Regional Science Policy & Practice 18 (2026) 100258

Contents lists available at ScienceDirect

Regional Science Policy & Practice

journal homepage: www.sciencedirect.com/journal/regional-science-policy-and-practice

Spatial spillover effects on the support for populist radical right parties in Slovakia

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ARTICLE INFO

Keywords:
Populist radical right parties
Spatial spillovers
Spatial econometrics
Slovakia
LSNS

ABSTRACT

Populist radical right parties known for populist, anti-immigrant, and Eurosceptic stances have gained varying electoral support in the European Union. Slovakia is no exception and this study investigates the determinants of support for populist radical right parties in Slovakia, focusing on spatial spillover effects and regional disparities. Using spatial econometric models and panel data from 79 Slovak districts across three election cycles (2016, 2020, 2023), the analysis identifies both contextual and compositional factors influencing PRRP support. By integrating advanced spatial econometric approaches, we revealed that variations in PRRP support arise not only from the characteristics of a specific region (direct effect) but also from the influence of neighboring regions' characteristics (indirect effect), emphasizing the role of spatial interdependencies in shaping political preferences. The study highlights the need for regionally coordinated policies to address economic inequalities and foster social cohesion. Findings of this study contribute to the broader discourse on populism and regional development in CEE, underscoring the importance of targeted interventions in lagging regions to mitigate the spread of populist narratives and strengthen democratic resilience.

1. Introduction

Populist radical right parties (PRRP), which espouse populism, employ anti-immigrant discourse, endorse xenophobic ideologies, and exhibit Eurosceptic stances, have recently garnered varying degrees of electoral support within the European Union member states (Hainsworth, 2008; Colantone and Staning, 2019; Dijkstra et al., 2020). The growing sense of discontent expressed by the rise of populism can be understood as inherently linked to geography. It arises from the unique interplay of economic and cultural geographical factors, coupled with growing variances in the everyday realities of diverse socioeconomic and racial groups (Florida, 2021). The discontent is often occurring in the "places that don't matter" (Rodríguez-Pose, 2018). This notion refers to regions characterized by economic stagnation and decline, which have articulated sentiments of being sidelined and forsaken.

Although the majority of existing research has focused on Western Europe, the issue extends well beyond those borders, as countries in Central and Eastern Europe have likewise recorded a notable increase in support for populist, eurosceptic, and radical right-wing parties. In Slovakia, parties such as People's Party Our Slovakia (Ľudová strana naše Slovensko - ĽSNS) and Republika have gained substantial support, mirroring trends seen in neighboring states. The post-communist transformation, coupled with regional inequalities, ethnic conflicts and economic uncertainties, has provided fertile ground for the rise of these parties (Bustikova, 2014). These dynamics highlight the need to examine the underlying contextual (socioeconomic) and compositional (demographic) factors driving PRRP support in this region, which differ significantly from the conditions in Western Europe.

In contrast to previous research, this study also focuses on examining spatial dependence in PRRP support. Support for PRRP may be influenced not only by local factors but also by the situation in neighboring regions (Bourdin, Tai1 2022; Sümeghy, 2024; Maza and Hierro, 2025; Lenzi and Perucca, 2025; Koeppen et al., 2025). Cross-regional interactions—such as contacts between residents within families, workplaces, or social settings, whether occurring face-to-face or via social media—may lead to changes in voting behavior. Thus, the primary objective of this article is to explore the contextual and compositional determinants of PRRP support in Slovakia, with particular emphasis on the role of spatial spillover effects.

To achieve this objective, we use electoral data on the results of two PRR parties from the parliamentary elections in 2016, 2020, and 2023, covering 79 districts of Slovakia. The panel structure of the data enables

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https://doi.org/10.1016/j.rspp.2025.100258
Received 31 January 2024; Received in revised form 6 October 2025; Accepted 7 October 2025
Available online 8 October 2025

us to examine the role of local factors, assess their spatial spillover effects, while controlling for unobserved regional characteristics that remain constant over time. By incorporating spatial interactions and addressing spatial heterogeneity, this study offers a more comprehensive understanding of mechanisms driving voting behavior in Slovakia.

The article is structured as follows. After the introduction, Section 2 reviews the existing literature on PRRP in Slovakia. Section 3 briefly describes spatial patterns of voting support which results from spatial heterogeneity and spatial interactions. Section 4 introduces the methodology, including the data and variables used in the analysis, followed by a subsection outlining the spatial econometric approach. Section 5 presents the results of the empirical analysis. Section 6 discusses the interpretation and broader implications of the findings. Finally, Section 7 concludes the article by summarizing the main results and discussing their policy implications, as well as offering suggestions for future research.

2. Populist radical right parties in Slovakia

The radical right in Slovakia has been successful and dynamic, benefiting from its adaptability to societal changes and focus on resonant issues such as political and economic transformations, public xenophobia, and key events such as EU accession and the refugee crisis (Kluknavská and Smolík, 2016). Unlike Western Europe, where populism often arises from immigration backlash, Slovakia faces significant outmigration. Its nationalism, shaped by post-communist transformation and the peaceful split from Czechoslovakia, reflects a focus on sovereignty and historical vulnerability (Harris, 2022) rather than colonial legacies. Additionally, foreign direct investment drives economic growth but exacerbates regional inequalities, fueling populist narratives of justice and anti-elitism. The Slovak extreme right, rooted in ethno-nationalist traditions, has strategically adapted to local grievances and national identity concerns (Kluknavská and Smolík, 2016). These unique dynamics, combined with limited research on PRRP in Slovakia, highlight its importance for understanding how PRRP mobilize in post-communist societies. Slovak National Party (SNS) initially created fertile ground for this success by normalizing ethno-nationalist rhetoric through its role in nationalist-populist coalitions. Since then, various forms of extreme-right parties have emerged within this environment, including mainstream-established parties and their splinter groups, marginal non-parliamentary movements, and more radical offshoots. Among these, the SNS had long been the longest-standing and electorally most successful (Kluknavská and Smolík, 2016). However, in 2016, ĽSNS unexpectedly broke into national politics, capitalizing on this atmosphere with a more radical and openly xenophobic program (Kluknavská, 2012). ĽSNS, established in 2000, was taken over by radical right politicians in 2010. In its initial parliamentary elections, the party received 1.33 % of the vote in 2010 and 1.58 % in 2012. However, its support increased significantly in the following elections, with 8.04 % in 2016 and 7.97 % in 2020. In 2021, a group of members left ĽSNS to form a new party, Republika. By the 2023 elections, ĽSNS's share of the vote had decreased to 0.84 %, while Republika secured 4.75 %. Whilst the pre-election period in 2023 saw major parties increasingly adopt radical-right narratives to gain electoral advantage, this culmination of mainstreaming further entrenched these ideologies in Slovak politics. This reflects deep-rooted societal factors and the persistent appeal of ethno-nationalist rhetoric (Mihálik, Jankoľa, 2016; Walter, 2017; Mesežnikov, Gyárfášová 2018), which trace back to ideological links with the wartime fascist Slovak State (Harris, 2022).

