Political Social Networks Reveal Strong Party Loyalty in Brazil and Weak Regionalism

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Abstract

Politics fascinate people—we all live in places with political structures governing many aspects of our daily lives. In several countries, people identify themselves not only with their country but they tend to demonstrate some "regionalism" in their attitude. We have seen examples of regionalism in different parts of the world (e.g. Kurdistan in Iraq, Catalonia in Spain, Crimea in Ukraine, to name but a few). Politicians at the lower house are elected to represent one particular region in the national congress and the population in those regions expect the politicians to work for the benefit of the region. In this paper we collected data from 6 different legislatures in Brazil and investigated its structure. One very surprising finding in this study is that politicians appear to put party interest over the interest of the region they represent—we found almost no evidence of regionalism but strong party loyalty. We also found two main legislators characteristics in the Brazilian Chamber of Deputies: (*i*) the party borders are not as clear as in bipartisan systems, a feature that leads to collaborations across party lines, and (*ii*) the opposition in the last legislatures appears to be diminishing its size and weakening its structure.

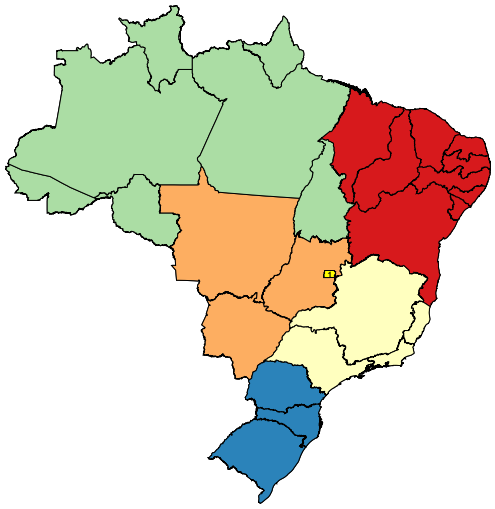


Figure 1: Brazil is divided into 26 states plus the Dederal District (number 1 in the map) and is also organized into 5 geographical regions: north, northeast, center-west, southeast, and south (different colors on the map).

1 Introduction

Brazil is a federative republic divided into 26 states plus the Federal District (Brazil's capital) forming 5 major regions (see Figure 1). Being the 5th largest country in the world by population and area with approximately 200 million people (2013 estimate) and 8.5 million km^2 respectively, it is not surprising to find that the country has challenges, resources, and desires that differ significantly from place to place.

Brazil is not unique when it comes to divisions. Take for instance the USA, a country with 317 million people (2013 estimate) and 9.8 million km^2 in area making it the 3rd largest in both categories. The USA is divided into states and regions (see Figure 2) and most people are very linked to the region they live.

The political system in Brazil has been designed to allow for all the states to be represented in the Chamber of Deputies (lower house) proportionally to the population of that state and equally in the Federal Senate (upper house). Currently in the 54$^{\text{th}}$ legislature, there are 513 members in the house and 81 in the senate with a stagering variety of parties being represented; 21 parties have representation in the Chamber of Deputies and 15 parties are represented in the Federal Senate. Figure 3 provides a visualization of the seats by parties in the Chamber of Deputies and Federal Senate in this legislature.

If we concentrate on the Chamber of Deputies, it would be fair to say that deputies should represent the state and even smaller regions in the state they reside. In fact, a deputy is like a proxy to the fraction of the population that elected her and have obligation to represent her constituents. Although Brazil's political laws do not implement the idea of district elections, in practice deputies cannot be reelected if they do not pay attention to the needs of their constituents. Accordingly, one could expect high collaboration levels between deputies representing similar regions.

Another characteristic of the Brazilian political system is that they are party-proportional. This means that although people vote for a candidate, they are really first voting for the party and only second for the individual. At the end of elections, parties are assigned shares of the total number of deputies proportional to the votes the party receives in the state. States have a number of representations proportional to the state's population but with a pre-set minimum and maximum (*i.e.* never less than 8 and never more than

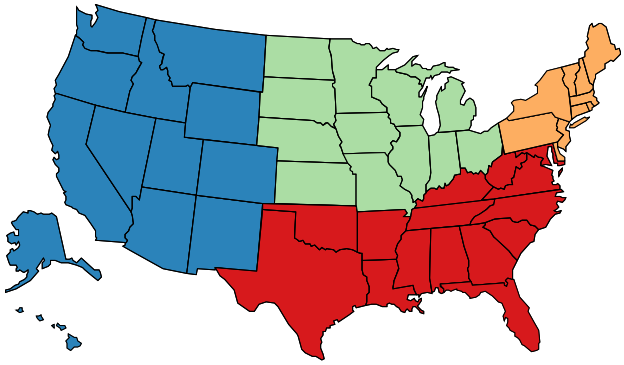


Figure 2: The USA is divided into 50 states and is also organized into 4 census regions: west, south, midwest, northeast (different colors on the map).

