

Spatial polarization of Czech Parliamentary voting since 1992: The “V” shaped trend uncovered

Research Article

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Received 25 December 2024; Accepted 05 September 2025

Abstract: The association between social sorting and political polarization is increasingly evident. Often overlooked is, however, the role of spatial sorting. In line with the US evidence, we can expect internal homogenization and external differentiation of neighbourhoods in their voting behaviour, also in the European context. In this article, we conduct the first longitudinal analysis of such spatial polarization in a European multi-party system, exploring its degree and development across several spatial scales, innovatively employing multi-group statistical indices developed for the study of ethnic segregation. We analyse the case of Czechia, contributing to a scarce amount of political polarization evidence in this country. The resulting spatial polarization of voting is generally very low, with the trajectory in the shape of the letter “V,” corresponding to three phases of Czech party politics. The 2002 legislative election saw the greatest degree of internal electoral heterogeneity of neighbourhoods, preceded by the period of formation of Czech party politics and followed by the period of increasing prominence of populist/anti-populist and cultural cleavages. Despite the increase in spatial polarization in recent years, Czech electoral behaviour still remains more or less evenly distributed in space, and the Czech mass political polarization should be rather attributed to factors other than neighbourhood homogenization.

Keywords: Czechia • Electoral geography • Multi-group segregation indices • Spatial polarization

1. Introduction

Political polarization is a common buzzword in both academic and popular discourse. Political parties, party members, voters, and society as a whole are presumably fragmenting and diverging in an increasing manner along the ideological, partisan, and even geographical lines (e.g. Rohla et al. 2018; Iyengar et al. 2019; Gidron, Adams, Will 2023). Individuals in polarized societies not only disagree with but also antagonize and, particularly in the case of severe affective polarization, dehumanize their political opponents and are more open to political violence (Kalmoe, Mason 2022; Hrbková, Macek, Macková 2023; Hrbková, Voda, Havlík 2023). Such polarization erodes political and social trust (Martini, Torcal 2019) and presents a danger to democratic norms and institutions (McCoy, Somer 2019). Frequently, the effect of such political polarization also transcends politics and influences everyday life (McConnell et al. 2017; Hrbková, Voda, Havlík 2023).

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Current research indicates, however, that political polarization is not a monolith; it consists of different dimensions that are intertwined and mutually reinforcing. Hence, particularly social sorting and stratification, but also ideological and issue polarization, increase affective polarization and *vice versa* (Mason 2018; Hartevelde 2021b).¹ Nonetheless, often neglected in this nexus is the effect of spatial polarization. This concept describes (re) distribution of people in space, their embeddedness in the local information networks, and the impact of such dynamics on mass political polarization (Bishop, Cushing 2009; Johnston, Manley, Jones 2016; Mason 2018; Tilley, Hobolt 2024).

¹ Affective polarization stands for increasing dislike towards political outgroups (Hartevelde 2021a). While the concept of spatial polarization studied in this article is tied to all dimensions of political polarization, its relationship towards affective polarization is often seen as the most impactful (Tilley, Hobolt 2024).

The concept of spatial polarization gained prominence with Bishop, Cushing's (2009) idea of "The Big Sort," which argues that the US public, however more diverse than in the past, is getting more uniform on the level of neighbourhoods. People of similar features, whether the same education level, age, lifestyle, ethnicity, or voting behaviour, are allegedly clustering in the same areas. Be it through migration, as the residential sorting thesis implies (Gimpel, Hui 2015; Efthyvoulou, Bove, Pickard 2023), or through the homogenization of neighbourhoods via socialization and conformity, that is the "neighbourhood effect" (Pattie, Johnston 2000; Hartevelde, Van der Brug 2023). While we have abundant evidence of such "spatial polarization" in the US context (Kinsella, Mctague, Raleigh 2015; Johnston, Manley, Jones 2016; Rohla et al. 2018; Mastrostavvas 2024), evidence of spatial polarization in the European multi-party systems and thus societies that are presumably less prone to residential sorting is still scarce. Although in recent years, some notable works also focused on Great Britain (Efthyvoulou, Bove, Pickard 2023; Tilley, Hobolt 2024), Italy (Bellettini, Ceroni, Monfardini 2016), Catalonia (Nel-lo, Gomà 2018) or Finland (Harjunen, Saari-maa, Tukianinen 2023), longitudinal analysis of more than mere binary divides (e.g. republican vs democrat, conservative vs labour, separatist vs unionist, or non-voter vs voter) is lacking.