Current research shows that economic marginalization, including high unemployment and low incomes in certain regions, low education levels, and pervasive anti-minority attitudes—particularly toward the Roma—create fertile ground for PRRP support in Slovakia (Mesežnikov, Gyárfášová 2018). ĽSNS has capitalized on these conditions by adapting its messaging to reflect societal frustrations and leveraging socio-economic and cultural issues. According to Kluknavská and Smolík (2016), ĽSNS effectively employed anti-minority rhetoric, particularly against the Roma, while integrating broader nationalist and anti-establishment narratives. Its growth was further driven by dissatisfaction with political elites and economic inequalities, which resonated with voters. During the 2015 refugee crisis, the party expanded its platform to include xenophobia toward immigrants and Muslims, exploiting heightened public anxieties (Kluknavská and Smolík, 2016; Voda et al., 2021).

While the SNS primarily attracts support through cultural and nationalist appeals, ĽSNS's success appears more closely tied to regional economic grievances, particularly in areas with high unemployment and low wages, where local communities feel neglected by mainstream parties (Rehák et al., 2021). Analyses of exit polls from the 2016 elections show that ĽSNS gained significant support from young, first-time voters, particularly those who are less educated and face limited opportunities (Gyárfašová & Slosiarik, 2016; Rehák et al., 2021). The party's support is geographically concentrated in areas near Roma settlements, where ethnic tensions amplify its anti-minority rhetoric (Kluknavská, 2014).

3. Spatial aspects of support for populist radical right parties

Preferences for populist radical right parties (PRRPs) typically exhibit strong spatial variation. These parties often have electoral strongholds, regions of high support, while enjoying much less support elsewhere. The resulting spatial pattern reflects multiple underlying processes. First, regional differences in PRRP support arise from spatially heterogeneous demographic characteristics (*compositional factors*) and socioeconomic contexts (*contextual factors*) (Essletzbichler et al., 2021; van Leeuwen et al., 2021; Crulli and Pinto, 2025). Population composition varies across regions because individuals with similar traits and values tend to cluster geographically—driven by socioeconomic conditions, local amenities, and lifestyle preferences. Regional economic performance, employment opportunities, and the quality of public services also vary. Poor economic outcomes, limited job prospects, and weak public infrastructure generate dissatisfaction, creating fertile political terrain for PRRPs (Rodríguez-Pose, 2018; Diemer et al., 2022). Key drivers include the so-called "holy trinity" of age, income, and education (Dijkstra et al., 2020). However, even after controlling for these compositional and contextual factors, some spatial variation remains unexplained, often due to omitted variables that are unobserved or improperly measured.

Electoral outcomes cannot be fully accounted for by demographics and socioeconomic conditions alone. Voting behavior is a complex process embedded in social space, shaped by interactions both within and across regions. Most interactions occur face-to-face among residents of the same region, yet regions are open units, with interregional movement for work, education, leisure, and recreation. Moreover, digital communication, mass media, and social networks enable interactions across distance and subsequently may result in change of voting preferences (Jambrina-Canseco, 2023; McKay et al., 2024). Whether in-person or digital, most exchanges occur among spatially proximate actors (Bastos et al., 2018). Through social interaction, individuals share values, anxieties, and economic experiences (Bicchieri, 2005; Koeppen et al., 2025), potentially adjusting their political preferences, and thereby influencing demand for PRRPs (Golder, 2016). Supply-side factors matter too (Golder, 2016), PRRPs' opportunities to compete, via local campaign events, billboards, media appearances can extend into neighbouring regions through social media sharing, regional broadcasts, and leader mobility. Demonstration effects may also arise, strong PRRP support in one district may legitimize similar support in adjacent districts over time (Essletzbichler et al., 2021). Wiesehomeier et al. (2024) found that such diffusion is facilitated in areas with similar contextual conditions, as these lower the barriers to adapting populist ideas.

4. Data and methods

4.1. Data

This analysis utilizes data from 79 districts at the LAU2 level in Slovakia, spanning three election periods in 2016, 2020, and 2023, resulting in a panel dataset comprising 237 observations. The dependent variable is the percentage share of votes received by PRRP in parliamentary elections for each respective year. To identify PRRP in Slovakia, we used the 2019 Chapel Hill Expert Survey (CHES) (Jolly et al., 2019) which assesses the ideological positions of EU political parties based on expert evaluations. CHES includes electorally relevant or ideologically significant parties and covers dimensions such as populism, anti-elitism, and attitudes toward European integration. ĽSNS was classified as a populist radical right party based on its ideological score of 9.31 on a 0–10 scale, where 0 represents the extreme left and 10 the extreme right. In 2023, we combined the votes of ĽSNS and Republika, as Republika was formed by former members who left ĽSNS. This aggregation allows us to capture the overall voter support for these parties as a continuation of the former PRRP. Fig. 1 illustrates the evolution of LSNS electoral results across districts over time. While year-to-year variations and spatial patterns are not immediately apparent, several notable trends can be identified. Higher and more stable support for LSNS is observed in districts within central and northern Slovakia. Conversely, LSNS support remains consistently lower in districts containing major urban centers (e.g., Bratislava, Košice) and in the southern regions of western and eastern Slovakia, characterized by a high concentration of the Hungarian minority population.