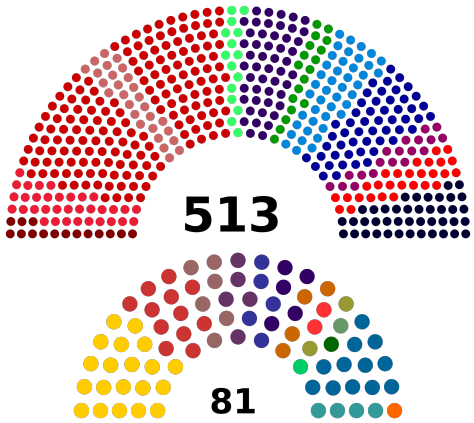


Figure 3: 21 political parties represented amongst the 513 members of the Chamber of Deputies, and 15 represented amongst the 81 members of the Federal Senate in Brazil.

70). Only after the party knows the proportion of seats it will get, the individuals are chosen (those with the largest number of votes within the party). One expects that the system naturally leads to party loyalty since the election results strongly depend on the success of the party as a whole.

In this paper we investigate how loyalty to the states and region evolved since the establishment of the so called "new republic" period in Brazil with the 49th legislature. We demonstrate that members of the Chamber of Deputies do not appear to be voting together with other members of the same state they have been elected to represent. This becomes apparent because the social network they form does not show any indication of "regionalism" which could happen if deputies of the same state tended to vote similarly. Yet, the same data shows strong party loyalty.

The paper then continues looking at the composition of party relationships in Brazil and how it changed depending on the period (if conservatives or liberals were in power). The basis of our analyses is a political social network built from collaboration in the Chamber of Deputies. The study focus on deputies' voting practices and measure their homophily with regards to region of origin and party.

The paper is divided as follows. In Section 2 we briefly describe some other works related to networks and politics. We follow with Section 3 where we describe how the network of legislators is built, how the data was collected and how we had to filter the network to extract meaning from it. In Section 4 we describe all the experiments we have performed and the information we learned from the network of legislators in Brazil. We finish this work in Section 5 with our conclusions and description of future research.

2 Related Work

There have been many works looking at the interplay between politics, social networks, and social media. The general idea of most of the works is to find hidden relations between politicians that could be used to understand the political scene and maybe make predictions about the outcome of elections.

One of the first works in the field of Political Networks was done by Johnson and Orbach [6]. In their study they looked at a small network of political figures and discussed how their perceived centrality in the network differs from the real centrality that is computed using an approach similar to what has been reported by Kumbasar et al. [7].

Fowler [4] produced the first work on cosponsorship networks for congresses. He has shown how to map the United States congress using 280,000 bills in the US House and Senate from 1973 to 2004. His approach used directed networks because bills have sponsors and co-sponsors. The edge is directed from co-sponsor to sponsor. He introduced a metric called *connectedness* that was used to make predictions about members of congress and their ability to pass legislation.

Waugh et al. [11] followed up the work of [4] by introducing the concepts of *divisiveness* and *solidarity* showing that these are significant predictors of reelection success. Their work makes heavy use of Modularity [9] to understand group dynamics in politics.

More recently, we have seen researchers looking at the relation between success and social networks in general. Halu [5] proposed a model of opinion dynamics during the election period and demonstrated that densely connected social networks is key to party victory, but small committed minorities can play a crucial role on election results.

Often opinion comes from the media. Mahmood and Menezes [8] looked at two major newspapers in the USA (NY Times and NY Post) and demonstrated that they portray a completely different picture of US politics. The central actors of a social network constructed from the NY Times do not match the central actors according to the NY Post.

3 Network of Legislators

The processes occurring in a deliberative assembly (*e.g.* congresses, state legislatures, city councils, etc.) are regulated by its internal documents describing all procedures followed by the legislators. In short terms, regardless their minutiae, when a proposition (*e.g.* creation or modification

of a law) is discussed in an assembly, a voting process takes places involving all the present members in the assembly, assuming there is quorum.

In a voting process, a legislator can vote about a proposition with an *Yes* (agrees with the proposition) and with a *No* (disagrees with the proposition). Other kinds of vote is possible depending on the assembly terms. For instance, in the Brazilian Chamber of Deputies, the deputies can also vote with an *Obstruction*, in this case, if the number of this type of vote is greater than a predetermined threshold, the voting session is canceled (the voting process is obstructed). Additionally a deputy also can vote *Abstention*, that means they are counted in the quorum, but their vote does not have any effect on the result of the approval or disapproval of the proposition.