We address this gap by conducting the first longitudinal analysis of spatial polarization in political attitudes and, more specifically, voting behaviour in a multi-party system, exploring its degree and development over time. We chose the case of the Czech legislative election between 1992 and 2021 in order to contribute to a so far scarce amount of political polarization evidence in this country (although see Hrbková, Macek, Macková 2023; Hrbková, Voda, Havlík 2023). Czechia provides an interesting case for analysis due to three distinct phases of the party system development (Balík, Hloušek 2016; Havlík, Lysek 2022), transitioning between extreme and limited pluralism. These shifts correspond to the changes in electoral volatility (Hájek 2020; Linek et al. 2023), party nationalization development (Stauber 2017) and, as we argue, even with changes in spatial voting patterns. In this article, we thus examine the questions of (a) how spatial polarization in Czechia develops over time, (b) whether and how it aligns with the three phases of Czech politics and, methodologically, (c) whether spatial polarization is likewise relevant in an "unstable" party system, and not only in the bipartisan systems.

The article is structured as follows. First, we provide a theoretical discussion of spatial polarization of voting behaviour, its relevance, impacts, evidence and interlinks

with other dimensions of political polarization. In the next part, we document the case of Czechia. After that, we introduce our data and the methods employed. Most notably, we present an innovative use of multi-group segregation indices developed for the study of ethnic segregation and their application at multiple scale levels. The last two sections pertain to presenting the results of the analysis, discussing the main findings, and outlining opportunities for further research.

2. Spatial polarization of voting behaviour

Polarization is a multifaceted concept associated with various, albeit intertwined, forms, most of which transcend party politics (Bauer 2019). Nonetheless, there is good evidence in the literature that non-political divisions reinforce political polarization (Mason 2018; Hartevelde 2021b). Social sorting based on socioeconomic characteristics such as income or housing and sociocultural positions such as ethnicity or religion frequently heightens mass political polarization of the electorate. Geographical isolation of these different societal sorts arguably intensifies mutual distrust, saturates affective polarization, and contributes to the increase in the spatial polarization of voting behaviour (e.g. Bishop, Cushing 2009; Johnston, Manley, Jones 2016; Druckman, Levendusky, Mclain 2018; Mason 2018; Butters, Hare 2022). Related to this process is elite and party-system polarization, which is based on diverging ideological positions and advocated political issues (Fiorina, Abrams 2008). Although spatial polarization, which stands at the forefront of this article's focus, is a part of the broader mass polarization process,² it is inevitably connected with the developments of the party systems as well.

We understand spatial polarization as a dynamic concept that can be grasped only if a complex time-space development is taken into account (Johnston et al. 2004). It manifests as an increase in unevenness of voting support for parties, ideologies, or political issues over time between areas. Frequently, areas correspond to the level of the neighbourhood (Johnston, Manley, Jones 2016), although we can also trace voting polarization between

² However, while spatial polarization of voting might correlate with structural or attitudinal characteristics of mass polarization, ecological fallacy may be at play if one automatically assumes so, as even the fine-grained level of neighbourhoods does not equate individuals.

larger regions (Lepič 2017). In any case, this process amounts to the gradual homogenization of voting behaviour within areas and their increasing differentiation from external spaces. Such an understanding of polarization is connected to and builds upon the concept of segregation (Catney 2017). Although this term is more commonly used in urban and ethnic studies, it is also a useful point of departure for the study of spatial polarization in voting behaviour.

Homogenization of neighbourhoods based on their voting behaviour is not only a symptom of political polarization, but it can also influence the affective dimension of political polarization. Crucial to this process is the role of geographical encounters (e.g. Valentine 2008). Generally speaking, if spatial proximity increases the probability of interpersonal interactions, then most of the encounters and interactions of individuals living in segregated environments will occur within these segregated and increasingly homogenized and isolated neighbourhoods (Butters, Hare 2022). Such a situation eventually leads to the gradual reinforcement of local majoritarian views (Martin, Webster 2020). Thus, as the popularity of the party or ideology becomes more and more dominant in the local social network, people will become less likely to be confronted with alternative political views, creating a vicious cycle of self-reassurance in their political views. As McCoy, Rahman, Murat (2018: 23) noted, political polarization, which itself has a dehumanising tendency, dividing people into “us and them,” gets “a further boost by physical segregation and feeds on the existing feeling of antagonism.” In this scenario, spatial polarization feeds the affective polarization and *vice versa*, in accordance with the study of the diversity of social networks (Mutz 2002; Butters, Hare 2022).

There are also some possible limitations of the assumptions behind the spatial polarization of voting behaviour. Modern processes transforming neighbourhoods, such as globalization, suburbanization, gentrification, and the development of modern information and communication technologies, have allegedly weakened local ties. People often do not even know the names of their neighbours, let alone discuss politics with them (Abrams, Fiorina 2012). Similarly, Paasi (2004) stressed that the individual-centred conception of place is often trans-local, which may partially undermine the strict boundaries imposed by the segregated neighbourhood.³

³ For this reason, we avoid the term “geographical” in our measure of polarization, simply because geographical effects are more complex and surmount the possibilities of usual quantitative analysis of spatial polarization.

