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Patterns of Spatial Voting in 2014 and 2018 Elections for the Brazilian Chamber of Deputies

Patrones de votación espacial en las elecciones para la Cámara de Diputados de Brasil en 2014 y 2018

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ABSTRACT

This study compares voting patterns in Brazil's 2014 and 2018 federal deputy elections with those of 1994 and 1998 (Carvalho, 2003). Electoral data provided by the TSE election data are analysed quantitatively and compared with geographic and HDI data, revealing significant changes. There are more pronounced differences between the recent consecutive elections; the largest municipalities have become more competitive. Although this study cannot predict future electoral outcomes, the use of recent data reveals the political geography of voting and the changed political context. These findings provide a significant contribution to the literature, potentially supporting decision-making in several related areas, including the Brazilian electoral system.

KEYWORDS: *concentration, distributivism, dominance, legislative branch, votes, Brazil.*

RESUMEN

Este estudio compara los patrones de votación en las elecciones de diputados federales de Brasil de 2014 y 2018 con los de 1994 y 1998 (Carvalho, 2003). Los datos electorales proporcionados por el TSE se analizan cuantitativamente y se comparan con datos

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geográficos y del IDH, lo que revela cambios significativos. Hay diferencias más pronunciadas entre las recientes elecciones consecutivas; los municipios más grandes se han vuelto más competitivos. Aunque este estudio no puede predecir resultados electorales futuros, el uso de datos recientes revela la geografía política de la votación y el contexto político cambiado. Estos hallazgos representan una contribución significativa a la literatura y potencialmente apoyan la toma de decisiones en varias áreas relacionadas, incluido el sistema electoral brasileño.

PALABRAS CLAVE: *concentración, distributismo, dominio, poder legislativo, votos, Brasil.*

Introduction

In recent decades, many researchers have investigated elections in Brazil, mainly because of their significant impact on parliamentary decisions. Electoral institutions are particularly important, as they offer a context for studying and predicting the future decision-making behaviour of Members of Parliament (MPs), particularly in commissions and in the plenary chamber, throughout their term of office.

About 20 years ago, Nelson Rojas de Carvalho (2003) studied the political geography of voting and legislative behaviour in Brazil during the 1994 and 1998 elections. His work, which combined theory and empirical data, represented a milestone in the study of political geography in Brazil. The present study extends that research by investigating municipal voting profiles during the 2014 and 2018 elections, analysing those elections, and comparing the results with those from two decades ago. In line with the distributive model of legislative studies, this paper focuses on the electoral moment, assuming that deputies' unique spatial voting patterns determine varied aspects of their legislative behaviour.

Although it is important to analyse the concentration and spatial dispersion of votes, which have great explanatory potential, to date only a handful of published studies have used these patterns to analyse the legislative activity of MPs. This perspective deserves more in-depth research, as it can form the basis for a wide range of investigations, covering the association between vote concentration and dispersion and variables related to the professional profiles of elected deputies, socioeconomic variables, and the political-institutional aspects of the MPs' local origins. Such research can also verify the existence of components of the majority electoral system in Brazil's formally proportional system, the expected deterioration of localism following the adoption of a proportional system, and the geographical voting profiles of ideologically oriented parties, in comparison to catch-all parties.

The present research analyses voting patterns in the 2014 and 2018 Chamber of Deputies elections, comparing the results with those of 1994 and 1998 (Carvalho, 2003). It aims to identify the voting profiles of elected federal

deputies by determining their spatial voting patterns, as proposed by Barry Ames (2003), based on the concentration and dominance of votes.

Using Ames's (2003) typology, we investigate the voting patterns of elected deputies through two vectors —concentration and dominance— arranged orthogonally on a plane. By classifying the voting patterns of elected deputies using fragmentation and dominance indexes, we are able to analyse both vectors, either separately or together. We also analyse the concentration and dominance patterns characterising the six leading political parties.

Spatial voting patterns

When studying the spatial voting patterns of federal deputies in Brazil, it is standard to use the work of Barry Ames (2003) and to project two orthogonal vectors: the dimension of concentration (represented by a horizontal vector) and the dimension of dominance (represented by a vertical vector). According to Ames (2003), the dimension of dominance reflects the extent of voting for a deputy in a given city. It shows how important deputies can be for certain municipalities, based on the percentage of votes attributed to them in these locations. The dimension of concentration reflects the pattern in which the deputy's votes are distributed, indicating whether his or her votes are concentrated in certain municipalities or dispersed over a large number of cities. In general, as proposed by Indjaian (1981) and Dias (1991), this calculation is carried out by applying an inverted Rae fragmentation index.

