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EFFECTS OF LOCAL POLICIES AND PUBLIC GOODS ON TOURISM IN RURAL AREAS: EXPLORING SPATIAL DEPENDENCE PATTERNS

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ABSTRACT: The main objective of this paper is to compare the effects of the occurrence of public goods versus local government expenditures on the development of touristic facilities in rural areas. The specific objective focuses on identifying patterns of spatial dependence and analysing the distance bands in which spatial effects occur, especially accounting for backwash effects. The analysis provides insight into the spillovers that are usually omitted while building spatial development plans. The robust-VCE Poisson Spatial Durbin Model based on data from the entire population of counties in Poland was used. We found that local policies, spending, and spatial planning can compensate for a lower endowment of public goods. The negative spatial effect of the occurrence of public goods generally exceeded the positive effect of clustering.

KEYWORDS: agritourism, spatial effects, public goods, environmental policy, backwash effect, SDM

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Introduction

Cultural, recreational, and natural resources influence the attractiveness of a given destination to tourists, and they are important factors in the development of tourism (Vargas-Vargas & Mondéjar-Jiménez, 2010; Villanueva-Álvaro et al., 2017). These amenities can be treated as typical public goods, and their occurrence should determine the volume of tourism traffic. In response to the increase in tourist demand, accommodation facilities have developed. Thus, the touristic base can be treated as a proxy for touristic demand.

Theoretically, touristic infrastructure should develop in places where public goods (touristic attractions) occur in abundance, but this is not always the case in rural areas. In more remote areas, the development of touristic facilities is also linked to the general level of economic development of the area and appropriate policies (Baptista Alva et al., 2022; Liu et al., 2020). These factors may, at least to some extent, substitute for naturally existing public goods. The paradox, however, is that rural areas with better infrastructure receive more aid (Cárdenas Alonso & Nieto Masot, 2022; Engelmo Moriche et al., 2021). This creates a kind of endogenous relation in which the tourist base is dependent on policy funds, but the stream of funds can also be impacted by the level of tourism development.

Moreover, the development of tourism in rural areas is further subject to the clash of two opposing effects, called "spatial dependence" in spatial econometrics. On the one hand, rural municipalities can create clusters of tourism in rural areas, especially where there are particularly high levels of natural and cultural public goods (Chhetri et al., 2017; Delgado et al., 2010; Dias-Sardinha et al., 2018). On the other hand, rural areas can also be subject to a backwash effect (Cater, 2002), i.e., negative spatial dependence. This means that one area (a municipality, for example) can attract a large number of tourists while neighbouring municipalities suffer from a low interest in what they offer. Spatial dependence, especially if it is negative, is very often neglected in studies of determinants of touristic demand and the development of accommodation facilities. Therefore, we believe that interactions between touristic infrastructure, public goods, policies, and their spatial dependence in rural areas are complex and insufficiently investigated.

The main objective of the paper was to compare the effects of public goods (environmental and cultural) and local government expenditures on the development of various types of touristic facilities in rural areas. The secondary objective was to identify patterns of spatial dependence in this development, including analysing the distance bands in which spatial effects occur.

Two **research questions** were formulated:

First, to what extent does the development of the tourist base (infrastructure) in rural areas depend on the local provision of public goods—natural resources and cultural heritage – and to what extent is this a result of the wealth of the region and the amount of public spending?

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Second, what is the importance of spatial dependence for the development of the tourist base in rural areas, and which pattern in this regard is dominant: clustering (positive spatial dependence) or the backwash effect (negative spatial dependence)?

We hypothesise that the scarcity of public goods in rural areas can be partially compensated for by public policies and that tourism clusters are the basic development pattern of tourism in rural areas.

Although spatial effects and the impact of public policy on tourism in rural areas have been studied, ours is the first research to comprehensively compare different determinants of touristic infrastructure development that account for spatial patterns (both negative and positive spatial dependence) using an innovative methodology, namely the Robust-VCE Poisson Spatial Durbin Model (SDM). We not only analyse the occurrence of clustering and the backwash effect, but we also provide a detailed analysis of the distances in which both effects exist and vanish. We use the example of Poland between 2010 and 2020. It has one of the biggest potentials for the development of tourism in rural areas in Europe, but its infrastructure is still underdeveloped compared to major western EU countries.