However, current evidence also shows that interactions within online social networks might replicate the physical space (Laniado et al. 2018); the decline in some social ties (Putnam 2000) is being replaced by others (Clark 2015); and the globalization process has paradoxically led to neo-localism (Schnell 2013). Even if we disregard such counterarguments, the critique of spatial polarization, however appealing, does not stand up to the fact that spatial polarization has been confirmed numerous times (Kinsella, Mctague, Raleigh 2015; Belletini, Ceroni, Monfardini 2016; Johnston, Manley, Jones 2016; Rohla et al. 2018; Nel-lo, Gomà 2018; Mastrosavvas 2024). Therefore, while the driving forces of spatial polarization are a point of contention (Mummolo, Nall 2016), as is the impact of segregated neighbourhoods on affective polarization (Tilley, Hobolt 2024), the homogenization of neighbourhoods itself is apparently taking place.

3. Development of Czech party politics since 1990

Democratic parliamentary voting in the modern history of Czechia (and Czechoslovakia) dates to 1990, when the first democratic election since the fall of the communist regime took place. Since the 1990 election, the Czech party system has undergone three distinct phases of development (following the approach of Sartori 1976; see Balík, Hloušek 2016; Havlík, Voda 2016).

The period between 1990 and 1998 saw the (re)establishment of the Czech party system, which manifested in the form of extreme and polarized pluralism, with several small parties competing for dominance. Elections in 1998 marked the beginning of a period of limited pluralism between 1998 and 2010, when merely four political parties dominated the party system and accounted for the vast majority of electoral votes up until the 2010 election, when a gradual decline of the “traditional” parties began (Brunclík, Kubát 2014; Havlík Voda 2016). Following the 2010 election, a shift into the second period of extreme and polarized pluralism occurred, symptomized by the entry of populist and radical right parties into the political arena (Balík, Hloušek 2016). Brunclík, Kubát (2014) described this transformation as a crisis of Czech politics, while Smolík (2022) talks about a series of “electoral earthquakes.” The critical change was the advent of ANO 2011, a populist “catch-all” party led by billionaire Andrej Babiš.

These three phases of the party system development also align with changes in the Czech party nationalization (Stauber 2017) and correlate with the shifts in electoral

volatility (Linek et al. 2023), as voters abandoned established parties en masse (Smolík 2022). Although such correspondence is unsurprising, it clearly delineates three general phases of Czech party and electoral politics. First is the phase of reconstruction of the party politics, second (after 1998) is the phase of stability, and the last (starting in 2010) is the phase of a cleavage shift towards cultural issues and the advent of populism (Barša, Hesová, Slačálek 2021; Havlík, Kluknavská 2022; Hrbková, Macek, Macková 2023).

The phases have also been closely tied to the spatial patterns of voting. The early post-communist elections not only marked the re-establishment of the party system but also the re-emergence of spatial voting patterns, partially building on patterns established during the interwar period of democratic Czechoslovakia (1919–1938) (Jehlička, Kostecký, Sýkora 1993). These patterns stabilised geographically during limited pluralism (1998–2010) (Kostecký et al. 2014). The rise of populist and radical-right parties after 2010 then brought new spatial dynamics, as their support base spanned diverse regions previously dominated by traditional parties (Lysek, Pánek, Lebeda 2021; Lysek, Macků 2022; Suchánek, Hasman 2023).

In contrast to the prevailing view of Czech party system development presented above, Hájek (2020) argues against interpreting the post-2010 phase as a polarized pluralism, highlighting instead the role of ideological polarization rather than party system fragmentation and electoral volatility. Nevertheless, even his perspective does not contradict the primary division into three phases separated by the 1998 and 2010 elections.

Hrbková, Macek, Macková 2023; Hrbková, Voda, Havlík 2023) show that even in the case of an unstable party system in Czechia with large electoral volatility, a party or issue preference causes societal division. The instability of Czech party politics is, hence, not the reason to undermine the relevance of mass political polarization. On the contrary, it is plausible to assume that the phases of Czech party politics correspond to the development of the spatial polarization of voting.

Thus, a larger degree of spatial polarization is expected in the periods of extreme pluralism, that is, in the years prior to 1998 and after the 2010 election. In the former period, such polarization is attributable to the formation of the Czech party system and, consequently, the formation of the spatial patterns of voting behaviour. In the latter period, the rise in spatial polarization can be associated with the increased political salience of cultural issues and the gradual replacement of traditional left-right ideological competition by the populism/anti-populism divide (Barša, Hesová, Slačálek 2021; Havlík, Kluknavská

2022; Hrbková, Macek, Macková 2023).⁴ The rise in mass polarization in the third phase of Czech party politics is also registered by the V-Dem expert survey (V-Dem 2023).