In addition, the typological frame proposed by Ames (2003) includes four basic types of geographic vote distribution: concentrated-dominant, concentrated-shared, dispersed-dominant, and dispersed-shared. The present study uses this typology to classify elected deputies, verifying the most common voting patterns by region.

To understand the representatives' profiles through their vote distribution, we also draw on the work of Carvalho (2003). Deputies with a concentrated, dominant vote tend to be parochial parliamentarians. As a general rule, they dominate a region of contiguous cities, starting from a key municipality in which they win a large proportion of the vote. In these municipalities, it is common to find employment and patronage relationships between voters and politicians.

The dispersed-dominant profile is associated with parliamentarians who already hold positions in the state bureaucracy, usually ones where they can implement distributive policies. They include secretaries of education, health, infrastructure, and social action. The combination of votes spread across several municipalities and high average-dominance levels indicates that their influence is not restricted to a particular region. Instead, these parliamentarians have support networks in various areas.

Deputies with concentrated-shared voting are generally found in densely populated areas, such as capitals and some regional hubs. They are non-dominant because although they receive a considerable number of votes in these cities, they receive a lower proportion of the total votes in the municipalities. In most cases, they represent part of the population of these large centres with an affiliation to a specific cause or political platform.

Finally, following Carvalho (2003), we introduce the dispersed-shared profile, which describes deputies whose support is spread across a wide geographical area and who do not receive a significant proportion of the vote in the municipalities. They are less dependent on local networks because their supporters are spread throughout the state. They tend to gain votes either because they have held prestigious administrative or elective positions at the state or national level, or because they are able to mobilise a more ideological vote, sensitising particular sectors in diverse regions, such as evangelicals or representatives of a particular social class.

Analytical studies on voting patterns in Brazil and their results

Prior studies of voting patterns in Brazilian deputy elections date back to the 1970s. The present study analyses the last two elections —in 2014 and 2018— as it is important to understand the research on election results in recent decades. Current behaviour can be understood more readily through a comparison with the recent past.

Ames (2003) has contributed several important findings in addition to the research mentioned below (a spatial taxonomy of the electoral bases of Brazilian deputies). The first finding relates to the dominance index, which was higher in states of the Northeast region of the country. He could not account for this fact through economic factors, such as poverty and underdevelopment, even in variable 'regions'. He therefore hypothesised that the phenomenon was caused by the large number of politicians' families in the area and the existence of parochialist policies, which sometimes included clientelism. In the Northeast, states with more municipalities, where the population was concentrated in capital cities, had lower rates of concentration, demonstrating the importance of demographic factors in this variable. The final important conclusion was that dominance was falling in all regions.

Another important study provides a better understanding of electoral concentration in Brazil (Avelino, Biderman & Silva, 2016). As these authors note, the weakness of political parties, the possible existence of "informal districts", and their impact on the performance of parliamentarians have been the subject of recent political discussions in Brazil. When parliamentarians have more concentrated voting profiles, their "electoral connections" cause them to favour more fragmented public policies (so-called "pork barrel politics") to benefit their respective electorates.

Borges, Paula, and Silva (2016) have developed an interesting analysis of the impact of national and state governing coalitions on the geography of the vote in Chamber of Deputies elections. In particular, they have examined the impact of the government-opposition cleavage on the territorial distribution of votes for parties and candidates. Among several important conclusions, they argue that most situationist candidates are likely to fit the fragmented-dominant candidate type. The effect of incumbency on a candidate's ability to dominate key municipalities is less relevant than the advantages that arise from access to resources controlled by the executive power at the federal level. In addition, this study also proposes that rookie candidates affiliated with the state government party have a greater chance of receiving a dominant vote. This study offers the general conclusion that, even with incentives for individual strategies, the preponderance of executive power in Brazilian presidentialism makes access to national and state governing coalitions an important factor in legislative elections.

Brazil has adopted an open-list proportional system, with no single-member districts. According to some authors who have analysed the voting profiles of federal deputies, the Brazilian electoral college contains small, informally defined districts. Avelino, Biderman, and Silva (2016) suggest that, over time, deputies adopt a recurrent strategy: initiating their political lives via municipally concentrated voting profiles, then expanding operations to the region, and ultimately reaching a more geographically dispersed electorate.