We divided independent variables into so-called compositional and contextual factors (Stockemer et al., 2018; Maxwell, 2019; van Leeuwen et al., 2021; Lenzi and Perucca, 2021). The contextual variables capture the economic characteristics of the districts. Average nominal monthly wage was chosen as an independent variable because it effectively captures regional economic disparities, which are strongly linked to support for PRRP. Previous research has consistently shown that economic grievances, including wage stagnation and inequality, play a significant role in driving PRRP support. Studies like those by Colantone and Staning (2019) and Inglehart and Norris (2016) highlight how lower wages and economic insecurity fuel voter discontent, while Rodríguez-Pose (2018) emphasizes regions with lower wages often feel excluded from national progress, aligning with the "places that don't matter" theory, where economic stagnation drives populist sentiment. The share of employment in the manufacturing industry represents the average number of employees working in the manufacturing industry on the district level. The share of people working in the manufacturing industry in relation to voting for PRRP reflects regional economic vulnerability and structural dependence on traditional industries, which are often affected by globalization and economic transformation. Regions with higher industrial employment tend to experience economic and cultural dislocation when industries decline, fueling grievances that PRRP exploit through anti-globalization and protectionist rhetoric (Rodrik, 2018; Colantone and Staning, 2019). This variable has also been used to explain major political outcomes, such as Brexit, where Becker et al. (2017) link deindustrialization to Eurosceptic support. Including this variable allows us to account for the economic and structural shifts that underpin voter behavior. The unemployment rate serves as a significant indicator for analyzing support for PRRP, as it highlights economic insecurity and regional disparities, both of which are strongly linked to voter dissatisfaction. High unemployment rates contribute to economic grievances and perceptions of neglect, fueling support for PRRP that promise to address these issues (Inglehart and Norris, 2016; Rodríguez-Pose, 2018). Additionally, unemployment amplifies perceived competition for jobs and resources, which PRRP exploit through anti-immigrant and protectionist rhetoric (Golder, 2016).

We collected all of the above-mentioned secondary data from the Statistical Office of Slovakia to ensure accuracy and relevance to the Slovak context for the years 2016, 2020 and 2023. The unemployment rate data for 2023 were not available at the district level and were only provided at the regional level. To address this limitation, linear estimation was employed to calculate the unemployment rate for 2023.

The compositional indicators reflect the demographic structure of the region and its cultural aspects. Gross internal migration balance rate in terms of internal migration on the district level—movement out of and into regions—provides critical insights into regional disparities and demographic dynamics that influence support for PRRP. Regions with net outmigration often experience economic decline and depopulation causing weaker tax bases, and reduced public service provision, fostering discontent that PRRP capitalize on through anti-elite rhetoric, while areas with net in-migration can face resource competition and social tensions, further fueling populist sentiment (Rodríguez-Pose, 2018). van Leeuwen et al. (2021) found that while population decline does not directly increase populist support, regions with net outmigration often face socio-economic challenges like lower incomes and higher unemployment. These conditions amplify dissatisfaction, indirectly fostering populist voting. Including internal migration balance as a variable captures the broader impact of demographic shifts on regional disparities and political behavior. The share of residents living in small municipalities (up to 5000 inhabitant) or large municipalities (larger than 20,000 inhabitants) reflects the urban-rural divide and disparities in opportunities. Smaller municipalities, with low population density, often face economic stagnation and geographic isolation, fostering grievances that PRRP exploit through anti-elite and nationalist rhetoric (Cramer, 2016). In contrast, larger municipalities may experience tensions related to diversity and resource competition (Essletzbichler et al., 2018). Ford and Goodwin (2014) showed that rural and small-town areas in Britain strongly supported radical right parties due to cultural

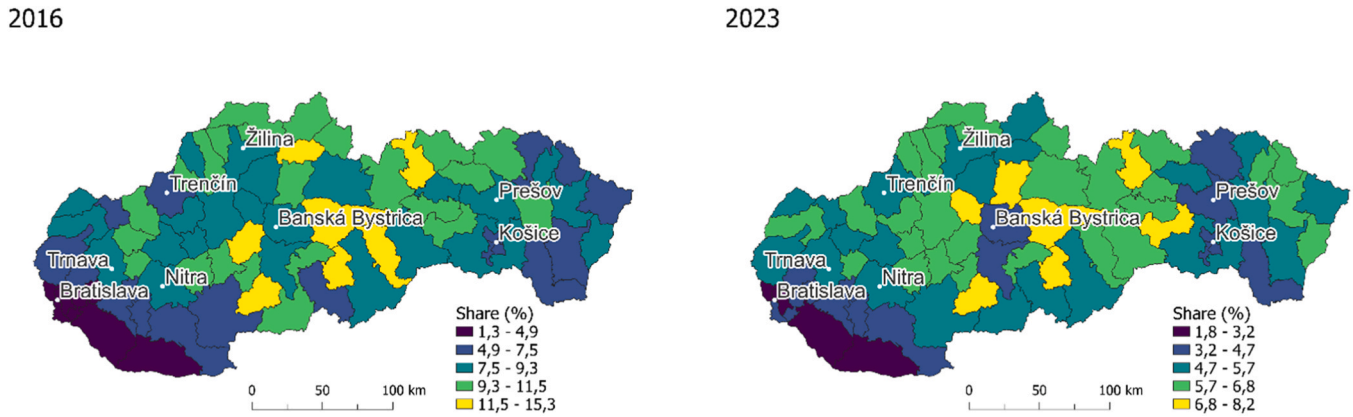

Fig. 1. Evolution of LSNS electoral results across districts over time (2016, 2023).

