Voting patterns in the Swiss National Council

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Abstract—**Political polarization and voting patterns have received an increased attention of the public in the last decade. With upcoming elections in the parliament, the subject receives a great deal of interest in Switzerland as well. In this analysis, voting data of the Swiss National Council was used to construct and analyze a network based on the similarity of votes. Our research indicates, that contrary to public perception, political polarization is not on the rise in the Swiss National Council. While some parliamentary groups sporadically show phases with an increased party isolation, this is not a general trend that can be observed for the whole parliament.**

I. Introduction

The increased polarization of national parliaments in western democratic states have caused great concern among political scientists and journalists. The United States House of Representatives and Senate are increasing perceived as a "worst case scenario" for a two-party parliamentary democracy, where bipartisan agreements become the exception rather than the normal course of law-making. Few scholars however are aware of the fact that the modern Swiss constitution of 1848 was strongly influenced by the American constitution of 1787 and has similar democratic institutions such as the National Council (corresponding the US House of Representatives) and the Council of States (such as the US Senate) [1]. While much research has investigated the degree and historical development of polarization in the political institutions of the United States, only little research has focused on Switzerland.

This study aims at evaluating the polarization and voting patterns of Swiss politics by using data science algorithms. For the analysis, publicly available datasets containing all the votes held in the national council dating back to the start of the 48th legislature in 2007 were used. The voting results of the other parliamentary chamber, the Council of States members, are still not recorded electronically and could therefore not be included in this analysis.

The data of the national council was transformed into a network by assigning each member of the national council to a node and giving them edges with weights that depend on the voting similarity of the two councillors that are linked. Several data science algorithms were used on this resulting weighted adjacency matrix. Laplacian eigenmaps were computed and used to visualize and compare the relative position of the nodes. Inspired by previous work on the US Senate [2], the polarization of the National Council was assessed quantitatively by modularity. Moreover, different centrality measures were computed for evaluating which politicans were playing a key role in avoiding polarization.

II. Methods

A. Datasets

The dataset consists of the voting results for all 200 members of the Swiss National Council for the years 2008-2018. This time period covers almost three full parliamentary legislatures (each with a duration of 4 years) : the 48th (2007-2011), 49th (2011-2015) and 50th (2015-2019) legislature. The items are sorted by date and affair that was up for vote. For each affair, the vote of each councillor is labeled with one of the following: *Yes*, *No*, *Abstain*, *Excused*, *Not participated*. In order to label nodes with their respective political party, a data set containing the names and the parties of every councillor since 1848 was used.

B. Network construction

The first step in creating a voting similarity network consisted of assigning numerical values to each vote. Every vote was assigned to a number. A *Yes* was replaced by 1, *No* by 0, *Abstain* as well as *Excused* and *Not participated* by 0.5. Hence, all councillors are described by a vector of features $\in 0, 0.5, 1$ every councillor had a vector of votes. An issues arises here due to councillors resigning during a legislature and not the elections. This is a common strategy employed by virtually all parties in the National Council to avoid losing the seat to another party. In that case, the freed-up seat is not put up for election. Instead, the previous party has the right to suggest a successor from within its ranks. Councillors who gave up their seat during a legislature and their successor hold *NA* values for votes during which they were not a member anymore. Nodes with more than ten such *NA* values were removed from the data. Subsequently, the remaining votes that contained *NA* values were also removed.

The distance d_{ij} between each councillor is calculated using the cosine distance, since it is better suited for high-dimensional data than for example the L_2 norm. Finally, edge weights were computed using a heat kernel

$$W_{ij} = e^{-\frac{d_{ij}^2}{2\sigma^2}} \tag{1}$$

where σ^2 is the variance of d.

For the signal, a party map was created to assign a number to each party for example -6 being PSS and 6 UDC.
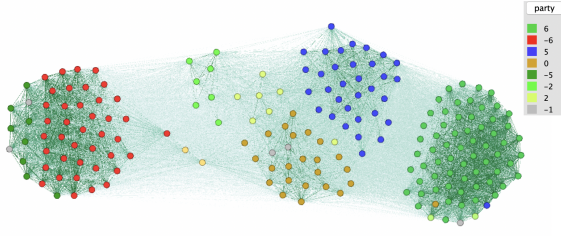
Fig. 1: Gephi *Force Atlas* layout with party as signal for the 50th legislature.