In analysing this pattern of voting behaviour, which transitions from a more concentrated profile to an increasingly dispersed profile, Silva (2017) shows that the large number of electoral colleges contributes to the spatial concentration of votes, while also proving (once again) that an increase in the number of votes reduces concentration. This author emphatically affirms the existence of a causal relationship between competition and vote concentration. Regardless of whether the candidate for deputy is elected or is a member of the same party as the state-government winner, his or her votes tend to disperse more and more.

In research on the 2006 and 2010 federal-deputy elections, Câmara (2011) shows that, although the Brazilian electoral system allows any candidate to seek votes throughout the state, votes for candidates in these elections are highly concentrated, a trend identified in almost all states. The use of Ames's (2003) taxonomy to frame voting profiles also confirms that the concentrated-shared profile is prevalent. This corroborates the findings of other authors, who have shown that most elected deputies adopt the strategy of establishing themselves territorially in particular municipalities, without worrying about being hegemonic. With regard to political parties, the predominant profile was similarly concentrated, regardless of ideology or the social dimension.

It is important to highlight the work of Gonçalves (2016). Unlike Carvalho (2003), who focused on municipalities, which he called 'primary electoral units', Gonçalves revealed the importance of using other units of analysis to aggregate new knowledge within an area. Notwithstanding the institutional

strength of municipalities, the spatiality of voters (encompassing the economic-social variable of place), and public exposure to different political campaigns, contact with local social networks is fluid and does not necessarily reflect stagnant political-administrative cuts.

Methodology

The present quantitative research study treats the data statistically, using simple tabulations for multiple regression analyses. Since the general objective is to replicate for the 2014 and 2018 elections Carvalho's (2003) analysis of the 1994 and 1998 elections, the second step corresponds to his mapping of methodologies and consolidation of information. We have identified the primary data sources that record votes for federal deputies in each municipality in the country. Most of the data have been extracted from files on the 2014 and 2018 elections made available in text format by the Superior Electoral Court (TSE). Geographical and HDI data have been accessed via the website of the Brazilian Institute of Geography and Statistics (IBGE).

To store and process the data, we modelled and created a database in the third step. It was then loaded in accordance with the procedures developed for import purposes. Using queries formulated in the SQL language, we generated the first layer of information. Finally, using the R programming language, we automated the calculations of relevant quantities for research purposes: calculating the dominance and dispersion of votes for elected deputies; aggregating this information by state and geographic region; distributing elected deputies in accordance with the dimensions of concentration and dominance; and mapping patterns of concentration and dominance among the six political parties that received the most votes. This made it possible to generate tables using information comparable to Carvalho's data (2003).

During the fourth and final stages, two types of analysis were carried out on the results obtained: the first compared the two earlier elections with federal-deputy elections in 2018 and 2014; the second compared data from the two previous elections with those found by Carvalho 20 years ago.

To calculate the degree of concentration, we have used a similar logic. The methodological path is the inverted Rae index, adapted to the concentration-calculation context. The dispersion is then calculated as the inverse sum of the ratio of the square of the vote in each municipality, divided by the square of the final vote in the state. In other words, we have:

$$\mathrm{Dp} = \frac{1}{\sum_{i=1}^{n} \frac{v_i^2}{V^2}}$$

where Dp is the dispersion calculated for the candidate, n is the number of cities in the state, v is the number of votes for the candidate in city i, and V is the total number of votes for the candidate.

To calculate the dominance of each candidate, we followed Ames (2003), analysing two quantities in each municipality. The first was municipal dominance, the ratio between the votes received by a candidate in a municipality and the electorate of that municipality. The second was average dominance, the ratio between a candidate's votes in a particular municipality and in the election overall. Finally, the candidate's dominance was the sum, in all municipalities, of the product of municipal dominance and average dominance, as follows:

$$\text{Dom} = \sum_{i=1}^{n} \left(\frac{v_i}{M_i}\right) * \left(\frac{v_i}{V}\right)$$

where Dom is the dominance calculated for the candidate, n is the number of cities in the state, v is the number of votes for the candidate in city i, V is the total number of valid votes for federal deputies in the city, and M is the total number of votes for the candidate in the state.

Results and discussion

To determine spatial voting patterns, we have focused on elected candidates. In doing so, we have used lessons developed by Ames (2003), who modelled the vote for Brazilian deputies using two orthogonal vectors: the concentration and dominance dimensions.

Voting concentration and dispersion

We have used the same methodology as Carvalho (2003) to calculate the degree of spatial dispersion and dominance in the vote for elected federal deputies in 2014 and 2018.

To assign political meaning to the continuous values produced by the formula used to calculate dispersion, as in Carvalho (2003), we have defined four bands, categorising the elected deputies in accordance with a fragmentation index, as presented in Table 1.