and economic grievances, while Rodden (2016) linked low population density to anti-establishment voting patterns. Nationality structure represents the share of the population claiming Hungarian nationality, the share of the Roma population, and the share of other minorities in Slovakia. Research shows that regions with significant minority populations or demographic shifts are more likely to support PRRP, as these parties exploit perceived cultural and economic threats associated with minorities. For instance, Rydgren (2008) and Lubbers et al. (2002) highlight how ethnic diversity and perceived competition drive radical-right voting, while Ford and Goodwin (2014) demonstrate that areas with larger minority populations show stronger support for PRRP in Britain. Age structure is divided into two age groups - population 15–29 and population 65 + . Age is widely used in analyzing PRRP voting patterns due to its strong influence on voter behavior (Essletzbichler et al., 2018; Ford and Goodwin, 2017; Goodwin and Heath, 2016). Older voters, often more culturally conservative and skeptical of immigration, align closely with PRRP appeals, prioritizing welfare and cultural security (Hobolt, 2016). Regions with a higher share of older residents are particularly susceptible to PRRP messaging, while younger, more liberal populations are less inclined to support these parties (Ford and Goodwin, 2014). All of the above-mentioned variables were obtained from the Statistical Office of Slovakia on the district level for the years 2016, 2020, and 2023.

Variable religiosity is divided into three groups - catholic, protestants and greek catholics. Religiosity as a predictor was used in previous studies as it represents deeply rooted cultural values and underscores the influence of religious identity on political preferences. Religious individuals often align with PRRP positions on traditional moral values, such as opposition to LGBTQ+ rights or abortion, and perceive these parties as defenders of national and religious identity against perceived threats like secularism or immigration (Mudde, 2007; Norris and Inglehart, 2011). In contexts where religion is intertwined with national identity, as in Slovakia, PRRP capitalize on these sentiments to build voter support (Brubaker, 2017). Educational structure as a variable represents two groups - primary and lower secondary education that was calculated together and tertiary education. Research shows that lower education levels correlate with greater susceptibility to anti-elite, nationalist, and protectionist rhetoric, driven by economic insecurity and cultural conservatism (Inglehart and Norris, 2016). Moreover, it is often linked to a lack of opportunities, as individuals with lower education and skills tend to be disproportionately impacted by crises, exacerbating regional inequalities (Becker et al., 2017; Rodríguez-Pose, 2018). In contrast, tertiary education fosters cosmopolitanism, political engagement, and tolerance, reducing PRRP support (Hakhverdian et al., 2013; Mau et al., 2008; Mancosu and Sarcone, 2025). Mechanisms explaining this relationship include the cognitive skills and liberal norms gained through higher education (Stubager, 2008), as well as its role in preparing individuals for globalization (Gabel and Palmer, 1995).

Data on religiosity and educational structure were obtained from the Slovak Public Census Database for the years 2011 and 2021. Using these datasets, linear estimation was applied to derive the values for 2016, 2020, and 2023, as data for these years were not directly available.

We included voter turnout as a control variable to ensure a robust analysis of PRRP support. Immerzeel and Pickup (2015) found that successful PRRs can influence turnout differently across regions: in Eastern Europe, their emergence lowers turnout, particularly among young voters and those with positive attitudes toward immigrants, reflecting an anti-system response. Conversely, in Western Europe, PRRs mobilize higher-educated, politically engaged citizens to oppose them at the polls.

Descriptive statistics of the dependent variable as well as the independent variables are presented in Table 1.

Table 1
Descriptive statistics.

Statistic	N	Mean	St. Dev.	Min	Max
PRRP support	237	7,61	2,90	1,29	17,03
Voting turnout	237	64,23	6,93	43,55	78,75
Wage	237	1194,88	301,04	658,00	2253,00
Employment in manufacturing	237	31,86	13,77	2,77	68,11
Unemployment	237	7,89	4,54	1,58	24,58
Migration balance	237	0,01	4,43	−5,94	25,64
Pop. in mun. up to 5000 inh.	237	47,85	20,64	0,00	87,64
Pop. in mun. larger than 20,000 inh.	237	29,71	32,77	0,00	100,00
Hungarian minority	237	6,00	13,40	0,02	72,26
Roma minority	237	1,84	2,71	0,00	11,79
Other minorities	237	8,10	5,75	1,98	51,67
Population 15–29	237	17,01	2,73	9,62	25,47
Population 65 +	237	16,93	2,76	9,12	23,76
Catholic	237	56,05	16,48	8,04	93,68
Protestants	237	6,16	7,40	0,24	47,25
Greek catholic	237	5,18	9,94	0,19	50,01
Tertiary education	237	17,43	7,27	8,88	52,34
Primary and lower secondary edu.	237	51,22	7,83	25,49	66,17

4.2. Econometric approach: spatial econometric models for panel data

PRRP support exhibits a characteristic spatial dimension, but only few studies have used spatial econometric models to account for spatial dependencies in regression models (e.g. Fiorino et al., 2021; Essletzbichler et al., 2021; Gutiérrez-Posada et al., 2021; Iglesias-Pascual et al., 2022). Unlike previous research we utilize panel data which allows us to control for unobserved characteristics specific to individual spatial units. In addition, a larger sample size improves the accuracy of the estimated coefficients. As in the case of cross section spatial models, spatial autocorrelation can be included in the model through spatially lagged variables or through spatial error autocorrelation. Unobserved characteristics can take the form of fixed (correlated with explanatory variables) or random (uncorrelated with explanatory variables) effects. Since our research employs fixed effect models (see Section 5), the following section describes this group of models. The econometric specification of the spatial panels in our article is based on Bouayad Agha et al. (2018).