4. Data and methods

While spatial polarization of voting has been studied before, its empirical examination has been mostly limited to analyses of binary divides (e.g. republican vs democrat, non-voter vs voter). From a methodological point of view, the analysis of a multi-party system is much more complicated. Standard methods, such as commonly used Moran's I spatial autocorrelation or the dissimilarity index (used in this sense by Kinsella, McTague, Raleigh 2015; Mastrovavvas 2024), analyse only two groups. To assess the overall spatial polarization of more than two political parties, we had to employ different methods. Although not standard in political science,⁵ multi-group indices of segregation are common in the study of ethnic segregation or socio-economic inequality (e.g. Winkler, Johnson 2016; Benassi et al. 2021; Bitonti et al. 2023) and can be easily translated for the study of spatial polarization.

Benassi et al. (2021) show the benefits of the combined use of more segregation indices at once. We thus opted for the use of three distinct segregation indices. Each index measures different aspects of segregation: the Information theory index (H) is a multi-group version of the Theil index, the Normalized exposure index (P) is a multi-group version of Bell's exposure index, and the Multigroup dissimilarity index (D) is a multi-group version of Duncan's dissimilarity index. In the famous segregation typology of Massey, Denton (1988), both H and D are tied to the dimension of (un)evenness, while P is tied to isolation, the two constituent aspects of both spatial polarization and segregation. These indices can be mathematically expressed as follows:

⁴ In parallel (and partly related) to the evolution of the political party structure and party oppositions, there was also a significant social and economic transformation, as well as a transformation of the administrative structure, all of which can influence spatial polarization of voting. Analysis of these factors is however not the article's objective and should become the focus of future studies.

⁵ Interesting is the use of a Gini-based party nationalization score (Stauber 2017). However, because such a measure was not scrutinised on the key segregation measure criteria (Reardon, Firebaugh 2002), it might not be as appropriate for the study of spatial polarization as it is for nationalization.

$$H = \sum_{m=1}^M \sum_{j=1}^J \frac{t_j}{TE} \pi_{jm} \ln \frac{\pi_{jm}}{\pi_m}, \quad (1)$$

$$P = \sum_{m=1}^M \sum_{j=1}^J \frac{t_j (\pi_{jm} - \pi_m)^2}{T (1 - \pi_m)}, \quad (2)$$

$$D = \sum_{m=1}^M \sum_{j=1}^J \frac{t_j}{2TI} |\pi_{jm} - \pi_m|. \quad (3)$$

The notation of these equations is derived from Reardon, Firebaugh (2002). M stands for the number of groups; J for the number of spatial units; T for the total population across all units; t identifies size; j spatial unit; π proportion. Hence, t_j denotes the total population of the spatial unit j ; π_{jm} is the proportion of group m in unit j , and π_m is the overall proportion of group m in the population. The E in equation (1) is the Theil's Entropy Index (Theil, Finezza 1971) and I in the equation (3) stands for the Simpson's Interaction Index (Lieberman 1969; White 1986). Both can be written as follows:

$$I = \sum_{m=1}^M \pi_m (1 - \pi_m),$$

$$E = \sum_{m=1}^M \pi_m \ln \left(\frac{1}{\pi_m} \right).$$

The Information theory index (H) is generally considered “the most conceptually and mathematically satisfactory index” of segregation (Reardon, Firebaugh 2002: 33) and can be interpreted as “one minus the ratio of the average within-unit population diversity to the diversity of the total population” (Reardon, Firebaugh 2002: 42).

The Normalized exposure index (P) measures the degree of isolation between groups and can be interpreted as the extent of group interaction relative to the maximum possible exposure. Isolation, together with unevenness, is considered a key dimension of segregation (Massey, Denton 1988; Reardon, O'Sullivan 2004), which makes it a suitable choice for a robustness check as it measures different dimensions of segregation compared to the H .

Multi-group dissimilarity index (D) can be interpreted as “the percentage of all individuals who would have to transfer among units to equalize the group proportions across units, divided by the percentage of those who would have to transfer if the system started in a state of complete segregation” (Reardon, Firebaugh 2002: 42). Unlike H and P , it is much easier to interpret D . It indicates the proportion of individuals who would need to move to achieve perfect evenness relative to the maximum amount of movement needed in the case of complete segregation.