Levels of concentration	Inverted Rae index
High concentration	Between 1,0 e 4,0
Medium concentration	Between 4,0 e 7,0
Medium dispersion	Between 7,0 e 11,0
High dispersion	Above 11,0

Source: Prepared by the authors using Carvalho's (2003) parameters.

Table 1.
Criteria for classifying the patterns of voting for elected federal deputies using a fragmentation index

Carvalho (2003) confirmed the balance between elected deputies with a pattern of dispersed (46%) and concentrated (54%) voting in the 1994 elections, emphasising that this phenomenon, which could be explained by randomness, appeared to be a tendency, since a similar pattern could be found in 1998. In the 2014 and 2018 elections, the fragmented profile proved to be predominant, accounting for 65% and 68% of the deputies elected in 2014 and 2018, respectively. Our findings confirm that the fragmented profile identified by Carvalho (2003) was not an outlier or exception to the rule.

Table 2.
Concentration and dispersion patterns for elected federal deputies by region

		High Concentration		Medium Concentration		Medium Dispersion		High Dispersion	
		2014	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**
Brazil	Percentual	22%	19%	13%	13%	13%	11%	51%	57%
	Deputies	110	94	67	67	68	57	260	287
Southeast	Percentual	32%	26%	18%	16%	12%	14%	37%	45%
	Deputies	58	46	33	28	21	25	67	80
North	Percentual	45%	37%	15%	18%	12%	5%	28%	40%
	Deputies	29	24	10	12	8	3	18	26
South	Percentual	10%	10%	8%	9%	13%	10%	69%	70%
	Deputies	8	8	6	7	10	8	53	54
Midwest	Percentual	3%	15%	15%	18%	27%	12%	55%	55%
	Deputies	1	5	5	6	9	4	18	18
Northeast	Percentual	9%	7%	9%	9%	13%	11%	69%	72%
	Deputies	14	11	13	14	20	17	104	109

Source: Prepared by the authors using TSE data.

As Table 2 illustrates, the Southeast Region performed in the last two elections just as it did 20 years ago. In contrast to the rest of the country, it produced elected deputies with a concentrated profile (50% in 2014 and 42% in 2018) that was well above the country average (35% in 2014 and 32% in 2018). In addition, Southeast, the most important region in the country from an economic standpoint, also maintained the downward trend in the percentage of concentrated profiles in 1994 and 1998 (67% and 64%, respectively). The percentage of deputies with a high concentration of votes – possibly those from capitals and rural districts – was above the national average, having dropped from practically half the total 20 years ago, to a third in 2014 and a quarter in 2018.

The regions with the highest incidence of fragmented deputy profiles were the Northeast and Midwest (20 years ago, they were the Northeast and South). In accordance with the increasing incidence of this profile, the Northeast, which in the nineties was just over 70%, has now reached more than

80%. Finally, the case of the South Region stands out, which shows remarkable volatility in the numbers. In 1994 and 1998, the percentage of deputies with fragmented profiles was above the Brazilian average, although this difference was clearly greater in the first election. In 2014, the percentage of deputies with dispersed profiles in this region (82%) was well above the 65% average for Brazil; in 2018, it dropped precipitously to 67%, coming close to the Brazilian average of 68%.

	Concentrated 2014 (%)	Concentrated 2018 (%)	Dispersed 2014 (%)	Dispersed 2018 (%)
Brazil	35	32	65	68
Southeast	51	41	49	59
North	60	55	40	45
Midwest	18	19	82	81
South	18	33	82	67
Northeast	18	17	82	83

Source: Prepared by the authors using TSE data.

Table 3.
Concentration and dispersion patterns of voting for elected deputies by region

In Table 3, where the regional analysis is achieved by grouping together the two concentration ranges and two electoral dispersion ranges, clear differences can be seen in the most recent elections. The first difference is the fact that only the South Region lacked stability 20 years ago; now the Southeast Region is also unstable. Furthermore, as Table 2 makes clear, the polarity of 20 years ago, which was characterised by a concentrated Southeast Region and dispersed South and Northeast Regions has changed; the polarity now involves a concentrated North Region and dispersed Northeast and Midwest regions.

Diverse dominance patterns in two legislatures

By shifting the focus to the vertical penetration of voting for deputies in the municipalities, we can work with the other axis proposed by Ames (2003), namely, dominance. As in the analysis of dispersion, we have assigned a political meaning to the values associated with each parliamentarian by defining four ranges: no dominance, low dominance, medium dominance, and high dominance. Here, as in Carvalho (2003), the limits of each band are not pre-defined. We have chosen to divide the values into two groups using the average value of each legislature's period of dominance. These values are then divided into two other subgroups, using the value of a standard deviation.