Therefore, a social network of legislator here is composed by legislators connected between themselves by similarity ties. These ties are stronger if the legislators have consonant opinion in the assembly. The following sections describe how these networks are built.

The network we use here is not akin to networks of sponsored bills as defined by Fowler [4], instead the network is of voting similarities. We believe this is the first study that looks at the actual activity during voting instead of the proposition of bills. Our network shows an accurate picture of the positions taken by legislators given that it is possible and even known that legislators have voted against their own introduced bill.[1]

3.1 The Network Building

Brazil has had 6 legislatures since the establishment of the the "new republic" in 1989. In this paper, we have looked at the structure of each of these legislatures separately because the dynamics of the parties and leanings (from left to right) are highlighted over the years.

As we said before, the network is built out of voting sessions. The legislators vote on many sessions, thus a voting process network $\mathbf{V}^k$ for session k is defined as the network of the legislators that are connected if they agree between themselves (i.e., they voted in the same way) in that specific vote session. Therefore, the edges of $\mathbf{V}^k$ is defined as:

$$V_{ij}^k = \begin{cases} 1, & \text{if } \text{vote}_i^k = \text{vote}_j^k, \\ 0, & \text{otherwise.} \end{cases} \tag{1}$$

where vote_i^k is the vote value (e.g. *Yes*, *No*, etc.) of the legislator i on the voting process k. Hence, it is easy to see that the network $\mathbf{V}^k$ is by definition composed of different cliques, where each clique is a type of vote shared by the legislators. We can now build a network for any period N we want by adding all $\mathbf{V}^k, \forall k \in N$. We have defined N to be the entire length of each legislature. The edges of the overall voting legislator network $\mathbf{V}$ of N different voting sessions is defined as:

$$V_{ij} = \sum_{k=1}^{N} V_{ij}^k. \tag{2}$$

[1]Dan Friedman. Grimm Votes Against Taking Up His Own Flood Bill. http://goo.gl/KMnkLf

However, note that one has to account for the fact that legislators may not have been present in all voting sessions. We do not want to artificially inflate the similarities or dissimilarities between legislators just due the fact that they were not in the same voting session. In order to avoid this bias, the ties between two nodes should be proportional to the number of voting sessions that these two legislators were present at the same time. Thus, with this in mind, the voting session participation function $\varphi_k(i,j)$ is defined with the purpose to know if two legislators i and j voted in the same voting session k:

$$\varphi_k(i,j) = \begin{cases} 1, & \text{if } \sum_m V_{im}^k \times \sum_m V_{jm}^k > 0, \\ 0, & \text{otherwise.} \end{cases} \tag{3}$$

The function φ enables us to create a network $\mathbf{V}^P$ of legislators who voted on the same session. The weights of the edges of this network are defined as:

$$V_{ij}^P = \sum_k \varphi_k(i,j). \tag{4}$$

In $\mathbf{V}^P$, the weight of the edges actually represents the number of times the legislators participated in the same voting process. By using this sessions information we can now redefine a network $\mathbf{V}$ that includes all N different sessions as:

$$V_{ij} = \begin{cases} 0, & \text{if } i = j, \\ \sum_{k=0}^{N} \frac{V_{ij}^k}{V_{ij}^P}, & \text{otherwise.} \end{cases} \tag{5}$$

Thus, by definition, the strength of the ties on $\mathbf{V}$ is the percentage of the voting sessions the deputies participated that they shared the same opinion and there are no self-edges.

3.2 The Data

This paper concentrates on the data from Brazil, but we have also collected some data from the USA. The reason for the USA data was to confirm whether our analysis about Brazil legislature is reliable. Given the amount of work that exist in data from the USA (as described in Section 2), we applied our technique to the USA data also. In Section 4 we show the party loyalty and regionalism on the USA also.

The data used to create the networks analyzed in this paper are from the Brazilian Chamber of Deputies and the United States House of Representatives. They are the lower house of the Congress of Brazil and United States, respectively.

Recall that we want to have an analysis of the *New Republic* period in Brazil. That period runs from 1989 to today. Since this paper has been written in 2014 and we do not have the entire data for this year, we have considered all the years from 1989 to 2013 (full years). Table 1 describes each of the legislatures in the Brazil and USA.

The US data were retrieved from the GovTrack.us project[2] which contains all the data we required to apply

[2]http://www.govtrack.us/

Table 1: Both Brazil and the USA have had legislatures during periods when the president in power was Conservative and Liberal.