Value 0.1 means that the movement needed for full evenness is 10% of the movement needed for reaching this evenness in the case of complete segregation. Therefore, we could say that while H and P are better for assessing the trend of spatial polarization, D is better for interpreting the degree of spatial polarization of voting. All three indices range from 0 to 1, with 0 indicating no polarization and 1 maximum polarization. The indices were calculated using the PySAL segregation Python package (Cortes et al. 2020).⁶

The key disadvantage of the presented methods is that they are aspatial. They do not regard spatial proximity and measure only the distribution of groups among organizational units (in our case, the electoral districts, municipalities, and administrative districts) without taking the neighbourliness of the units into account. Neither do these indices decompose spatial polarization in a way which allows approaching local non-stationarity across the territory; on the contrary, a single value of spatial polarization is returned for the whole of Czechia at each point in time, scalar level, and political opposition. While several spatial forms of multi-group polarization/segregation indices have been proposed (Reardon, O'Sullivan 2004), the form of our data prohibits their use, as we would need geolocation of our data, which is not available for older years. To partly counter this issue, we employ the methods at different spatial scales.

4.1 Data

We analysed voting support in the legislative elections, as these are Czechia's most significant elections, consistently attracting the highest voter turnout. More specifically, we focused on the elections between 1992 and 2021.⁷ The first democratic election in 1990 was omitted from the analysis due to profoundly different municipal and political party structures. Data were obtained from the Czech Statistical Office (ČSÚ 2024). Three spatial scales were used: (1) electoral districts (~14,900 units), (2) municipalities (~6,253 units), and (3) administrative divisions (76 units). The

⁶ Reproducible Python script is available upon request.

⁷ The 1992 elections were held in the context of federal Czechoslovakia, which included both the Czech and Slovak National Councils (serving as national parliaments) and Federal Assembly (the federal Czechoslovak parliament). In the analysis, we use Czech National Council elections, which have greater continuity to subsequent Chamber of Deputies elections after the dissolution of Czechoslovakia.

use of fine-grained electoral districts addresses the frequent issue noted by several authors (Abrams, Fiorina 2012; Hartevelde, Van der Brug 2023) of conceptually studying neighbourhoods while using populationally large areas in the analysis. A comparison of results at different scales is vital for disentangling the neighbourhood and regional spatial polarization variances.

In the best-case scenario, methodologically speaking, we should have a constant number and shape of spatial units in use since the segregation indices are not time-independent. Although electoral districts and municipalities underwent some changes in their delimitation in the analysed period of 29 years, it was not feasible to account for these alterations. However, the overall number of units remained about the same, ensuring data comparability. The total number of electoral districts ranges from 14,756 in 2017 to 15,034 in the 1992 legislative election, and the number of municipalities ranges from 6,200 in 1992 to 6,388 in 2021. In the case of the largest cities, municipalities correspond to city districts, while whole city units have been excluded from the analysis. Control calculation using whole city units instead of city districts did not alter the results. Special electoral districts representing votes from abroad were removed from the analysis. The administrative district of Jeseník, which was created in 1996, was reattached to its former district, Šumperk, to ensure the same number of administrative districts for all years analysed.

4.2 Categorizing political groups

Although the multi-group nature of the methods employed allows us to analyse more political parties simultaneously, it still requires the use of a consistent number of groups for every analysed election year. Similarly to the number of spatial units, the number of groups also affects the results. And while the changes in the number of electoral districts, amounting to approximately 0.5% between each

election, have only a negligible effect, differences in the number of political groups could distort the results. Considerable variation in the number of political parties throughout the elections under study forced us to assemble political parties into groups. This procedure is also conceptually appropriate. In the multi-party systems, political polarization based on partisanship is transcended by polarization on issues and ideologies (Hrbková, Macek, Macková 2023) and political camps (Bantel 2023). People do not dislike out-partisans equally (Wagner 2021), “rather, dislike of fellow citizens tends to grow with ideological distance” (Hartevelde 2021a: 10). From the perspective of spatial polarization, it is not probable that people who cease to vote for one right-wing party and start voting for another right-wing party will suddenly become isolated from their former co-voters. Aggregating parties based on their ideology and voter transitions into broader groups is thus appropriate, especially in unstable multi-party systems with high electoral volatility, such as the one we are dealing with (Linek et al. 2023).

Given that the way we group parties (and consequently the voters) together can alter the results, we have decided to use three different political groupings prevalent in the literature to ensure the robustness of our results. Table 1 provides an overview of these classifications. The detailed composition of these political groupings, together with the theoretical grounding of their group assignment, is presented in the Supplementary Appendix 1.