Spatial dependence on the support of PRRP may stem from different spatial processes. On the one hand, it can result from omitted variables that are spatially differentiated, so called spatial heterogenity (e.g. differences in infrastructure, local policies, cultural differences, etc.), or it can result from spatial interactions (e.g. interactions between people in neighboring regions or economic linkages, etc.). In the first case, these spatial processes are represented by the spatial error model (SEM) and in the second case by the spatial lag model (SAR), or it may be a combination of both processes represented by the spatial autoregressive lag and error (SARAR) model.[1]

The first specification is the SAR panel data model with fixed effects.

$$y_{it} = \rho \sum_{i \neq j} w_{ij} y_{jt} + \quad x_{it}\beta + \alpha_i + u_{it}$$

This model contains an endogenous spatial interaction effect between the dependent variables,

which is represented by the spatially lagged dependent variable $\sum_{i \neq j} w_{ij} y_{jt}$. Inclusion this variable implies that the value of the dependent

[1] There are also other specifications of spatial models such as the Spatial Durbin Model (SDM), which contains an endogenous interaction effect between dependent variables as well as an exogenous interaction effect between explanatory variables, the Spatial Durbin Error Model (SDEM), which contains an exogenous interaction effect between explanatory variables and an interaction the effect between the error terms, and finally the spatial lag of X model (SLX), which contains the exogenous interaction effect between the explanatory variables.

variable at time t in observation i is not only explained by the values of the explanatory variables for that specific observation but also by the explanatory variables of neighboring spatial units.

Second specification is the spatial error panel model with fixed effects, which includes spatial interaction in the error term.

$$y_{it} = \quad x_{it}\beta + \alpha_i + u_{it}$$

$$u_{it} = \lambda \sum_{i \neq j} w_{ij} u_{jt} + \varepsilon_{it}$$

Third alternative specification is the SARAR model with fixed effects which combines SAR and SEM model.

$$y_{it} = \rho \sum_{i \neq j} w_{ij} y_{jt} + \quad x_{it}\beta + \alpha_i + u_{it}$$

$$u_{it} = \lambda \sum_{i \neq j} w_{ij} u_{jt} + \varepsilon_{it}$$

Several methods exist for choosing a specific model, which are divided into two groups, the so-called bottom up (Anselin et al., 1996) and top-down approach (LeSage and Pace, 2009). To estimate spatial panel models, we use the *splm* library in R (Millo and Piras, 2012), which uses a bottom-up approach based on Lagrange multiplier tests, or on their robust versions (Anselin et al., 1996). The tests are based on the analysis of the residuals of the linear OLS model, while investigating whether it is necessary to include spatial autocorrelation in the dependent variable or in the error term. Debarsy, Ertur (2010) developed a version of these tests for panel data with fixed effects.

4.2.1. Spatial weights matrix

The specific interactions between spatial units often remain unknown, and they vary for each variable within the model and are not constant over time. Spatial weights are primarily based on the neighborhood of spatial units (e.g., queen contiguity), geographic distances between units (with or without a cut-off point), nearest neighbors (nearest-neighbor matrix, e.g., Knn), and non-spatial proximities such as social networks, economic, and cultural proximities (for a comprehensive overview, see Anselin, 2021). Distance-based weights employ distance decay functions between two units, with the most prevalent functional forms being the inverse distance function and the negative exponential function. It is standard practice to assess the robustness of estimated models by employing different spatial weights. In our study, we will estimate parameters using queen contiguity, and K-nearest neighbor contiguity.

4.2.2. Estimation methods

Estimation of spatial models with panel data is most often based on maximum likelihood estimation (MLE) or on the basis of generalized methods of moments (GMM). The MLE method estimates the parameters using the maximization of the likelihood function seeking parameter values that best explain the observed data. The assumption of using MLE is that the residuals of the model follow a normal distribution. The GMM method was extended for panel data by Kapoor et al. (2007). The method is based on the use of moment conditions that connect the model parameters with the expected values of the observed data. Unlike MLE, it does not require residuals to be normally distributed, making it more robust to heteroscedasticity. Our primary method for estimating model parameters is MLE, however we also use the GMM method to assess the robustness of our results.

4.2.3. Direct and indirect effects

Unlike the coefficients of the OLS model, the results of the models with autoregressive coefficient cannot be interpreted as marginal effects because the estimated coefficients are not partial derivatives (LeSage and Pace, 2009). Spatial dependence between observations means that the effect of the investigated variable on the dependent variable is also affected by the values of neighboring observations. Since the impact of independent variables varies over all regions, LeSage and Pace (2009) propose a summary measure of these varying impacts, which are as follows. Direct effects denote the influence of the variable in a municipality on PRRP support in a given municipality, averaged over all municipalities. Indirect effects capture the effect of a change in the variable in other municipalities on the average change in PRRP support in a given municipality. The sum of direct and indirect effects is referred to as total effects. The interpretation of the overall effect can be twofold. First, it addresses the average overall impact on the PRRP support in a typical municipality arising from the change of the variable in all municipalities. The second interpretation is the overall cumulative effect arising from one municipality changing the variable on the average change in PRRP support in all other municipalities.

4.2.4. Tests

To distinguish between fixed and random effects in spatial panel regression, we used the spatial Hausman test for spatial panel models. The null hypothesis of the test is whether the random effects are correlated with the explanatory variables. Based on the results of the spatial Hausman test (chisq = 311.23, p-value = 2.2e-16), we rejected the null hypothesis and estimated the model with fixed effects in the next empirical analysis.

We used tests based on the Lagrange multiplier to identify the specification that is most appropriate for incorporating spatial dependence into the model. The results of the LM tests of the fixed-effects model are presented in Table 2. Both simple and robust versions of the tests suggest rejection of the null hypothesis. However, the test results do not allow us to distinguish which model best explains the spatial autocorrelation in our data, so we estimate the SARAR model, which includes both spatial lag and spatial error dependence.