Legislature	Years	President	Party	Ideology
Brazil				
49^{th}	1991–1995	Fernando Collor	PRN	Conservative
50^{th}	1995–1999	Fernando H. Cardoso	PSDB	Conservative
51^{st}	1999–2003	Fernando H. Cardoso	PSDB	Conservative
52^{nd}	2003–2007	Luis I. Lula da Silva	PT	Liberal
53^{rd}	2007–2011	Luis I. Lula da Silva	PT	Liberal
54^{th}	2011–2015	Dilma Rousseff	PT	Liberal
USA				
102^{nd}	1991–1993	George H. W. Bush	Republican	Conservative
103^{rd}	1993–1995	Bill Clinton	Democratic	Liberal
104^{th}	1995–1997	Bill Clinton	Democratic	Liberal
105^{th}	1997–1999	Bill Clinton	Democratic	Liberal
106^{th}	1999–2001	Bill Clinton	Democratic	Liberal
107^{th}	2001–2003	George W. Bush	Republican	Conservative
108^{th}	2003–2005	George W. Bush	Republican	Conservative
109^{th}	2005–2007	George W. Bush	Republican	Conservative
110^{th}	2007–2009	George W. Bush	Republican	Conservative
111^{th}	2009–2011	Barrack Obama	Democratic	Liberal

the approach described in Section 3-3.1. In the case of the legislatures of Brazil, a Web crawler had to be written to gather the data from the official website of the Chamber of Deputies[3].

3.3 Filters and Measures

Some network filtering must take place in order to retrieve information from data. First, the value V_{ii}^P (*i.e.* the number of voting sessions the legislator i was present) is used to remove the legislators absent in many sessions. These absences can happen, for instance, when a deputy is promoted to state minister.

The frequency of the legislator i in the assembly is defined as:

$$F_i = \frac{V_{ii}^P}{N}, \tag{6}$$

where N is the total number of voting sessions. Thus, a legislator i is filtered out from the network if F_i is lesser than a threshold. In this paper, this threshold is set to $\sum_i^T F_i/T$, where T is the total number of legislators, *i.e.* this threshold is the average participation of the legislator in the assembly.

In order to create a network of similarity, a second filter based on the strength of the network ties is used. The filtering threshold takes into account the average weight between legislators and the standard deviation of these weights. All edges with weight less than the average minus one standard deviation are removed from the graph. The rationale for this filter is that we want only the agreement ties in this network, thus we remove the edges that are disagreement ties or neutral ties.

All the graph measures used were applied on the networks filtered with these filters. However, the analysis of the link between different parties was made only with the average participation filter applied, once this analysis considers both similarity and dissimilarity between legislators.

The analysis of the parties ties was made in two ways. First, the distribution of edges weights between two parties A and B was compared to the value 0.5. The rationale here is to measure the leaning of a party towards another one, given the neutral value is 0.5. Thus, the sum of all frequencies of weights that are lesser than 0.5 is subtracted to the sum of all frequencies of weights that are equal or greater than 0.5. This value gives the tendency of the ties between these two parties. For example, if the distribution is symmetric, this value is zero, thus these two parties agree and disagree with the same frequency.

The second analysis compares the distribution of the edges weights of two parties with the distribution of the whole network. That is, this analysis shows how the relationship between these two parties influences the whole network. In order to achieve that, the Bhattacharyya distance is used:

$$D_B(p,q) = -\ln\left(\sum_{x\in X}\sqrt{p(x)q(x)}\right), \tag{7}$$

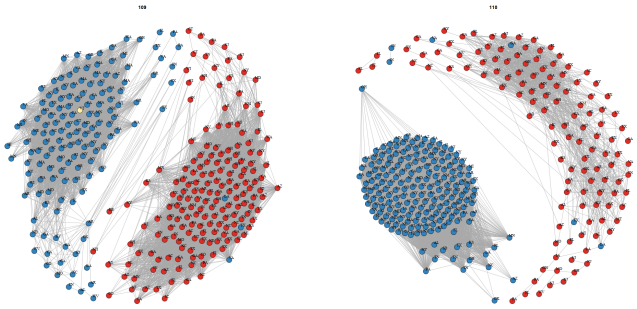
where p and q are two different distributions, in this case, the distribution of the edges weights of the two parties and the distribution of the whole network [3]. This metric reveals how two distributions are similar. In order to know to know what is the similarity direction (*i.e.* if the tendency of two parties is to agree or to disagree), the signal of the difference between the average of the two distributions is used on $D_B(.)$. Therefore, this distance is the way we compare the two distributions. The rationale for this analysis is that by comparing the relationship of two parties in the congress with the average relationship in the congress, we can assess how these two parties modify the overall congress relationships and we avoid the comparison with an arbitrary value.