5. Results

As the longitudinal results of all three polarization indices for the three party classifications (Figure 1), reveal, the pattern of spatial polarization remains consistent regardless of the party classification and the polarization measure. It follows a general trend evoking a V-shape. More specifically, spatial polarization of voting behaviour in

Classification label	Overall number of groups	List of groups
Party families	6	Fiscally-conservative parties; social-democratic parties; Christian-democratic parties; communist parties; other parties; non-voters
Left-wing/Right-wing	4	Left-wing parties; Right-wing parties; other parties; non-voters
Government/Opposition	4	Government parties; Opposition parties; Non-parliamentary parties; non-voters

Table 1. Overview of party classifications used in the analysis.

Source: Authors based on the literature presented in Supplementary Appendix 1.

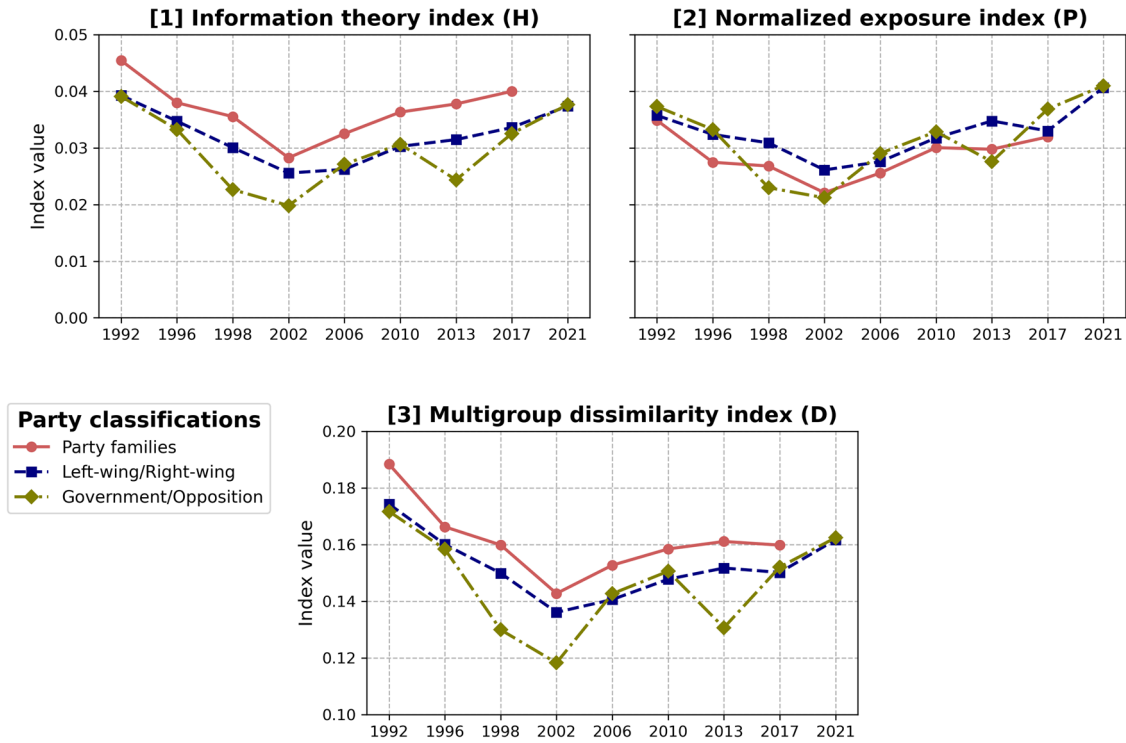


Figure 1. Spatial polarization of voting in Czechia: Comparison of statistical indices on the level of electoral districts. Source: Authors based on their own calculation; data: ČSÚ (2024).

Czechia declined after the 1992 legislative election. It reached its lowest level in the 2002 election, after which it started to gradually rise. The only divergence to this trend occurs in the case of the multi-group dissimilarity index value for the party family classification (plot [3]), where the spatial polarization following the 2002 election does not show a continuous increase. However, since the dissimilarity index (D) is, mathematically speaking, a less relevant measure for assessing trend over time, greater weight should be placed on the values of the information theory index (H) and the normalized exposure index (P), both of which record consistent changes in spatial polarization across all of the party classifications.

The trend is smoothest in the case of the left-wing/right-wing classification and the most variable in the government/opposition classification. That is not surprising, given that the left-wing/right-wing classification represents relatively stable voter groups. In contrast, in the government/opposition classification, the population is resorted in every election year. For example, the most significant decline in spatial polarization of the government/opposition classification in the 2013 election is likely due to the left-wing ČSSD governing together with ANO, which at that time attracted former right-wing voters

(Gregor 2014). This alignment grouped previously distinct voter bases together under the “government” category, affecting the spatial polarization results. However, despite such partial divergences, even the government/opposition classification shows the V-shaped trend.