A first graphical representation of our network (Figure 1) was produced in Gephi with a Force Atlas layout [3]. This graphic clearly shows that our adjacency matrix is representative as the clusters match with the signals. Moreover the parties are arranged as they would be on a political spectrum.

C. Spectral analysis of party positioning

The eigen-decomposition of the graph normalized Laplacian was computed to reveal partitions of our network and create and create an alternative visualization with Laplacian eigenmaps. In order to analyze the relative positions of the parties in between each other over time, the components of the Fiedler vector which partitions the network in a left-to-right spectrum [4] was plotted for each parliamentary year and its evolution observed. It is important to note that the positions of parties on such vectors do not represent an absolute value but rather their positions relative to the other parties.
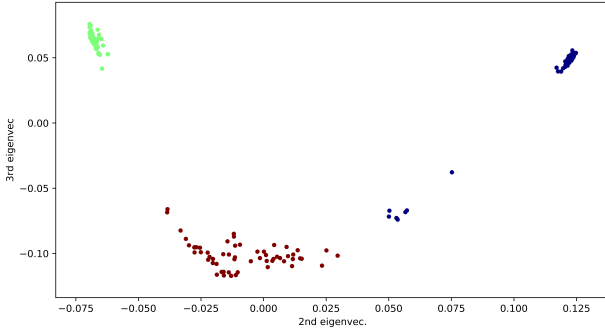

Fig. 3: Laplacian eigenmap with partitions detected with the Louvain method at a resolution of 1

D. Measuring polarization with modularity

For the US Senate and Congress, a modularity analysis of the voting network has proved to be a good measure for polarization. The modularity of a networks gives an indication of its division into isolated communities. The higher the modularity, the more segregated and dense the communities tend to be. As the political system in the US essentially is a two-party system, the measure of modularity reduces to a measure of bipartisan collaboration between the Democratic and Republican Party [2]. Switzerland has a considerably more diverse party system with 7 different parliamentary groups in the current legislative period. This makes modularity rather an

indicator of inter-party collaboration over all parties than of a two-dimensional division into a left and right wing.

The modularity of partition of the network is given by

$$Q = \frac{1}{2m}\Sigma_{i,j}[A_{i,j} - \frac{k_i k_j}{2m}\delta(c_i, c_j)] \qquad (2)$$

where k_i is the weighted degree of node i, c_i is the community that it is assigned to and m is the sum of all edge weights in the network. Partitions can be revealed by maximizing Q for a particular community resolution. High-modularity partitions were detected in our network using the Louvain algorithm [5]. A Python implementation of this algorithm is publicly available on Github [6].

E. Centrists and dealmakers

Many political parties call themselves "centrist", meaning that they do not take part in the political radicalization of the left and the right. In Switzerland, the Green-Liberal Party (pvl), the Christian Democratic People's Party (PDC) as well as the Conservative Democratic Party (PBD) claim to be centrist parties. But is this really true? Do self-declared centrist politicians resist the appeal of radical and clear positions? In order to measure the degree to which politicans belong to the political center, the closeness centrality [7] was used. This value is the inverse of the sum of all shortest paths from the node in question to the remaining nodes of the network. A good centrist politician would therefore have a high closeness centrality value, indicating that the shortest path from this person to the left and the right is equally short.

In order to reduce political polarization, it is not sufficient to have many politicans with a centrist ideology. Additionally, it is crucial that these politicians build bridges between the political poles and help forming nonpartisan agreements. The betweenness centrality [8] is a measure that quantifies the number of times a node is serving as a bridge along the shortest path between two other nodes. In other words, one could expect that politicians with a high betweenness centralities are crucial elements in the formation of nonpartisan political alliances and therefore especially relevant for avoiding polarization.

The algorithms for closeness and betweenness centrality that are included in the NetworkX package were used in this analysis. Even though the original networks were fully connected, it is arguably reasonable to assume that there is no connection between the two extreme wings, in particular when computing the two mentioned centrality metrics. Thus, all edges with a weight below 0.4 were removed for these two calculations, effectively negating any direct path between right and left wing.