4 Network Characteristics

Our main purpose is to understand the structure of collaborations and how deputies vote. As described before, we have constructed networks for all legislatures for the USA and Brazil. Since our focus is understanding the structure in Brazil (particularly because many works have looked at the case of the USA) we refrain here from displaying all networks for the USA except for two (just as an example).

Figure 4 shows the 109^{th} and 110^{th} legislatures in the USA. Note how different they look. In the 109^{th}, we observe a network that although split shows some channels of communication between the Democratic side and the Republican side. This changes completely in the 110^{th} when we start to see a stronger split between the parties while the democratic party is much more cohesive. The 112^{th} congress is *completely* disconnected between the Democrats and the Republicans which correlate well with the current situation in the USA where people in one party. rarely communicate or are willing to collaborate with people in another party.

[3]http://www.camara.leg.br/



(a) 109th (b) 110th

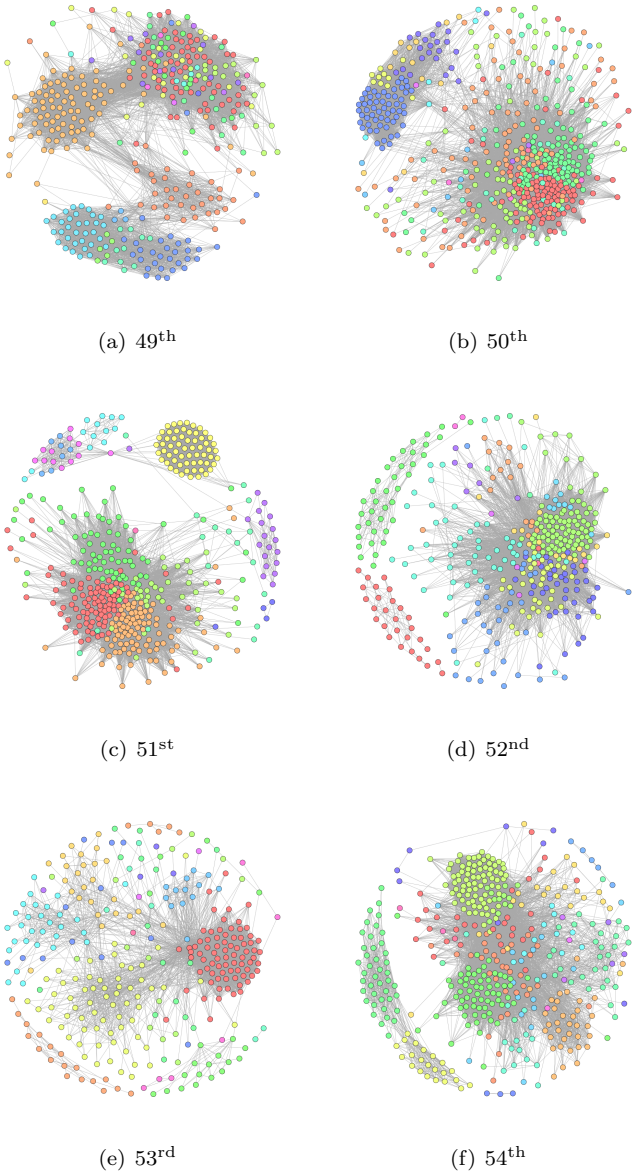
Figure 4: Two legislatures in the USA. Both of them are during the presidency of George W. Bush but the 109th had a Republican (red) majority while the 110th had a Democratic (blue) majority. In yellow, an independent congressman.

	Legislature	n	m	z	r_p	r_s	r_r	C
Brazil	49	369	11578	30.92	0.3613	0.0185	0.0182	0.7380
	50	526	24625	72.69	0.2048	0.0043	0.0183	0.6714
	51	439	19981	69.29	0.3030	0.0058	0.0126	0.8196
	52	374	14589	65.96	0.1599	−0.0009	0.0006	0.7034
	53	311	3762	27.08	0.6668	0.0052	0.0159	0.6586
	54	439	12543	42.40	0.4187	0.0139	0.0323	0.6761
United States	102	440	18512	67.56	0.9683	0.0089	0.0408	0.8122
	103	432	20091	58.51	0.9723	0.0060	0.0303	0.8159
	104	394	23997	64.60	0.9708	0.0062	0.0271	0.8672
	105	433	22303	61.56	0.9079	0.0100	0.0522	0.8159
	106	423	22843	51.15	0.9392	0.0113	0.0589	0.8243
	107	432	23066	71.73	0.8897	0.0077	0.0395	0.8090
	108	420	24715	58.52	0.9563	0.0105	0.0489	0.8344
	109	435	24178	53.85	0.9389	0.0131	0.0647	0.8252
	110	437	25804	93.04	0.9813	0.0019	0.0178	0.8239
	111	405	23330	89.97	0.9870	0.0014	0.0125	0.8451

Table 2: Basic statistics for the networks considered: the total number of vertices n; the total number of edges m; the average weighted degree z; the assortativity coefficient related to legislators' party r_p, state r_s and region r_r; and the average clustering coefficient C.