The crucial point in the interpretation of the results is assessing the actual degree of spatial polarization. Even in the years of the highest polarization, the dissimilarity index (D) remains below 0.18. That is generally a very low value. It says that a mere 18% of the total amount of shifts that would be hypothetically needed in the case of total segregation would be actually needed to make the population electorally fully even in this case. Although comparison of polarization indices’ values with the results of studies from different environments can be tricky due to the dependence of measurement on the population sizes of spatial units, the gap is still immense. For instance, the D value of ethnic segregation in the USA, as documented by Winkler, Johnson (2016), was 0.45. The case of ethnic segregation in Naples, Italy, even shows the D value of 0.71 (Bitonti et al. 2023). We are constrained by the lack of studies applying multi-group segregation indices to the study of spatial polarization of voting; however, considering the maximum possible polarization, the values are

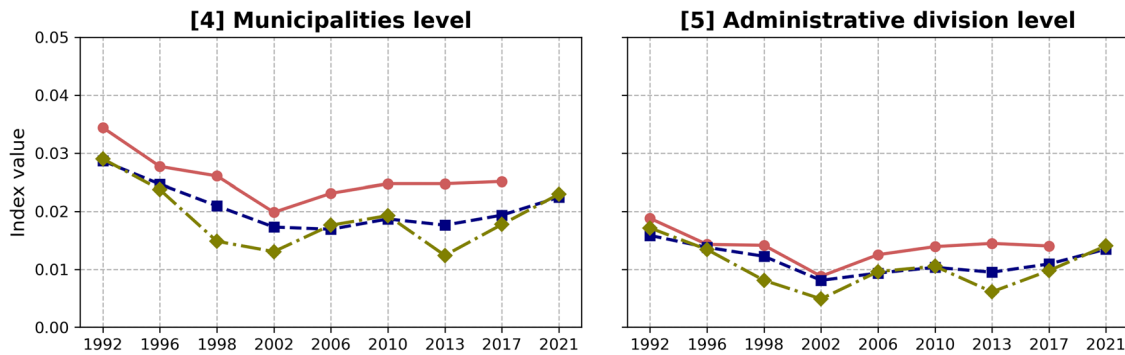


Figure 2. Spatial polarization of voting in Czechia: Comparison of Information theory index results across geographical scales. Source: Authors based on their own calculation; data: ČSÚ (2024).

very low. This is even exacerbated in the case of H and P indices, where the resulting index values are marginal. Although polarization increased by about 20% from 2002 to 2021, this change proceeds from a very low baseline and does not suggest rapid or significant polarization. Spatial polarization in today's Czechia remains comparable to the levels observed throughout the 1990s.

Such findings are particularly interesting regarding the socio-spatial differentiation of Czechia after the Velvet Revolution (Ouředníček, Temelová 2011). Theoretically, if the spatial polarization was influenced only by the post-communist spatial differentiation, we should observe a more or less linear increase in spatial polarization of voting. However, rather than by the social and economic transformation (which nonetheless cannot be fully ruled out), spatial polarization seems to be influenced by the party system transformations and the ascent of the populist and radical right parties in Czech politics after the 2010 legislative election. This aligns with our assumption. Spatial polarization of voting mostly corresponds to the three phases of Czech party politics development as described in section *Development of Czech party politics since 1990*. Nevertheless, we cannot attest to the causality of this connection from this research.

Looking at the comparison of spatial polarization at different geographical scales (plots [1], [4] and [5] in Figures 1 and 2), we can see that the degree of spatial polarization is even lower at the level of municipalities (obce) and administrative districts (okresy).⁸ This is because populationally greater spatial units tend to reflect voter proportions closer to the national mean. Also, as Johnston, Manley, Jones (2016) stress, spatial polarization measured at finer scales tends to be higher, as such

polarization also includes polarization at the larger scales. More importantly, however, results at different scales point to partly distinct patterns. From 1992 to 2002, spatial polarization decreased at all scales, yet after 2002, polarization significantly increased only at the level of electoral districts. This evidence indicates a shift from regional polarization in the 1990s to neighbourhood-level polarization after the 2002 election. All areas went through a transforming phase in the 1990s, but while larger regions remained relatively uniform after 2002, neighbourhoods started to gradually polarize. Individual neighbourhoods within regions and cities began to mutually diverge in “their” voting behaviour while becoming internally more homogeneous. Such differences might stem from the changing drivers behind polarization. While spatial polarization in the 1990s might be tied to the formation of the Czech party system and spatial voting patterns, spatial polarization after 2006 might have been brought about by the advent of populism/anti-populism and cultural cleavages (Barša, Hesová, Slačálek 2021; Hrbková, Macek, Macková 2023). Such spatial polarization is thus possibly closer to general mass polarization, which, according to the V-DEM expert survey, also increased only in the third phase of Czech party politics (V-Dem 2023).

