

Analyzing social networks in the European Parliament, and changes in the social network over time

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Abstract—We analyze a dataset of amendment co-sponsorship in the European Parliament. From this dataset, we construct a graph representing the co-sponsorship social network of the European Parliament, and we analyze its changes over time, paying special attention to the effects of major events, such as Brexit, COVID-19 and the Russo-Ukrainian war. We also analyze the breakdown of the social network by country and by political group.

Index Terms—Social networks, political groups, European Parliament, graph projections.

I. INTRODUCTION

The European Parliament (EP for short) is a legislative institution of the European Union, in which representatives from each of the 28 (27 after Brexit) member states vote on legislation concerning the European Union. The Parliament consists of *Members of the European Parliament* (MEPs), each of whom have a well-defined country of origin and political party. The political parties of each MEP are specific to their country of origin, but parties holding similar views organize themselves into *political groups*, which act as super-parties in the context of the European Parliament.

The major political groups in the EP are the European People's Party (EPP, centre-right), the Progressive Alliance of Socialists and Democrats (S&D, left), Renew Europe (RE, liberal), the Greens–European Free Alliance (Greens/EFA, green), European Conservatives and Reformists (ECR, right), Identity and Democracy (ID, far-right) and The Left in the European Parliament (GUE/NGL, left). Representatives who do not belong to any of these groups are usually called Non-iscripts (French for ‘not registered’), often abbreviated as NI.

Our aim is to analyze the social networks of the European Parliament, and the temporal changes incited by major global events, such as the global COVID-19 pandemic, and the Russo-Ukrainian war.

Some analysis of social networks in the European Union has already been done in [1] and [2]. Work that is analogous to ours in the context of the United States Congress and Senate has also been seen before in [4], [6], [10] and [11]; while in [5], Fischer et al. conducted an analysis of such co-sponsorship networks in the Swiss parliament.

The present paper is organized as follows. In Section II, we discuss our dataset, and how we prepared our data for analysis. We also briefly mention the limitations of the dataset. In Section III, we analyze the dataset in its entirety, without regard for the changes over time. We do this to familiarize

the reader with the dataset, and to thus allow a deeper understanding of the European Parliament, before conducting the main part of our analysis, in Section IV. In Section IV, we dissect our dataset into a series of discrete time intervals, and we will analyze the evolution of the dataset over time. We will take special measures to make sure that the effects of certain major events are pronounced in our analysis. We do this by partitioning our data into meaningful intervals, and conducting our analysis by analyzing how the social network changed between these intervals. Finally, in Section V we conclude our analysis by giving a few final remarks, and in Section VI, we discuss future research plans, and other possible research topics related to this one.

II. OUR DATA

Our dataset was acquired directly from the European Parliament's website. It is organized as a `csv` file which contains entries for each proposed amendment to a law, with information about when the amendment was proposed, some details about the amendment, and more importantly, information about who proposed the amendment, what party they belong to, which EP group said party belongs to, and which country are they are representative of.

This data can therefore be viewed as a bipartite graph, in which one part consists of the MEPs, and the other consists of the proposed amendments. An MEP and an amendment are joined by an edge if and only if said MEP contributed to the amendment (*sponsored* the amendment). Importantly, a single amendment may have multiple contributors, which allows us to analyze the social structure of the European Parliament as a whole.

In total, our dataset contains 750,578 entries, which is the total number of edges in this bipartite graph. The dataset has data on a grand total of 754 MEPs.

To analyze the social structure, we *projected* this bipartite graph onto the set of MEPs. This procedure creates a new graph, wherein the nodes represent MEPs, and each edge connects two MEPs which have a contribution in common. (I.e. they *co-sponsored* a bill.)

With this projection, a new, not necessarily bipartite graph was created, which represents the state of the social network of the European Parliament. Notably, the number of contributions in common are not considered. An edge between two MEPs in this graph might represent a single amendment they co-sponsored, or it might represent a long-lasting relationship

of co-sponsorship. The projection unfortunately obscures the details of the strength of the co-sponsorship based connection.

To account for this, we also worked with a different type of projection, a *weighted projection*. This modification of the projection algorithm serves to solve the problem outlined above. With a weighted projection, as previously, we create a new graph, whose nodes represent the MEPs, and connect to MEPs if they have co-sponsored a bill together. However, we also account for the number of co-contributions, which become the weight of each edge.