Having seen that the networks for the USA which is a country know for its bipartisan system appear to indicate the correct structure of congress, we can now look at the multi-party system (more complex) that is Brazil. Figure 5 shows an interesting evolution in Brazilian Politics. In the networks, colors represent parties. It is interesting to see that structurally speaking the network of today (54th legislature) is less cohesive than it was in the previous 4 and resembles more the network of the 49th legislature. Note that during the 49th, Brazil's politics were in disarray due to the impeachment of Fernando Collor. Another interesting observation is that in legislature 50-53 we have a clear definition of government (denser part of the network) and opposition (outskirts of the networks). Today, the 54th appears so show that the party boundaries are less relevant given that most deputies appear to collaborate others from most other parties.

Next we decided to look at some network properties that



(a) 49th (b) 50th (c) 51st (d) 52nd (e) 53rd (f) 54th

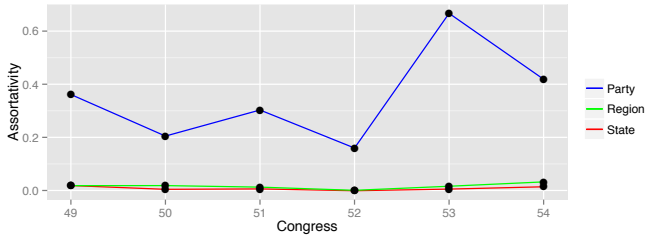
Figure 5: Networks from each legislature in Brazil go from disperse, to cohesive and back to disperse. Color nodes represent the deputy party.

are interesting in the context of politics because the visualizations in Figures 4 and 5 may hide important details. We measured for each legislature in the USA and Brazil their average node strength z [2], the average weighted clustering coefficient C [12] and the assortativity coefficient r [10]. In order to evaluate the assortativity we used three legislators attributes: their party (r_p), their state (r_s) and their region (r_r). The region represents the five regions in Brazil described in Figure 1 and in the USA we used the four census areas as described in Figure 2. Table 2 summarizes all the statistics of the network of each legislature.

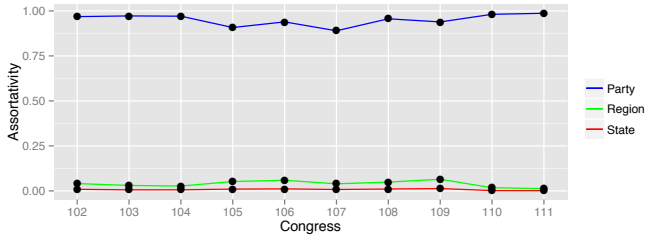
The average weighted clustering coefficients for all the networks indicate that the networks are highly clustered, that is, the way the politicians vote in the congress has a tendency to be grouped. However, the United States House

of Representatives has greater level of clustering, suggesting that the representatives are more cohesively connected, a feature that is noticeable in Figure 4 and Figure 5.

The values for r_p in all cases are positive, what suggests that politicians do have tendency to agree with the ones with the same party. However, the values for r_s and r_r, *i.e.* the assortativity respectively related to state and region, have values near to zero, indicating no inclination from politicians to agree with the ones from the same state or region. The comparison of the values of the assortativity coefficients r_s, r_p and r_r for each legislature is shown in Figure 6.



(a) Brazil



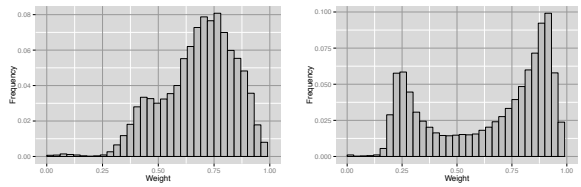
(b) United States

Figure 6: The evolution of the assortativity coefficient of attributes Party, State and Region through different legislatures.

The two graphs in Figure 6 clearly indicate that the politics in Brazil is different from the politics in the USA. The first difference we can observe the curves is that the USA shows a much higher party loyalty when compared to Brazil. This means that the USA has a better defined separation between ideologies leading to fewer instances of collaboration compared to Brazil. Note that the lower party assortativity r_p relates to higher instances of deputies collaborating with deputies from another party. Brazil's party loyalty is not as strong as in the USA but it is still high, particularly in the last two legislatures.