While our analysis did not aim to address explanations behind the spatial polarization of voting behaviour (such as the migration versus the neighbourhood effect theses), this indirect scale-based comparison favours the effect of migration. The growth of spatial polarization is noticeable when we divide the municipalities into electoral districts, which, in the measurement, amplifies the impact of places with the most of these districts. This, in particular, points to large cities and their proximate suburban areas since these are the places that experienced the most considerable migration turnover. However, such a premise needs to be analytically clarified in further research, especially since it goes against the relatively higher residential

⁸ More detailed results of the analysis on different scale levels are presented in the Supplementary Appendix 2.

stability of the Czech population compared to the traditionally studied US context.

6. Discussion and conclusion

With the rising popularity of political polarization as a concept for analysis, evidence of a spatial dimension of political polarization is also mounting. In this article, we have presented the first longitudinal analysis of spatial polarization degree in a multi-party system, employing several statistical indices derived from the study of ethnic segregation. As such, this article contributes methodologically to the study of spatial polarization in multi-party systems and expands the evidence of mass political polarization in Czechia.

Main findings reveal a general “V-shaped” trend of spatial polarization in voting behaviour over the period under study, which is robust across the classification and the statistical index used. From 1992 to 2002, the Czech parliamentary voting patterns manifested decreasing levels of polarization, while we observed an increase in the degree of spatial polarization after the 2002 election. Such a trend corresponds to the three phases of Czech party politics (delineated by the years 1998 and 2010). In the 1990s, higher spatial polarization is attributable to the formation of the Czech party system and the (re)formation of the regional spatial patterns of voting behaviour. From 2010 onwards, spatial polarization is tied to, and reflects, the homogenization of individual neighbourhoods and is arguably related to a general increase in mass polarization, driven by the populism/anti-populism divide and the rise in the salience of cultural issues (Barša, Hesová, Slačálek 2021; Hrbková, Macek, Macková 2023; Hrbková, Voda, Havlík 2023).

Results do not signal any radical polarization; however, the trend is clear, and without interruption, Czech society may gradually become politically polarized in space in their electoral behaviour and consequently also segregated in other attitudes and opinions. Such segregation might lead to an increase in affective polarization and a decline in political and social trust. Nonetheless, we urge caution when making strong statements about the degree and trajectory of Czech political polarization based on these results. Despite the increase in recent years, the overall level of spatial polarization remains very low. Czech society remains more or less evenly distributed in space in its voting behaviour, and the mass political polarization that is already occurring (Hrbková, Macek, Macková 2023; Hrbková, Voda, Havlík 2023) is probably tied more to factors other than neighbourhood homogenization.

Regarding the limitations of our research, a crucial one is the classification of parties into groups. We used several political groupings to ensure the robustness of our results; however, in any longitudinal analysis of spatial polarization, such classification will remain the main point of contention and should always be implemented with sufficient grounding in the literature. Given that we work with areal-level data, we also cannot overlook the risk of ecological fallacy or the modifiable areal unit problem. Nevertheless, the use of fine-grained electoral districts, multi-scalar comparison, and caution in the interpretation should mitigate such risks.

The exploratory character of our analysis opens several interesting avenues for future research. A comparison of results at multiple scales indicated that while the decrease in polarization prior to the 2002 election had not only local but also regional dimensions, in subsequent elections, the regions did not diverge in their voting behaviour as much as the neighbourhoods did. Detailed between-region and within-region analysis might provide a more rigorous assessment of this process. Moreover, while our analysis did not aim to address explanations of the spatial polarization of voting behaviour, basic comparison across scales favours the effect of migration decisions, and follow-up research should address this premise further. Besides, future research should also deal with the crucial questions of proximity and systematic multi-scalar analysis in the study of spatial polarization. Given the relevance of spatial polarization even in a comparatively steady Czech party system with nationalized voting patterns, it is reasonable to assume its importance likewise in countries exhibiting more divisive electoral geography, such as Slovakia or Poland (Zarycki 2015; Havlík et al. 2024), as well as other contexts beyond Central Europe. Such comparative research could further enrich the off-mentioned, nevertheless impactful case of spatial polarization of voting behaviour.

Funding information

This study was supported by Charles University, project GA UK No. 287823.

Author contributions

Pavel Cihlár contributed to all aspects of the article, including conceptualization, data collection, statistical analysis, visualization and interpretation of results, writing, and article supervision. Martin Lepič contributed

primarily to the conceptual and theoretical framing, research design, interpretation of results, and revision of drafts.

Conflict of interest statement

Authors state no conflict of interest.

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