F. Party isolation and loyalty of members

While network modularity gives an overall indication on inter-party collaboration, it does not describe which parties are more likely to collaborate with others. Simultaneously, the same would be of interest for single nodes. More specifically, the ratio of the edge weight sum inside the party over the sum of edge weights linking to nodes in other parties could
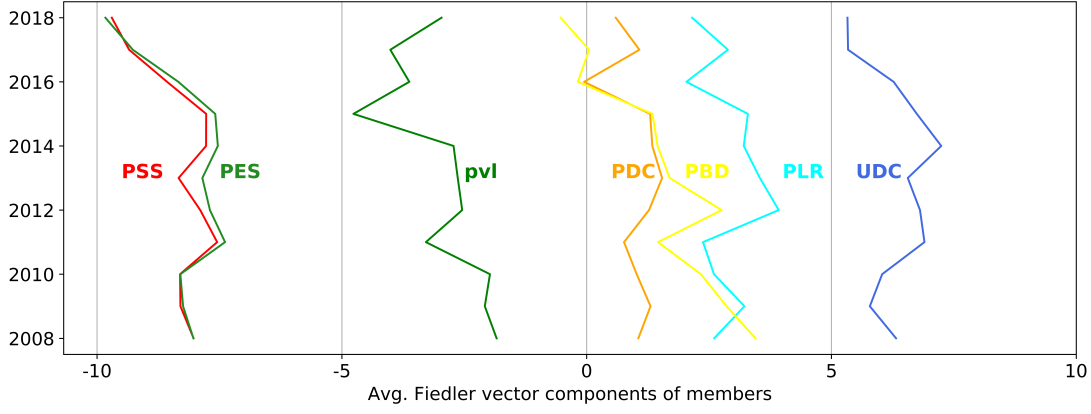
Fig. 2: Spectral analysis of party positioning over time

hint at how loyal a councillor is to his party or, respectively, how isolated a party is. Hence, for a party c_k, the following quantity was computed for that purpose:

$$I = \frac{\frac{1}{|c_k|}\Sigma_{i,j\subset c_k}W_{ij}}{\frac{1}{n_{nodes}-|c_k|}\Sigma_{i\subset c_k,j\not\subset c_k}W_{ij}} \qquad (3)$$

When considering a single node i this quantity will be denoted node loyalty. Summing up over all nodes in a party results in a measure that describes how isolated this party is from the rest.

III. RESULTS

A. Spectral analysis of party positioning

The eigengap heuristics [9] indicate that the network has three main clusters. As can be seen in Figure 3, there are indeed three distinct clusters recognizable, corresponding to parties that are traditionally seen as left wing, centrist, and right wing. The average coordinate of the Fiedler vector per party is shown in Figure 2. For the visualization of the Fiedler vector it is important to keep in mind that the represented values can only be interpreted as relative and not absolute values for the political positioning of the different parties.

In an overall assessment, the Green Party (PES) and the Socialist Party (PSS) seem to be the two parties with the least differences in positioning. Together, these two parties form the left-wing pole of the parliament. On the other side of the political spectrum, the Swiss People's Party (UDC) forms alone the right-wing pole. However, in relative terms, the distance between the left- and right-wing pole doesn't seem to have increased over the last years. This is a strong argument that stands in contradiction to the thesis of an increasing polarization of the political poles in the Swiss National Council.

When going more into details, the spectral analysis shows up one specific party that seems to have changed its relative positioning substantially during the last 10 years: the Conservative Democratic Party of Switzerland (PBD). Founded only in 2008 as a split-off Swiss People's Party (UDC), the party continuously moved further and further away from the positioning of its right-wing parent party. Also the Green-liberal party (pvl), founded as a split-off of the Green Party

(PES) in 2007, increased relative distance to its mother party for the period after 2015.

Finally, it can be observed that the PDC and PLR have slightly moved away from the left-wing pole closer towards the right-wing pole.