By shifting the focus to the dominance of federal deputies, we can see in Table 4 that the stability of the deputy distribution found in 1994 and 1998 is no clearer in the most recent elections. On the contrary, some regions

show considerable variation within each band between the 2014 and 2018 elections.

Regarding the first band (no dominance) we note that the Southeast Region continues to have the highest percentages of deputies with this profile (ranging, in the four elections, between 41% and 45%). In the second, most tenuous dominance band, the South and North Regions stand out, not only for having the highest percentages, but also due to their significant growth between 2014 and 2018. The explanatory hypotheses proposed by Carvalho (2003) to explain the existence of these less dominant regional profiles involve large electorates in capital cities and the existence of large urban centres in the Southeast.

Like the less dominant bands, the more dominant bands, when analysed, repeat the behaviour observed 20 years ago. In this case, the Northeast Region stands out, with 44% (2014) and 40% (2018) medium dominance. In the high-dominance range, the Northeast Region has the highest percentages, ranging from 22% in 2014 to 30% in 2018.

Table 4.
Federal deputy dominance patterns

	No dominance		**Low dominance**		**Medium dominance**		**High dominance**		**Total**	
	2014	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**
Brazil	20%	18%	31%	37%	31%	30%	17%	15%	100%	100%
	(102)	(90)	(156)	(186)	(159)	(152)	(88)	(77)	(505*)	(505)
Midwest	9%	3%	39%	42%	24%	45%	27%	9%	100%	100%
	(3)	(1)	(13)	(14)	(8)	(15)	(9)	(3)	(33)	(33)
Northeast	4%	7%	30%	23%	**44%**	**40%**	**22%**	**30%**	100%	100%
	(6)	(10)	(46)	(35)	**(66)**	**(61)**	**(33)**	**(45)**	(151)	(151)
North	12%	2%	**45%**	**60%**	35%	26%	8%	12%	100%	100%
	(8)	(1)	**(29)**	**(39)**	(23)	(17)	(5)	(8)	(65)	(65)
South	9%	6%	**38%**	**53%**	31%	31%	22%	9%	100%	100%
	(7)	(5)	**(29)**	**(41)**	(24)	(24)	(17)	(7)	(77)	(77)
Southeast	**44%**	**41%**	22%	32%	21%	20%	13%	8%	100%	100%
	(78)	**(73)**	(39)	(57)	(38)	(35)	(24)	(14)	(179)	(179)

* The total is 505. Although there are 513 federal deputies, we have not counted the eight representatives of the Federal District because there are no municipalities.

Source: Prepared by the authors using TSE data.

Table 5 groups the deputies into two categories: dominant (medium and high dominance) and non-dominant (no dominance and low dominance). Unlike the situation 20 years ago, in 2014 and 2018, there was no great stability in the percentages between the two consecutive elections.

	Non-dominant		Dominant	
	2014	2018	2014	2018
Brazil	51%	55%	49%	45%
	(258)	(276)	(247)	(229)
Midwest	48%	45%	52%	55%
	(16)	(15)	(17)	(18)
Northeast	34%	30%	**66%**	**70%**
	(52)	(45)	**(99)**	**(106)**
North	**57%**	**62%**	43%	38%
	(37)	**(40)**	(28)	(25)
South	47%	**60%**	53%	40%
	(36)	**(46)**	(41)	(31)
Southeast	**65%**	**73%**	35%	27%
	(117)	**(130)**	(62)	(49)

Source: Prepared by the authors using TSE data.

Table 5.
Aggregated dominance patterns of voting for federal deputies

As Table 5 also shows, polarisation has existed for 20 years, maintaining both the less dominant Southeast and North Regions and the more dominant Northeast Region. This pattern has persisted in the two most recent elections. It is important to note that these regions, in the 2014/2018 comparison, moved even closer to the extremes. By contrast, the Midwest Region moved closer to the national average, while the South Region transitioned from a profile slightly below the Brazilian average in 2014 to a profile slightly above the national average in 2018.

The intersection of concentration/dispersion and dominance/non-dominance in municipalities

According to the typology proposed in Ames (2003), there are four basic types of geographical vote distribution: concentrated and dominant, concentrated and non-dominant, fragmented and dominant, and fragmented and non-dominant. Table 6 uses this classification system to categorise the deputy elections.