III. PRELIMINARY ANALYSIS

In this section, we talk about the conclusions we can draw from the data while analyzing it in its entirety. This phase of our analysis allowed us to get a sense of what the data looks like from a bird's eye view.

A. Analysis of activity by country

We conducted an analysis of how many amendments were produced in each country. The data we acquired can be seen in Figure 1. Besides the contributions visible in the table, our data also included 175 data points, which did not have an MEP attached. For the remainder of this analysis, we will discard these data points.

We direct the reader's attention to the fact that representatives of the United Kingdom were the least active in this period. This is unsurprising, since these representatives left the European Parliament early, in February 2020.

Of course, this data is heavily influenced by the uneven population distribution within the Union. We can see that the most populous countries are among the most active as well.

In order to account for these differences, we normalized the data for population. For population data, we used the latest population data from [3]. Of course, there is an inherent inaccuracy in this, because the population of each country fluctuated during the time period we analyzed, but we believe that these errors are negligible.

In the normalized data, we see a near-perfect reversal of the previous chart. Having normalized for population, smaller countries seem more productive.

This is also unsurprising, however, in view of the fact that smaller countries get disproportionately more representatives per capita. While each member state of the Union gets a certain number of representatives based on its population, the process through which representatives are chosen is not that clear cut. A set of rules are in place to ensure that smaller countries get fairer representation, letting smaller countries have more MEPs for each unit of population. Because of this, Figure 2 is skewed towards smaller states.

To account for this, we have created another normalized chart, which normalizes the data for the number of representatives each country has. On Figure 3 we can see this data compiled into a table.

This data still skews heavily towards smaller countries having more active representatives, and larger countries having lazier ones. Notably, the top two countries on this table, Luxembourg and Malta, are also the two least populous.

Country	Contributions
 Germany	5539
 France	4242
 Spain	3853
 Italy	3550
 Poland	2531
 Romania	2497
 Netherlands	1941
 Sweden	1613
 Belgium	1411
 Portugal	1406
 Austria	1272
 Bulgaria	1260
 Slovakia	1201
 Hungary	1135
 Greece	1092
 Czechia	1020
 Denmark	955
 Finland	859
 Ireland	806
 Slovenia	760
 Croatia	636
 Luxembourg	623
 Malta	614
 Lithuania	541
 Cyprus	502
 Latvia	426
 Estonia	423
 United Kingdom	268

Fig. 1. Amendments by country

B. Analysis of activity by political group

Let us now turn to analyzing the political groups of the European Parliament. The political groups are overarching organizations that parties from any country can join, allowing them to have a unified voice in the European Parliament. In this subsection, we will take a look at how active each political group is. We investigate how many contributions were made by each political group, in total and by number of representatives per political group.

On Figures 4 and 5 we tabulated our data on each political group. On Figure 4, we see the number of contributions each EP group made to the proceedings of the European Parliament, while on Figure 5, we see this data normalized based on the number of MEPs belonging to each EP group.

What we can see from the normalized data is that in terms of contributions, the left-wing and liberal parties RE and S&D do the most in the European Parliament, and similarly, among the smaller parties, we see left-wing GUE/NGL punching above its weight.

At the same time, we see the far-right party ID not contributing nearly as much to amendments in the European Parliament. We believe that this has to do with ID's continued euroskeptic ideology. The other EP group that is trailing the chart, the NI, also includes many euroskeptics. A significant portion of right-wing nationalist parties are contained in this group.

Country	Contributions per million people
Malta	1181.76
Luxembourg	965.30
Cyprus	546.78
Slovenia	360.67
Estonia	317.61
Latvia	225.01
Slovakia	221.23
Bulgaria	193.26
Lithuania	192.47
Croatia	164.26
Denmark	160.97
Ireland	156.53
Finland	154.39
Sweden	153.30
Austria	139.69
Portugal	135.94
Romania	131.05
Belgium	121.81
Hungary	116.14
Netherlands	110.34
Greece	104.67
Czechia	96.92
Spain	81.29
Germany	66.54
Poland	66.54
France	65.01
Italy	60.32
United Kingdom	4.00

Fig. 2. Amendments by country normalized for population

As such, we may conclude that according to our data, left-wing political groups do more work in the European Parliament.