5. Results

Our starting model is the SARAR model with fixed individual effects estimated on the basis of maximum likelihood. The results are presented in Table 3. Six of the seventeen independent variables are statistically significant. Coefficients of spatial dependence *rho* (spatially lagged dependent variable) as well as *lambda* (spatially lagged error term) are both statistically significant.

As we explained in the previous section, the estimated coefficients cannot be interpreted as marginal effects, since the coefficients are not partial derivatives (LeSage and Pace, 2009). In Table 4 we present the mean effect and its standard deviation, together with 2.5 % and 97.5 % quantiles for direct, indirect and total effects based on the recommendation of LeSage and Pace (2009) A positive (negative) mean with a positive (negative) lower and upper interval are interpreted as positive (negative) effects. Effects whose interval includes zero are interpreted as statistically insignificant. Both direct, indirect and total effects consistently show that five of the seventeen variables are statistically significant.

First, we analyze the direct effects. The direct effects in Table 4 are different from the corresponding estimated coefficients in Table 3. This is because their size is also influenced by the feedback effect of other districts. Of the economic contextual variables, the unemployment rate

Table 2
LM tests for spatial dependence.

Test	Value	P-value
LM test for spatial lag dependence	43.280	4.744e−11
LM test for spatial error dependence	12.543	0.0003977
Locally robust LM test for spatial error dependence sub spatial lag	24.222	8.586e−07
Locally robust LM test for spatial lag dependence sub spatial error	54.959	1.231e−13

Table 3
Estimation of the fixed effects model with spatial autocorrelation (Maximum likelihood).

	Estimate	Std. Error	t-value	Pr(>|t|)
Voting turnout	−0.005	0.050	−0.101	0.920
Wage	−0.001	0.001	−1.349	0.177
Employment in manufacturing	−0.030*	0.016	−1.834	0.067
Unemployment	0.224***	0.062	3.603	0.000
Migration balance	−0.013	0.058	−0.234	0.815
Pop. in mun. up to 5000 inh.	0.013	0.032	0.416	0.677
Pop. in mun. larger than 20,000 inh.	0.016	0.011	1.440	0.150
Hungarian minority	−0.310***	0.105	−2.938	0.003
Roma minority	0.173**	0.082	2.115	0.034
Other minorities	0.020	0.043	0.474	0.635
Population 15–29	0.018	0.133	0.137	0.891
Population 65 +	0.193**	0.095	2.024	0.043
Catholic	−0.111	0.076	−1.447	0.148
Protestants	0.200	0.190	−1.049	0.294
Greek catholic	−1.732**	0.828	−2.095	0.036
Tertiary education	−0.000	0.087	0.001	0.999
Primary and lower secondary edu.	−0.009	0.032	−0.267	0.790
Rho	1.002***	0.110		
Lambda	0.786***	0.044		
Observations	237			

Note: * $p < 0.1$; ** $p < 0.05$, *** $p < 0.01$

Table 4
Direct, indirect and total impact estimates.

	Direct	Indirect	Total
Voting turnout	−0.006	−0.018	−0.024
	(0.060)	(0.176)	(0.235)
Wage	−0.002	−0.005	−0.007
	(0.001)	(0.004)	(0.005)
Employment in manufacturing	−0.039	−0.108	−0.147
	(0.021)	(0.071)	(0.091)
Unemployment	0.286*	0.799*	1.085*
	(0.081)	(0.336)	(0.403)
Migration balance	−0.016	−0.045	−0.061
	(0.074)	(0.216)	(0.289)
Pop. in mun. up to 5000 inh.	0.017	0.048	0.065
	(0.041)	(0.121)	(0.161)
Pop. in mun. larger than 20,000 inh.	0.021	0.059	0.080
	(0.015)	(0.046)	(0.060)
Hungarian minority	−0.400*	−1.115*	−1.515*
	(0.137)	(0.514)	(0.634)
Roma minority	0.221*	0.618*	0.839*
	(0.105)	(0.358)	(0.453)
Other minorities	0.027	0.075	0.102
	(0.055)	(0.161)	(0.215)
Population 15–29	0.025	0.071	0.096
	(0.171)	(0.498)	(0.665)
Population 65 +	0.250*	0.696*	0.946*
	(0.123)	(0.405)	(0.519)
Catholic	−0.141	−0.393	−0.534
	(0.099)	(0.310)	(0.403)
Protestants	−0.258	−0.721	−0.978
	(0.246)	(0.740)	(0.976)
Greek catholic	−2.243*	−6.250*	−8.493*
	(1.070)	(3.616)	(4.587)
Tertiary education	0.002	0.005	0.007
	(0.112)	(0.325)	(0.434)
Primary and lower secondary edu.	−0.011	−0.030	−0.042
	(0.041)	(0.120)	(0.160)

Note: Impact estimates are calculated using splm library in R; * indicates coefficient significantly different from zero.

is a significant predictor with a coefficient value of 0.286. Thus, an increase in the unemployment rate by 1 percentage point in the district is associated with higher support for the PRRP by 0.286 percentage points. The variables average wage and share of manufacturing employment are just below the threshold of statistical significance. Among the compositional variables, higher PRRP support is associated with higher representation of Roma nationality (0.221) and lower representation of Hungarian nationality (-0.400). Additionally, a higher proportion of older residents over 65 is also associated with higher support for PRRP (0.250). Among the indicators related to religiosity, only the proportion of residents with a Greek Catholic religion (-2.243) is statistically significant.

Indirect effects include spatial spillovers of other districts. It should be noted that indirect effects are the cumulative effects of all neighboring districts ($i \neq j$), neighbors of neighboring districts, and so on. Therefore, the value of the coefficient is 3–4 times higher than in the case of direct effects. The largest part of this influence takes place between immediately adjacent districts. The indirect effect of a 1 percentage point increase in unemployment rate in neighboring *j* districts is associated with 1.115 percentage points higher PRRP support in the monitored *i* district. A higher proportion of Roma residents (0.618) and the proportion of the population over 65 (0.696) also have a positive impact. As with the direct effects, a higher proportion of inhabitants with Hungarian nationality and a higher proportion of inhabitants with Greek Catholic faith in neighboring municipalities is negatively associated with PRRP support. Finally, for the sake of completeness, we also present the total effects in Table 4, which represents the sum of direct and indirect effects.