The first important issue to consider when analysing these data is the percentage of concentrated and dominant deputies. This profile is the Brazilian equivalent of the American type of district deputy, based on their electoral connections. Even 20 years ago, this profile was the least common (16% in 1998 and 17% in 1994); now, it is even rarer (10% in 2018 and 12% in 2014). Analysing the results by region, we can see that, although the South, Southeast, and Central-West had above-average profiles 20 years ago, the North and Cen-

	Concentrated and dominant		Concentrated and non-dominant		Fragmented and dominant		Fragmented and non-dominant		Total	
	2014	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**
Midwest	12%	**18%**	6%	15%	39%	36%	42%	30%	100%	100%
	(4)	**(6)**	(2)	(5)	(13)	(12)	(14)	(10)	(33)	(33)
Northeast	5%	8%	13%	9%	**61%**	**62%**	21%	21%	100%	100%
	(7)	(12)	(20)	(13)	**(92)**	**(94)**	(32)	(32)	(151)	(151)
North	**20%**	**15%**	40%	40%	23%	23%	17%	22%	100%	100%
	(13)	**(10)**	(26)	(26)	(15)	(15)	(11)	(14)	(65)	(65)
South	12%	9%	6%	10%	42%	31%	40%	49%	100%	100%
	(9)	(7)	(5)	(8)	(32)	(24)	(31)	(38)	(77)	(77)
Southeast	15%	9%	36%	32%	20%	18%	29%	41%	100%	100%
	(26)	(17)	(65)	(57)	(36)	(32)	(52)	(73)	(179)	(179)
Brazil	12%	10%	23%	22%	37%	35%	28%	33%	100%	100%
	(59)	(52)	(118)	(109)	(188)	(177)	(140)	(167)	(505)	(505)

Table 6.
Distribution of federal deputies according to the dimensions of concentration and dominance

Source: Prepared by the authors using TSE data.

tral-West regions (the latter only in 2018) were significantly above the national average in the most recent elections.

Another point worth highlighting is the fact that the fragmented and dominant profile was already dominant in the 1998 (35%) and 1994 (32%) elections. This profile (characteristic of the Northeast Region) has become even more significant, reaching 35% in 2018 and 37% in 2014. The concentrated and non-dominant profile, which was the second most common profile 20 years ago, was surpassed by the fragmented and non-dominant profile, characteristic of the South and Center-West regions.

Geographic patterns of vote distribution and political parties

Table 7 focuses on political parties, presenting the patterns of concentration and dominance aggregated by the six political parties that received the most votes during the two recent elections. It shows that the fragmented and dominant profile predominates in three of the six parties. In line with the results of 20 years ago, these parties correspond to an updated version of the pattern in which those receiving the most votes (PMDB, PP, and PSD) had the least ideological behaviour. The party with the lowest proportional representation in this range was the PSL.[1]

[1] PMDB – Brazilian Democratic Movement; PP – Progressive Party; PSD – Social Democratic Party; PSL – Social Liberal Party; PT – Workers' Party; PSDB – Brazilian Social Democracy Party.

	Concentrated and dominant		Concentrated and non-dominant		Fragmented and dominant		Fragmented and non-dominant			
	2018	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**	**2018**	**2014**
Brazil	10%	12%	22%	23%	35%	37%	33%	28%	100%	100%
	52	59	109	118	177	188	167	140	505	505
PT	6%	9%	19%	25%	28%	28%	47%	**38%**	**100%**	100%
	3	6	10	17	15	19	25	**26**	**53**	68
PSL	8%	0%	**40%**	0%	10%	0%	42%	**100%**	**100%**	100%
	4	0	**21**	0	5	0	22	**1**	**52**	1
PP	5%	13%	8%	8%	**59%**	**66%**	27%	13%	100%	100%
	2	5	3	3	**22**	**25**	10	5	37	38
PSD	9%	11%	11%	17%	**49%**	**49%**	31%	23%	100%	100%
	3	4	4	6	**17**	**17**	11	8	35	35
PMDB	9%	5%	6%	16%	**71%**	**59%**	15%	20%	100%	100%
	3	3	2	10	**24**	**38**	5	13	34	64
PSDB	**21%**	**25%**	14%	21%	31%	32%	34%	23%	100%	100%
	6	**13**	4	11	9	17	10	12	29	53

Table 7.
Concentration and dominance patterns for the six political parties that received the most votes

Source: Prepared by the authors using TSE data.