C. The MEPs with the highest degree

As we have turned our data into a graph of the social structure of the European Parliament, with nodes for each MEP, it makes sense to find out which MEPs have the highest degree in this graph. In other words, we want to find out which MEP co-sponsored the most bills.

On Figure 6 we can see the top 10 MEPs by degree in this social network graph. We can observe that only members of S&D and RE can be found in the top ten. Seemingly, only the members of these two liberal, left-wing political groups go above and beyond in terms of productivity in the European Parliament. This is consistent with the findings of Subsection III-B, where we concluded that on average, left-wing parties contribute to more amendments. This additional data suggest that not only do they contribute more on average, they also house the most productive members of the European Parliament.

Notably, four of the ten most active MEPs are from Romania. Romania and Portugal seem overrepresented among the most productive MEPs, along with other mid-sized and smaller countries. It is to be noted that in the top ten, none of

Country	# MEPs	Contributions per MEP
Luxembourg	6	103.83
Malta	6	102.33
Slovenia	8	95.00
Slovakia	13	92.38
Cyprus	6	83.67
Sweden	20	80.65
Romania	32	78.03
Netherlands	26	74.65
Bulgaria	17	74.12
Denmark	13	73.46
Ireland	11	73.27
Austria	18	70.67
Estonia	6	70.50
Belgium	21	67.19
Portugal	21	66.95
Spain	58	66.43
Finland	13	66.08
Croatia	11	57.82
Germany	96	57.70
France	74	57.34
Hungary	21	54.05
Latvia	8	53.25
Greece	21	52.00
Poland	51	49.63
Lithuania	11	49.18
Italy	73	48.63
Czechia	21	48.57
United Kingdom	73	3.67

Fig. 3. Amendments by country normalized for number of MEPs (pre-Brexit)

EP Group	Contributions
EPP	13384
S&D	11672
RE	8995
Greens/EFA	2288
ECR	2118
ID	2090
GUE/NGL	1816
NI	614

Fig. 4. Contributions to the European Parliament by political group

the top three most populous countries, Germany, France and Italy, appear; despite the large number of representatives they send to the European Union. We can compare this to the data in Subsection III-A, where we can see that in general, MEPs from more populous countries contribute less to the European Parliament.

D. Degree centrality in the social network

We have thus found the MEPs with the highest degree in the original, bipartite graph. Let us now find the MEPs with the highest degree in the projected social network graph. The difference from the previous subsection is that we are only

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

Fig. 5. Contributions to the European Parliament by political group, normalized by number of MEPs










Name	Pol. group	Degree
 Olivier Chastel	RE	5155
 Lina Gálvez Muñoz	S&D	4483
 Marc Angel	S&D	4350
 Maria-Manuel Leitão-Marques	S&D	4245
 Maria Grapini	S&D	4200
 Nicolae Ștefănuță	RE	3914
 Milan Brglez	S&D	3650
 Ramona Strugariu	RE	3544
 Manuel Pizarro	S&D	3533
 Dragoș Pîslaru	RE	3491

Fig. 6. Top 10 MEPs by degree in the MEP to amendment bipartite graph

considering how many co-sponsorship partners a certain MEP has, disregarding the amount of bill they co-sponsored.







Name	Pol. group	Degree
 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

Fig. 7. Top 10 MEPs by degree in the social network

On Figure 7, we can see the top 10 MEPs by degree centrality, i.e. by highest degree in the social network. We can see that some MEPs from the previous table also made the top 10 in this different measure, although there are also new faces.

We still see the dominance to the EP groups RE and S&D, although in this chart, a lone member of EPP can also be found. Once again, we mostly see people from minor and mid-sized countries. The largest countries, such Italy, France and Germany have not produced any well-connected MEPs by this measure either. We see countries like Belgium, Romania and Slovakia overrepresented.

IV. CHANGES TO THE SOCIAL NETWORK OVER TIME

In this section, we talk about how we divided the data based on time.

We divided our data based on time. Our goal was to make it possible to analyze the changes in the social environment based on time. We used major events that shaped European politics as breakpoints, because we expected that the social network might change drastically as a result of these events. The most important events we considered were the United Kingdom leaving the European Union (Brexit), on February 1st, 2019, and the start of the Russian invasion of Ukraine on February 24th, 2022. These events have undoubtedly shaped public opinion, and our research is centered around finding out whether they also influenced the social structure of the European Parliament.