B. Analysis of polarization with modularity

During the considered timespan between 2008 and 2018, the yearly value of modularity stayed in a range between 0.35 and 0.4 which is remarkably stable (Figure 5). Consequently, the overall inter-collaboration between the parties has remained stable during the last 10 years. This could be evidence for political stability and would be a good testimony for the Swiss National Council.
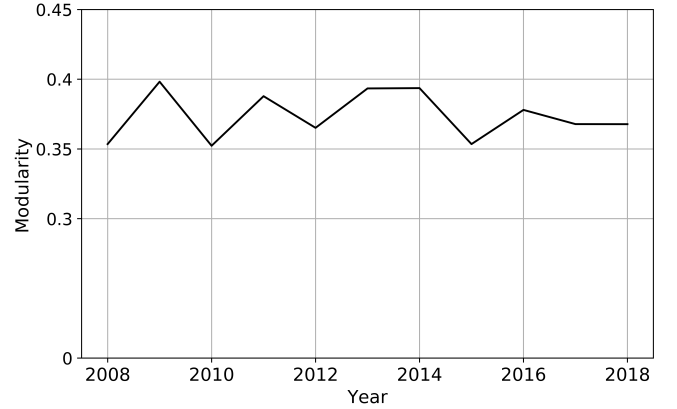

Fig. 5: Modularity over time, calculated with a resolution of 1.0

C. Centrists and dealmakers

As discussed before, the Green-Liberal Party (pvl), the Christian Democratic People's Party (PDC) as well as the Conservative Democratic Party (PBD) describe themselves as centrist parties. In order to verfiy these claims, the three members of the National Council with the highest closeness centrality for 50th legislature were listed below. Interestingly the Green-liberal party (pvl) does not appears in the top 10. On
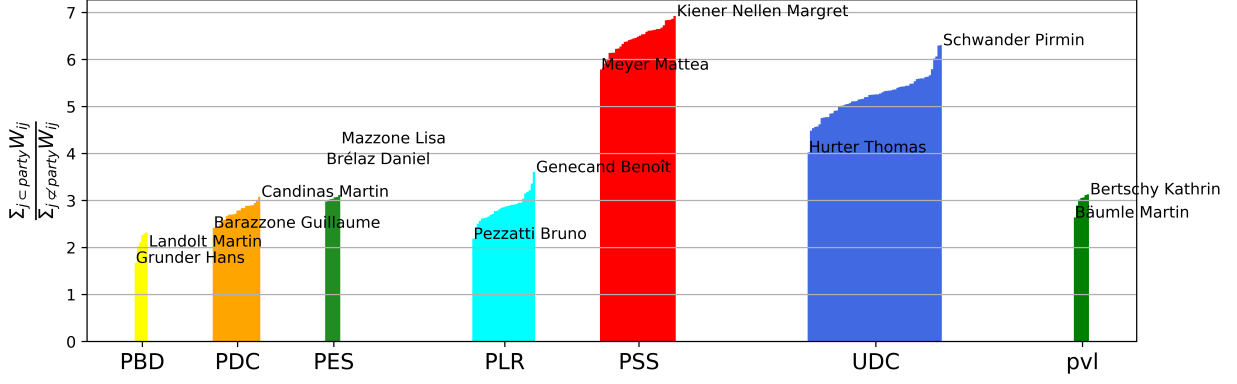
Fig. 4: Distribution of loyalty of nodes with respect to their party label

the other hand the liberal party (PLR) is strongly represented here, although they market themselves as being clearly at the right of the centre.

Name	Political Party	Closeness centrality
Pezzatti Bruno	PLR	0.644444
Müller Walter	PLR	0.639706
Burkart Thierry	PDC	0.625899
Bourgeois Jacques	PLR	0.617021
Regazzi Fabio	PDC	0.617021
Béglé Claude	PDC	0.614841
Landolt Martin	PBD	0.614841
Hess Lorenz	PBD	0.614841
Vogler Karl	csp-ow	0.614841
Riklin Kathy	PDC	0.614841

TABLE I: Politicians with highest closeness centrality in the 50th legislature

The analysis of the parliament members with the highest betweenness centrality reveals the potential of Green-liberal party (pvl) of being an important dealmaker alongside the liberals (PLR). One member of the Evangelical People's Party (PEV) is also present in the top 10 of parliament members with the highest betweenness centrality.

