RE | 173 |
| Marc Angel | S&D | 169 |
| Olivier Chastel | RE | 167 |
| Łukasz Kohut | S&D | 166 |
| Michal Šimečka | RE | 160 |
| Michal Wiezik | EPP | 152 |
| Ramona Strugariu | RE | 151 |
| Petras Auštrevičius | RE | 151 |
| Maria Walsh | EPP | 146 |

# Centrality of MEPs

Which MEPs are the most central?
We analyze the 'degree centrality' of each MEP in the social network graph
How many different co-contributors does each MEP have?

| MEP | EP Group | Degree centrality |
|---|---|---|
| Hilde Vautmans | RE | 183 |
| Karen Melchior | RE | 173 |
| Marc Angel | S&D | 169 |
| Olivier Chastel | RE | 167 |
| Łukasz Kohut | S&D | 166 |
| Michal Šimečka | RE | 160 |
| Michal Wiezik | EPP | 152 |
| Ramona Strugariu | RE | 151 |
| Petras Auštrevičius | RE | 151 |
| Maria Walsh | EPP | 146 |

The most central MEPs come from **smaller and mid-sized countries**

# Centrality of MEPs

Which MEPs are the most central?

We analyze the ‘degree centrality’ of each MEP in the social network graph

How many different co-contributors does each MEP have?

| MEP | EP Group | Degree centrality |
|---|---|---|
| Hilde Vautmans | RE | 183 |
| Karen Melchior | RE | 173 |
| Marc Angel | S&D | 169 |
| Olivier Chastel | RE | 167 |
| Łukasz Kohut | S&D | 166 |
| Michal Šimečka | RE | 160 |
| Michal Wiezik | EPP | 152 |
| Ramona Strugariu | RE | 151 |
| Petras Auštrevičius | RE | 151 |
| Maria Walsh | EPP | 146 |

The most central MEPs come from **smaller and mid-sized countries**

They mostly come from the more left-wing EP Groups such as RE or S&D.

# Centrality of MEPs

A different approach to the centrality measure

# Centrality of MEPs

A different approach to the centrality measure

We analyze the ‘eigenvector centrality’ of each MEP in the social network graph

# Centrality of MEPs

A different approach to the centrality measure
We analyze the 'eigenvector centrality' of each MEP in the social network graph

| MEP | EP Group | Eigenvector centrality |
|---|---|---|
| Hilde Vautmans | RE | 0.1127 |
| Karen Melchior | RE | 0.1058 |
| Michal Šimečka | EPP | 0.1031 |
| Olivier Chastel | RE | 0.0998 |
| Marc Angel | S&D | 0.0947 |
| Ramona Strugariu | RE | 0.0943 |
| Sophia in 't Veld | RE | 0.0892 |
| Łukasz Kohut | S&D | 0.0884 |
| Nicolae Ștefănuță | RE | 0.0867 |
| Dragoș Pîslaru | RE | 0.0867 |

# Centrality of MEPs

A different approach to the centrality measure

We analyze the 'eigenvector centrality' of each MEP in the social network graph

| MEP | EP Group | Eigenvector centrality |
|---|---|---|
| Hilde Vautmans | RE | 0.1127 |
| Karen Melchior | RE | 0.1058 |
| Michal Šimečka | EPP | 0.1031 |
| Olivier Chastel | RE | 0.0998 |
| Marc Angel | S&D | 0.0947 |
| Ramona Strugariu | RE | 0.0943 |
| Sophia in 't Veld | RE | 0.0892 |
| Łukasz Kohut | S&D | 0.0884 |
| Nicolae Ştefănuță | RE | 0.0867 |
| Dragoș Pîslaru | RE | 0.0867 |

As we can see, we have very similar results to the degree centrality

# Centrality of MEPs

The betweenness centrality approach

# Centrality of MEPs

The betweenness centrality approach

We analyze the ‘Betweenness centrality’ of each MEP in the social network graph

# Centrality of MEPs

The betweenness centrality approach
We analyze the ‘Betweenness centrality’ of each MEP in the social network graph

| MEP | EP Group | Betweenness centrality |
|---|---|---|
| Fabio Massimo Castaldo | NI | 0.0131 |
| Maria Grapini | S&D | 0.0128 |
| Petras Auštrevičius | RE | 0.0128 |
| Charlie Weimers | ECR | 0.0123 |
| Annalisa Tardino | ID | 0.0117 |
| Maria da Graça Carvalho | EPP | 0.0116 |
| Sophia in ’t Veld | RE | 0.0109 |
| Maria Noichl | S&D | 0.0109 |
| Luisa Regimenti | ID | 0.0107 |
| Sirpa Pietikäinen | EPP | 0.0100 |

# Centrality of MEPs

The betweenness centrality approach
We analyze the ‘Betweenness centrality’ of each MEP in the social network graph

| MEP | EP Group | Betweenness centrality |
|---|---|---|
| Fabio Massimo Castaldo | NI | 0.0131 |
| Maria Grapini | S&D | 0.0128 |
| Petras Auštrevičius | RE | 0.0128 |
| Charlie Weimers | ECR | 0.0123 |
| Annalisa Tardino | ID | 0.0117 |
| Maria da Graça Carvalho | EPP | 0.0116 |
| Sophia in 't Veld | RE | 0.0109 |
| Maria Noichl | S&D | 0.0109 |
| Luisa Regimenti | ID | 0.0107 |
| Sirpa Pietikäinen | EPP | 0.0100 |

These MEPs are different compared the eigenvector centrality list which was *mostly* the repetition of the Degree centrality list.

# Behavior of central nodes

Betwenness centrality
2020 as basis:

Betweeness_2020asBasis.png

# Behavior of central nodes

Betwenness centrality 2020 as basis:

Betweeness_2020asBasis.png

Eigenvector centrality 2021 as basis:

Eigenvector_2021asBasis.png

# Projection

Some visualizations of the MEP social network graph (there were also some 0 degree nodes):

# Projection

Some visualizations of the MEP social network graph (there were also some 0 degree nodes):

plain_picture.png

# Projection

Some visualizations of the MEP social network graph (there were also some 0 degree nodes):

plain_picture.png

The Smaller interval ones look similar, however they aren't necessarily connected like this one

# Projection

Color coding the nodes (according to EP groups):

# Projection

Color coding the nodes (according to EP groups):

PM_group_Colors.png

# What's next?

We require additional data for multiple reasons:

- Cutting at more relevant dates, for finer distiction.

  Further consideration might be fruitful, namely, the further useage of weighted projection. (Some machine learning opportunity)

**Thank you for your attention!**