According to Carvalho (2003), parties with a marked ideological orientation have greater proportional representation in another geographic configuration, concentrating votes in shared municipalities via the concentrated and non-dominant profile. While his study showed that the PT and PPB had the highest proportion of votes in this range, Table 7 reveals that the PSL stood out in the last elections, receiving 87% more than the national average. Carvalho argues that such parliamentarians represent segments of opinion associated with electoral colleges, which are large enough not to allow their voting to imply domination.

As for the concentrated and dominant profile, characteristic of the so-called "districtable" deputies, which had the PT as their exponent in the polls 20 years ago – these were represented by the PSDB in the 2018 and 2014 elections, with more than twice the national average percentage.

Concentration/dominance patterns and their explicative variables

This section aims to understand the extent to which certain variables can explain the distribution of parliamentarians, in line with the spatial patterns of votes described in previous sections. We have therefore tested models for so-

ciodemographic variables, including the size of the electorate, the number of municipalities, and the HDI of states. We have also tested for political-institutional variables, such as the number of parties and candidates competing in each election. Some predictive models have been enhanced, with a new variable added to each iteration, to better understand how these variables explain the average fragmentation of elected deputies. The results are shown in Table 8.

In Model 1, we can see how the distribution of votes for elected deputies is influenced by the concentration of the electorate in the states. Unlike the result found by Carvalho (2003), where 34% of the variance observed in the dependent variable (average fragmentation) was explained by the predictor variable (effective municipalities in the states), only 13% of the variance could be explained by the predictor variable in the 2018 model. Twenty years ago, the addition of an effective municipality produced an impact of 0.20 on the average number of effective municipalities of elected deputies; by contrast, the same increase in 2018 produced a much greater impact of almost 0.60 on the average number of effective municipalities.

Model 2 adds the HDI variable. Although, in the 1998 election, this variable was associated with a large increase in the model's predictive capacity, it added very little in 2018. However, it is worth mentioning that, as in 1998, most deputies with more dispersed voting profiles came from regions with a lower level of human development. Models 3 and 4 show that, in 2018, neither the number of effective municipalities in the states nor the total number of voters had any impact on its accuracy.

Turning attention to the other vector described by Ames (2003), Table 9 presents the results of the multiple regression with the dominance of deputies elected in 1998 as the dependent variable. The predictor variables are, with the exception of the total number of voters in the state, the same as those used in the models in Table 8: the number of effective municipalities in the states, the HDI of the states, the number of municipalities in the states, and the total number of candidates for the role of federal deputy in the state.

In the first model, which has a single predictor variable, the number of effective municipalities in the states explains only 3% of the variation in dominance. This number is much lower than the 32% found by Nelson Carvalho in 1998. However, the relationship between the average number of municipalities in a state and its dominance remains positive in 2018, as in 1998.

The second model adds a sociodemographic variable, the HDI of states. Although the variance in the dominance index explained by the variables increases considerably (from 3% to 18%), it is still well below the 55% found in 1998. Just as it did 20 years ago, the model explains that the negative value of the HDI variable (-0.559) shows that elected candidates have a much more limited vertical penetration in states with a higher degree of human development. In other words, candidates have more difficulty controlling the municipalities where they received votes.

	Model 1	Model 2	Model 3	Model 4
Constant	8,315 *** (1,694)	32,311 ** (12,078)	44,15 ** (14,31)	39,909 * (15,544)
Effective municipalities in the states	0,575 *** (0,065)	0,568 *** (0,065)	0,304 * 0,146	0,573 *** (0,066)
HDI of the states		-33,088 * (16,490)	-48,26 ** (20,69)	-45,412 * (22,885)
Number of municipalities in the states			0,022 * (0,011)	
Total number of voters in the states			0,000000255 (0,000000239)	
Total number of candidates for the Chamber of Deputies in the state				0,00192 (0,00247)
R^2	0,131	0,136	0,144	0,136

Source: Calculated using R and prepared by the authors using TSE data.

Table 8.
Dependent variable: average fragmentation of elected deputies – 2018

	Model 1	Model 2	Model 3
Constant	0,091 *** (0,006)	0,500 *** (0,042)	0,381 *** (0,054)
Effective municipalities in the states	0,000959 *** (0,0002)	0,000849 *** (0,0002)	0,000228 0,000450
HDI of the states		-0,559 *** (0,058)	0,364 *** (0,081)
Number of municipalities in the states			0,0000429 (0,0000299)
Total number of candidates to the Chamber of Deputies in the state			-0,0000435 ** 0,0000142
R^2	0,03	0,18	0,19

Source: Calculated using R and prepared by the authors using TSE data.