5.1. Robustness checks

To assess the robustness of our results, we estimated a series of additional models with different specifications. We present the results in Table 5. Model (1) represents our reference SARAR fixed-effects panel model with parameters estimated via maximum likelihood. Model (2) is also a SARAR model estimated by generalized methods of moments, which is more robust in the case of data heteroskedasticity problems. The results are similar to model (1) but several variables became statistically significant. These are average wages that are negatively associated with support for the PRRP and the share of manufacturing employment, the share of residents in municipalities with up to 5000 inhabitants, the share of other national minorities and the share of residents with the Catholic faith, which are positively associated with support for the PRRP. In the third model, in contrast to model (1), we expressed the contextual variables (wage, employment in industry and unemployment rate) as a change compared to 2010. In this way, we wanted to capture whether PRRP support is associated with a change in economic parameters instead of their level, especially in relation with the period after the economic and financial crisis. Of the changed contextual variables, only the increase in the unemployment rate is associated with a higher level of PRRP support. Other contextual variables are not significant. On the other hand, compared to model (1), a higher voter turnout in the district is associated with a decrease in PRRP support compared to 2010, and a change also occurred in the effect of the age structure, where PRRP support increased in districts with a higher representation of young residents. A significant predictor of higher PRRP support in this model is also a higher level of migration balance and lower education. Finally, we estimated model (5), in which, compared to model (1), we replaced the queen contiguity with the 5 nearest neighbors. Model (5) basically yields the same results as model (1).

[a] variables in Model (3) are expressed as a change since 2010

6. Discussion

We first examine direct effects from two groups of contextual covariates. First group consists of labour-market indicators—unemployment, average wage, and industrial employment share. Among these, only the unemployment rate demonstrated a significant effect. Unemployment is commonly associated with feelings of threat and future uncertainty,

Table 5
Estimation of the fixed effects model with spatial autocorrelation with different specifications.

	(1) Fixed effect (ML, queen)	(2) Fixed effect (GM, queen)	(3) Fixed effect (change, ML, queen)	(4) Fixed effect (ML, 5KNN)
Voting turnout	−0.005	−0.033	-−0.130*	−0.015
	(0.050)	(0.045)	(0.052)	(0.051)
Wage	−0.001	−0.006***	−0.003	−0.002
	(0.001)	(0.001)	(0.002)	(0.001)
Employment in manufacturing[a]	−0.030*	0.0255**	−0.029	−0.028
	(0.016)	(0.012)	(0.018)	(0.018)
Unemployment[a]	0.224***	0.262***	0.296***	0.210***
	(0.062)	(0.053)	(0.073)	(0.066)
Migration balance[a]	−0.013	0.045	−0.111*	−0.019
	(0.058)	(0.043)	(0.064)	(0.066)
Pop. in mun. up to 5000 inh.	0.013	0.029**	0.036	0.013
	(0.032)	(0.014)	(0.034)	(0.035)
Pop. in mun. larger than 20,000 inh.	0.016	0.004	0.006	0.021
	(0.011)	(0.008)	(0.012)	(0.013)
Hungarian minority	−0.310***	−0.084***	−0.696***	−0.262**
	(0.105)	(0.015)	(0.125)	(0.114)
Roma minority	0.173**	0.250***	0.996	0.255***
	(0.082)	(0.090)	(0.091)	(0.091)
Other minorities	0.020	0.060*	−0.031	0.008
	(0.043)	(0.036)	(0.049)	(0.047)
Population 15–29	0.018	−0.147	0.277*	−0.050
	(0.133)	(0.142)	(0.159)	(0.151)
Population 65 +	0.193**	0.300***	0.165	0.178*
	(0.095)	(0.097)	(0.112)	(0.102)
Catholic	−0.111	0.059**	−0.005	−0.112
	(0.076)	(0.024)	(0.085)	(0.083)
Protestants	0.200	−0.008	−0.142	−0.187
	(0.190)	(0.038)	(0.199)	(0.210)
Greek catholic	−1.732**	−0.115***	−1.582*	−2.414***
	(0.828)	(0.029)	(0.850)	(0.837)
Tertiary education	−0.000	0.056	−0.288***	0.040
	(0.087)	(0.056)	(0.096)	(0.098)
Primary and lower secondary edu.	−0.009	0.034	0.064*	0.003
	(0.032)	(0.027)	(0.036)	(0.035)
Rho	−1.002***	−0.210***	−0.670***	−0.989***
	(0.110)		(0.174)	(0.0141)
Lambda	0.786***	0.210**	0.290**	0.761***
	(0.044)	(0.085)	(0.129)	(0.047)
Observations	237	237	237	237

Note: * p < 0.1; ** p < 0.05, *** p < 0.01

often interpreted by PRRPs as a failure of mainstream political parties and state institutions (Margalit, 2019). Although closely linked to unemployment, the average wage was not a significant factor in our study. While changes in wages are connected to shifts in social status, these are not as radical as those induced by unemployment. Industrial employment share also lacks significance, indicating limited sectoral influence of PRRP support in Slovakia. A second group of indicators includes net internal migration and the urban-rural structure. Neither variable is significant, suggesting that PRRP support in Slovakia is not strongly correlated with urban-rural disparities. Compositional factors encompass district-level population structure: ethnicity, religion, age, and education. Ethnic composition has strong effects. Districts with higher proportions of the Hungarian minority exhibit lower PRRP support, whereas those with larger Roma populations show the opposite. Minority presence thus exerts divergent influences, shaped by contact patterns, history, and stereotypes. Similarly, higher shares of Greek-Catholics correlate with reduced PRRP support. Greek-Catholicism is historically linked with the Rusyn minority and was persecuted during Slovakia's WWII clerofascist regime (Cirner and Székely, 2023). Districts with more older voters (65 +) show higher PRRP support, consistent with the conservative preferences of older cohorts (Norris and Inglehart, 2019). The proportion of younger residents in a district was not significant, likely due to their more fragmented political views. Surprisingly, educational attainment has no significant direct effect, in contrast to earlier research in Slovakia (e.g., Rehák et al., 2021).