Name	Political Party	Betweenness centrality
Bäumle Martin	pvl	0.111102
Pezzatti Bruno	PLR	0.088842
Müller Walter	PLR	0.082346
Streiff-Feller Marianne	PEV	0.077262
Burkart Thierry	PLR	0.067171
Gössi Petra	PLR	0.060484
Vitali Albert	PLR	0.045592
Grossen Jürg	pvl	0.037017
Moser Tiana Angelina	pvl	0.034174
Flach Beat	pvl	0.029482

TABLE II: Politicians with highest betweenness centrality in the 50th legislature

D. Party isolation and node loyalty

As expected, the two pole parties on the left (PSS) and on the right (UDC) are the most isolated political parties, well above all remaining parties. However, this interpretation should be made with caution. Even if the nodes weights have been normalized by the party size, a residual bias remains: As the socialist party is very large compared to his allies. For

example the Green Party (PES) is considerably smaller in size and thus offers few linkage possibilities. Conversely for the smaller Green party, many potentially linkages to their allied Socialist Party remain. This leads to a bias that the Socialist party might seem more isolated than the Green party, even if they share large parts of their political program and tend to vote very similarly.
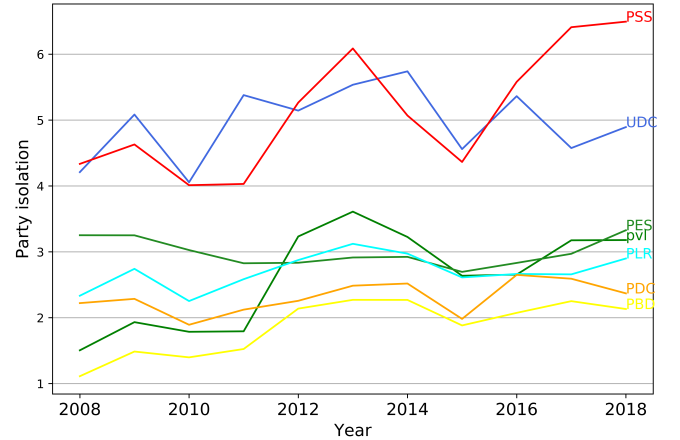

Fig. 6: Party isolation over time

It is however interesting to note, that that the value of isolation almost consistently increased for all parties in the year after the general elections (2011 and 2015) with respect to the foregoing year. In the first three of legislature before election year, the values of party isolation remain stable or tend to decrease. The big two exceptions to this tendency are the Green party (PES) and Socialist party in the two two following years after general elections in 2012 and the Socialist Party (PSS) after general elections in 2018. During these time periods both, the value of party isolation of both parties increased against the general tendency of a stabilization or decrease in party isolation. This could be due to a loss of political influence which has forced these parties into a role of opposition where they might have decided to sharpen their political profile with more clear and radical political positions. This might be especially true for the Socialist party after the 2015 election, where a center-right majority replaced the

former center-left majority and thereby de-facto deprived the Socialists of decisive legislative power in the National Council.

The more detailed focus on the node loyalty for each parliament member, as can bee seen in Fig. 3., reveals again that two pole parties, the left-wing Socialist Party (PSS) and right-wing People's Party (UDC), have very high levels of loyalty to the party. However, when taking a closer look at the loyalty within the party, considerable difference can be observed. For each party, the name of the most and least loyal party member has been visualized.

IV. Conclusion

This work investigated voting patterns in the Swiss National Council in the years between 2008 and 2018. The eigen-decomposition of the graph normalized Laplacian revealed that the relative difference between the left- and right-wing poles has not increased significantly during this period. We see this a potential indication that the polarization of radical poles has not increased in the National Council. While the major pole parties remain stable in their political positioning , smaller and younger parties such as the Conservative Democratic Party (PBD) and the Green-liberal-party (pvl) were observed to have undergone a change in their positioning with respect to their former parent parties. The yearly values for modularity where remarkably stable and situated in a small range between 0.35 and 0.4. We interpret this small range with no general tendency sign for a stable inter-party collaboration and a hint for stable level of political polarization. The study of the closeness centrality revealed the Liberal Party (PLR) and the Christian Democratic People Party (PDC) as the main parties of the political center, while betweenness centrality indicate that the Liberal Party as well as the Green-liberal Party (pvl) might be in a good position to be the main dealmaker parties in the Swiss National Council. Finally, the party isolation was assessed by comparing edge-weights inside the own party with the edge-weights outside. The highest values of party isolation were observed in the year following the general elections and then tended to decrease following years of the legislature.

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