Table 9.
Dependent variable: average dominance of elected federal deputies – 2018

Finally, Model 3, which includes the number of municipalities and the total number of candidates to the Chamber of Deputies in the states, shows very little increase in explanatory power, with the R^2 increasing by only 1%. As in 1998, the increase in the number of municipalities in the states causes the average dominance to increase, while the increase in the number of candidates makes it more difficult for candidates to stand out in cities.

Table 10 compares Carvalho's (2003) main findings on the elections of 1994 and 1998 with our own findings in 2014 and 2018.

Findings	1994 and 1998	2014 and 2018
Concentration	Balance between deputies with concentrated and dispersed profiles	Predominance of dispersed profiles
Regions with a higher percentage of deputies with dispersed profiles	Northeast and South	Northeast and Midwest
Region with a higher percentage of deputies with dominant profiles	Southeast	Northeast
Region with a lower percentage of deputies with dominant profiles	Southeast	Northeast
Concentrated and dominant profiles	Less common	Even more rare
Dispersed and dominant profiles	More common	Even more hegemonic
Concentrated and non-dominant profiles	Second most common	Third most common
Dispersed and non-dominant profiles	Third most common	Second most common.
Prediction of the average dispersion of deputies	The number of effective municipalities in the states and the HDI somewhat explains the dispersion and dominance.	The number of effective municipalities in the states and the HDI explains less of the dispersion than it did 20 years ago.

Table 10.
Main findings, comparing the concentration and dominance patterns of elected federal deputies in 1994 and 1998 with those in 2014 and 2018

Source: Prepared by the authors.

Conclusion

In this study, an analysis of spatial voting patterns has enabled us to identify the voting profiles of elected federal deputies and to compare them with the results of 20 years ago. In the concentration dimension, the concentrated profile continues to follow a decreasing trend, possibly reflecting the more pronounced political competition found in municipalities, which forces candidates to find votes in other places. Easy access to virtual campaigning may also have had an impact, since it allows candidates to present themselves to electorates far from their original base. The Northeast and Midwest regions have the highest incidence of dispersed profiles. There is notable volatility in the concentration numbers between elections in the Southern region, which fell both above and below the Brazilian average in consecutive votes. One hypothesis is that the profile of voters in the Southern Region changes frequently, making it difficult for governors to be re-elected themselves or to promote their successors.

In terms of dominance, the stability of the nineties has given way to considerable change. However, the Southeast and Northeast, in line with Carvalho (2003), still represent the extremes, with less and more dominance, respectively. One possible explanation for the end of stability is the fact that the 1994 and 1998 elections were won by the same presidential candidate, while the 2014 and 2018 elections were won by two opposing political forces.

Regarding the typology proposed by Ames (2003), the concentrated and dominant profile has become even rarer in recent elections. One hypothesis is that it has become more difficult for a deputy to be elected without expanding his or her electorate to other municipalities. Thus, deputies with concentrated voting can only be elected if their votes are concentrated in municipalities with a large number of voters, where candidates tend to be non-dominant. The fragmented and dominant profile has consolidated and become even more hegemonic in the country, remaining more common in the Northeast (analysis by regions) and in less ideological parties (analysis by parties). This may indicate that candidates who were previously concentrated and dominant have managed, through the diffusion of new forms of Internet-based political campaigning, to compete in locations beyond those in which they are dominant, in order to be elected. Another hypothesis is that some candidates, through the strength of their parties in certain regions, have managed to expand their electorates beyond their initial base. Still, with regard to party preponderance, the dominant concentrated profile – commonly attributed to "districtable" deputies and chiefly identified with the PT 20 years ago – has become more closely identified with the PSDB in the recent elections.

In the recent elections, unlike those of 20 years ago, the explanatory variables (the number of effective municipalities in the states and the HDI), cannot explain the average fragmentation of votes for elected deputies. Moreover, the number of effective municipalities in the state cannot explain the average

dominance as it did in the past. When the HDI is added to the model, there is some improvement, but not enough to make the model a good predictor. These findings show that recent elections have become more complex, making it necessary to identify additional variables to provide the model with a better predictive capacity. One hypothesis on the importance of the HDI in explaining fragmentation posits that the Internet has further democratised campaigns, allowing candidates with fewer resources to reach the lower strata of the population. The decreased ability of the model to explain the number of effective municipalities likely reflects the fact that more variables are needed to explain more complex elections, rendering the mathematical relationship between fragmentation and the number of effective municipalities less important.

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