Our dataset contained data from July 24th, 2019 to September 5th, 2022, and we divided this time interval into 12 parts. Our goal was to divide the time interval based on important events that happened during this time, in order to facilitate the study of how these events influenced the political network. For example, a major event in this time period was Brexit, since after Brexit, delegates from the United Kingdom left the European Parliament. We therefore divided our time interval in such a way that the date of Brexit is the endpoint of one of the parts. We did a similar thing for two more events in the specified time period. An important date we considered was the controversial Hungarian right-wing party Fidesz leaving the EPP political group inside the European Parliament, as we expected that this changed the dynamics between political groups. The last major event we considered was of course the start of the Russian invasion of Ukraine. Since our data ends in September 2022, we are unfortunately not able to analyze the effects of later phases of the war, notably the 2022 Kharkiv counteroffensive. In the future, we plan to continue our research to investigate whether the change in the dynamics of the war was able to further influence political networks in the European Parliament.

Beginning	End	Length (days)	# Data points
2019-07-24	2019-10-31	99	6291
2019-11-01	2020-01-31	91	18590
2020-02-01	2020-05-20	109	52589
2020-05-21	2020-08-31	102	71793
2020-09-01	2020-11-30	90	85737
2020-12-01	2021-03-03	92	70345
2021-03-04	2021-05-31	88	64459
2021-06-01	2021-08-31	91	75077
2021-09-01	2021-11-30	90	51429
2021-12-01	2022-02-23	84	105180
2022-02-24	2022-05-31	96	86629
2022-06-01	2022-09-05	96	62853

Fig. 8. Division of our data based on time

A. Consistent contributors

A natural question that might arise when researching this topic, is how many MEPs even managed to work throughout the entire 3-year period covered by our data. That is, how many MEPs contributed to at least *some* amendments across every interval. We found that 195 MEPs of the 705 contributed to an amendment at least once in every time period. This constitutes 27.7% of MEPs.

We then broke this data down by country and by political group. We found that all 27 member states (except for the UK) and all 8 political groups were present in the breakdown, although not evenly. Among countries, we found Italy to have the most MEPs that contributed in every interval, 27, while Germany, despite being the country with the most representatives in the European Parliament by far, only had 16 such contributors. The full data can be found in Figure 9.

Among political groups, we found that the general result of Section III, that is, left-wing parties contributing more, still appears to be true. We found that the two parties with the highest number of consistent contributors were RE with 55, and S&D with 42, both overtaking the largest political group, EPP, which only had 34 consistently productive MEPs. The full data broken down by political group can be found in Figure 10.




























Country	Consistent MEPs
 Italy	29
 France	25
 Spain	20
 Germany	16
 Netherlands	11
 Romania	10
 Czechia	8
 Poland	8
 Greece	7
 Slovakia	7
 Sweden	7
 Belgium	6
 Bulgaria	5
 Portugal	5
 Ireland	4
 Lithuania	4
 Austria	3
 Finland	3
 Luxemburg	3
 Malta	3
 Slovenia	3
 Estonia	2
 Hungary	2
 Croatia	1
 Cyprus	1
 Denmark	1
 Latvia	1

Fig. 9. Consistent contributors by country

EP Group	Contributions
RE	55
S&D	42
EPP	34
ECR	20
ID	19
GUE/NGL	13
Greens/EFA	8
NI	4

Fig. 10. Consistent contributors by EP group

V. CONCLUSION

In conclusion, we can say that the social networks of the European Parliament are an ever-changing structure. Some changes to it happen seemingly spontaneously, while some of them happen as a result of important events. The events that can have a noticeable effect on this social structure can be internal (such as Fidesz leaving the EPP group), or external, such as COVID-19, or the Russo-Ukrainian war.

VI. FUTURE RESERACH

In the future, we plan to expand our current work by collecting newer data, and analyzing the development of the European Parliament social network in the current day. We are especially interested in how the social network changes with respect to the major events of the Russo-Ukrainian war. Unfortunately, due to the limitations of the data, we were only able to study the effects of the start of the war, as we only had data up to September 2022. Since many major events in the Russo-Ukrainian war happened since September 2022, we are more than interested in studying their effects on the European Union, specifically the European Parliament.

Furthermore, we plan to apply even more mathematical methods to the dataset.

ACKNOWLEDGMENTS

Thanks so much to everyone involved in creating this wonderful masterpiece of a paper.

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