Our analysis underscores that PRRP support is shaped not only by local conditions but also by a situation in neighbouring districts. Indirect spillovers are significant across multiple compositional and contextual factors. For example, unemployment spillovers may reflect regional labour-market structures: commuting across district borders spreads economic insecurity and its effects. Information on poor economic conditions is further shared via media, social networks, and political campaigns, mobilizing voters across the region. Similar unemployment spillovers have been documented by Sümeghy (2024) in Sweden and Bourdin, Tai1 (2022) in France. Ethnic composition spillovers are also noteworthy. Higher shares of Hungarian minorities in neighbouring districts reduce PRRP support locally, consistent with the "contact hypothesis" (Allport, 1954). Contact between members of different ethnic groups can reduce prejudice and polarization not only within a district but also beyond its borders. The Hungarian minority's deep-rooted political and cultural institutions facilitate peaceful coexistence in many regions in Slovakia. In contrast, positive spatial spillovers concerning Roma populations may reflect perceived social threats, contributing to higher local PRRP support. The Roma minority is often socially segregated, living in poverty and exclusion, and lacks relevant political representation (Bahna and Zagrapan, 2020). According to Dean et al. (2019), the existence of clear geographical and social boundaries between groups increases the potential for conflict. Slovak PRRPs typically portray the Roma as a cultural and economic threat (Bahna and Zagrapan, 2020). While a higher proportion of Roma within a district is associated with increased PRRP support, negative prejudices also spread to neighboring districts through negative discourse. Residents may develop concerns about the proximity of Roma communities, which can be interpreted as supporting the group threat theory (Blalock, 1967; Blumer, 1958). Religious composition shows similar spatial spillovers: Greek-Catholic presence in neighbouring districts suppresses PRRP support, suggesting shared community and church influences transcending district borders. Age structure also spills over: high shares of older residents in neighbouring areas predict higher PRRP support locally, perhaps due to inter-family influence across borders. Bourdin, Tai1 (2022) report similar age-related spillovers, though Maza and Hierro (2025) found a negative effect in Spain, and Gutiérrez-Posada et al. (2021) identified no age spillovers in Brexit voting—highlighting possible non-linear or subgroup-specific patterns.

7. Conclusion

This article aimed to investigate the contextual and compositional determinants of PRRP support in Slovakia, with a specific focus on the role of spatial spillovers. Spatial econometric analysis based on data on district-level election results for three electoral cycles in 2016, 2020 and 2023 has brought about a set of interesting empirical findings that could help to understand the mechanisms behind such processes and may have implications for regional policy recommendations.

We confirmed that both compositional and contextual factors play important role in shaping the PRRP support in Slovakia. Empirical analysis revealed that main economic factor is the unemployment rate, suggesting that regional discontent has strong economic background. Among the composite factors, we identified a positive effect of the proportion of elderly residents, while religious affiliation, specifically the share of Greek Catholics, showed a negative effect on support for PRRP. An interesting finding is that the presence of ethnic minorities can reduce support for PRRP, as seen in the case of the Hungarian minority. However, the effect is reversed in the case of the Roma minority. This divergence can largely be explained by differing levels of minority integration. While the Hungarian minority is relatively well integrated, the Roma minority remains highly segregated and is often perceived by

the majority population as a social threat.

Our analysis shows that PRRP support is shaped not only by local factors but also by conditions in neighbouring districts, with significant spatial spillovers related to unemployment, ethnic composition, religion, and age structure. These spillovers reflect regional dynamics, such as labour-market connections, social networks, and cross-border interactions between ethnic or religious groups. Neighbouring district characteristics significantly affect local PRRP support, underscoring the interconnected nature of social and political environments. While the study does not establish causality, it contributes valuable empirical insights to the growing body of literature on spatial political behaviour and suggests that future research and policy interventions should account for the regional diffusion of socioeconomic and cultural influences.

Mostly, the findings underscore the importance of addressing both local and regional drivers of support for populist radical right parties. Policymakers should prioritize reducing economic disparities in structurally disadvantaged regions through targeted investments in employment, education, and public services. Interventions must also consider spatial spillover effects, as grievances and radical-right support often diffuse beyond administrative boundaries. Promoting social cohesion—through inclusive policies, intercultural dialogue, and support for marginalized communities—can mitigate the spread of exclusionary narratives and foster greater regional resilience to extremism. It does not necessarily mean more spending but more effective and targeted policies. Many of the mechanisms behind PRRP support—such as economic grievances or ethnic stereotypes—are amplified by spatial diffusion, policy responses must be coordinated across adjacent districts. Disconnected or fragmented interventions risk leaving "hotspots" of discontent intact. Communicating policy efforts more transparently and visibly in areas with elevated PRRP support, and doing so in cooperation with local actors, may reduce feelings of neglect and political alienation.

CRediT authorship contribution statement

Stefan Rehak: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Kuběnková Dana:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We express our gratitude to colleagues from the Department of Public Administration and Regional Development at the University of Economics in Bratislava for their valuable comments and suggestions. Our appreciation extends to the participants of the 61st ERSA Congress, who shared insightful perspectives with us. We would also like to express our sincere gratitude to the two anonymous reviewers for their insightful and constructive comments. This work was supported by the Vedecká Grantová Agentúra MŠVVaŠ SR a SAV [1/0774/19].

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