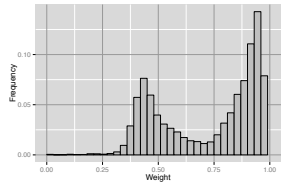
Another important characteristic is that in the USA we see a slight preference of legislators to collaborate with others in their region than in Brazil. Although Table 2 shows that, in general, assortativity is higher for region than for state (as expected), the difference in Brazil is insignificant. What we conclude from these pictures is that the party system in Brazil is not as well defined as it is in the USA but it appears that party loyalty to be getting more important in the last couple of legislatures.

The argument of the legislature in Brazil in the 54^{th} being less defined and similar to what happened in the 49^{th} can also be observed in Figure 7(a-f) represent edge-weight

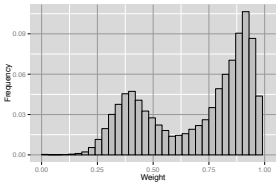


(a) 49^{th}

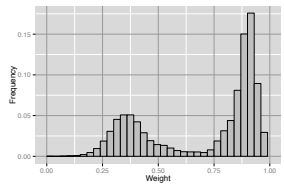
(b) 50^{th}



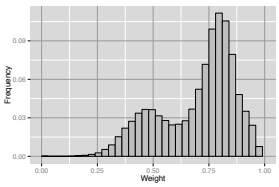
(c) 51^{st}



(d) 52^{nd}



(e) 53^{rd}



(f) 54^{th}

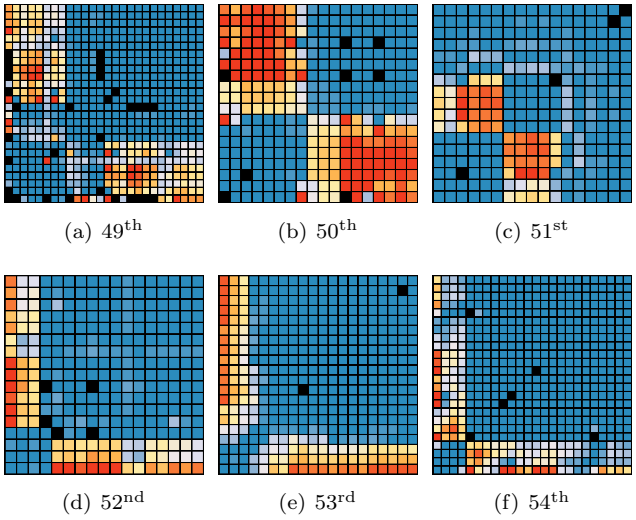
Figure 7: The edges weights distribution for each legislature. Note the better definition of a bi-modal distribution in legislatures (b-e). This definition reflects a stronger split in the Brazilian Chamber of Deputies between pro-government parties and the opposition.

distribution of each legislature studied. Their bimodal characteristic suggests a segregation between legislators. As before, this segregation is more prominent in Figures 7(b-e), where the bimodal characteristic is clearer.

Next we look at how parties related to one another. As explained before in Equation 5 we have computed the level of agreement between members of the Chamber of Deputies in Brazil. If we aggregate this information by party, we can see the level of agreement between these parties for the entire legislature.

First, we provide a visualization in the form of a heat map where the level of agreement between two parties is the comparison of the distribution of their edge weights with 0.5 mark. As explained in Section 3.3, when two parties do not have a preference in collaborating or not, this level of agreement is zero, that is, they agree and disagree at the same frequency. Figure 8 provides this view of the legislatures, the rows and columns are the parties and the black squares means lack of information, that can happen usually with small parties. In these heat maps, the reddish colors mean disagreement, the blueish colors mean agreement and the whitish colors are related to zero level of agreement.

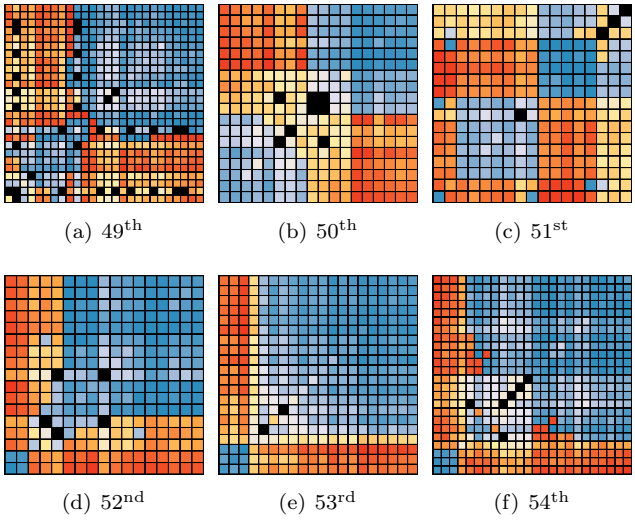
Note that we have a situation in which the 54^{th} legislature does not seem to demonstrate much disagreement between parties. Compare that to the 50^{th} where we clearly see defined groups of agreement and disagreement. The result of Figure 8 taken together with what is shown in Figure 5, describes a scenario in which the parties are not totally divided



(a) 49th (b) 50th (c) 51st

(d) 52nd (e) 53rd (f) 54th

Figure 8: The leaning of a party towards another one, given the neutral value is 0.5. The opposition group shrinks and looses its structure through the legislatures.



(a) 49th (b) 50th (c) 51st

(d) 52nd (e) 53rd (f) 54th

Figure 9: The comparison of the relationships of two parties with the average relationship in the congress. The opposition group shrinks through the legislatures.

and hence do not appear to have a strong enough ideology to lead to disagreement. Moreover, by analyzing the evolution of the heat maps through the legislatures, the size of the opposition decreases suggesting that the opposition is weakening, also, the agreement level between the opposition parties is also decreasing its value. This latter remark indicates that the opposition structure is also weakening, that is, the opposition parties do not collaborate between themselves.

Yet, Figure 8 could not be the best picture to observe because it compares to a neutral point that can be unattainable in practice. To make sure this issue is considered, we provide the same visualization, but comparing the agreement levels with the average level of disagreement in that legislature. Thus, in this analysis, the distribution of the edge weights between each party pair is compared to the whole network weight distribution.

Figure 9 allows us to better observe the divisions in the Chamber of Deputies. This visualization shows that in the last two legislatures the disagreement comes from 3-4 parties while the others appear to agree with each other. In fact, these 3-4 parties are the opposition to the Worker's Party (PT) which is currently in power. Moreover, likewise the analysis of the Figure 8, the opposition in the Figure 9 is shrinking through the legislatures, the oposition structure, however, does not seem to get weaker.

All heat maps in Figures 8 and 9 have different resolutions through legislatures. This is the case because the number of parties with representation changes each legislature. Legislatures 49th and 54th have the largest number of parties represented in the House of Deputies. Note also that we have not displayed the names of the parties in Figures 8 and 9 because our purpose is not to find which parties agree or disagree in a pairwise manner but instead understand the party structure of agreement and disagreement as a whole. We have performed all the pairwise comparison but believe it is not relevant to this work as most of the parties are unknown to an average reader.

5 Conclusion

Politics is a multifaceted topic and the true understanding of political dynamics requires deep analysis of current events in the world. However Data Science and in particular Network Science can shed light into an area that previously was understood solely by political scientists. In today's world the availability of data is likely to lead to tools that can aid the population, making decisions about their politicians and possibly change the way people vote. One can envision a time where tools can be analyzing real-time data and providing the population with information regarding their candidates' performance in previous legislatures or their performance according to data from Social Media outlets.

Our results have shown that both the Brazil and the USA present a strong party loyalty but weak regionalism at the state level. This means that politicians are more loyal to the party priorities than the priorities of their states. However, when we look at regions as described in Figures 1 and 2 we have a slightly different picture. Although the regionalism is still weak at the region level, in the USA the region preference is about 4-8 times stronger than the state while in Brazil it is about 2-4 times stronger. If we normalize by the number of states in each region, we can see that USA, looks more at regionalism than Brazil, although both do not do it enough: it is clearly party politics in lieu of state needs.

We then looked closely at the situation in Brazil to understand party relationship and the structure of the Chamber of Deputies. We found that looking at the New Republic period in Brazil the Chamber of Deputies today has two main characteristics *(1)* the party borders are not as clear and the collaborations happen across party lines, and *(2)* the opposition appears to be weaker and less organized today than it was 2 or 3 legislatures ago. Political scientists may be interested in these results and able to explain the similarities between the current legislature and the one just after the establishment of the New Republic (after many

years of a military dictatorship).

Many different works can be done in this data. One that we intend to do in the very near future is the application of metrics such as connectedness [4] and divisiveness and solidarity [11]. This should allow us also to look at these metrics in relation to election success. In a recent work, Barbosa-Filho et al. [1] have demonstrated how to measure party success in Brazil by looking at strategies for registering new and known candidates. Their work could be augmented with the notion of connectedness, divisiveness and solidarity.

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