The rest of this paper is organized as follows: in the next section, we review the literature on the impact of public goods and policy on the development of tourism in rural areas and the literature on the spatial effects of tourism in rural areas. The third section describes the data and methodology used in this research in detail. The fourth section presents results and a discussion, while the last section concludes.

An overview of the literature

The role of public goods and policy in tourism in rural areas

Public goods and their access are important resources for tourism activity in rural areas, and they might lay the groundwork for development at the local level (Rigall-I-Torrent, 2008). Rural destinations with high nature values are more attractive to visitors and, as a result, show higher levels of consumer satisfaction, accommodation capacity, and direct income from tourism (Blancas et al., 2011; Purwaningsih et al., 2017; Vannoppen et al., 2021).

Public goods in rural areas are related to natural resources, but they are also provided by agricultural activities (Viaggi et al., 2021). Bilbao-Terol et al. (2017) showed that the development of tourist infrastructure is influenced by the way agricultural land is used. A higher percentage of grassland (and a lower percentage of arable land) in rural municipalities increases the rental prices of accommodation sites. Territories with common land use and the specifics of tourism activity could create tourism clusters in rural areas. This illustrates spatial dependence on a variety of spatial effects (Bell & Irwin, 2002). Interestingly, pub-

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lic goods attract tourist flow, but there is also a reverse effect. The increasing demand for ecosystem services from the tourist side encourages farmers to voluntarily enhance the landscape (Zavalloni et al., 2015). Another source of public goods in rural areas is related to cultural heritage. Cultural tourism attractions have shown agglomeration effects and clustering for tourism in rural areas using the spatial approach (Liao et al., 2022; Zhao et al., 2022).

Álvarez-Díaz et al. (2017), using the Spatial Autoregressive (SAR) model and a gravity model, showed that attractive public goods had positive and significant effects on the number of tourist trips in Spanish regions. The importance of distance, transport cost, and accessibility also have been demonstrated. For example, Liu et al. (2020) showed that the development of transport systems compressed space and had spatial effects on tourist destinations. Short temporal destinations (those closer to cities) could benefit from spillover effects. For long temporal destinations, however, time–space compression has a negative impact because tourists can easily change their destinations and can visit several destinations during one trip.

Governance systems could promote the involvement of public goods in tourism activity, but this depends on regional and tourism policies. Some papers show that local governments and their tourism policies on rural areas could increase development in multidimensional scales, including tourism resources, infrastructure, marketing, and the capability of rural residents to run small and mid-sized businesses (Baptista Alva et al., 2022; Liu et al., 2020). Rural areas with better infrastructure receive more aid, but more peripheral areas need new activities and economic diversification (Engelmo Moriche et al., 2021; Cárdenas Alonso & Nieto Masot, 2022). These areas could be considered by policy-makers as problem regions that need financial intervention, and from the spatial approach, they can lose the possibility of sustainable development by wasting their potential. However, Bohlin et al. (2016), using Sweden as an example, have shown that the impact of tourism policy on the development of tourism in rural areas is less than usually assumed.

Spatial effects of the development of tourism in rural areas

Rural tourist destinations are partially dependent on complementary tourist products (food, accommodations, trade, attractions, etc.), which are mainly provided by individual businesses (Fotiadis et al., 2019; Genovese et al., 2017; Moric, 2013; Yang et al., 2021). According to this approach, tourism in rural areas can be presented as a cluster that includes tourism businesses. The advantages of these clusters are their potential for attracting tourism and providing access to local public goods (Chhetri et al., 2017; Delgado et al., 2010; Dias-Sardinha et al., 2018).

Tourism clusters in rural areas benefit from agglomeration when they are bound together with marketing channels and business transactions (Polo Peña et al., 2015; Tang et al., 2022; Wang et al., 2022). This cluster approach for devel-

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oping tourism in rural areas accelerates business activities for rural inhabitants. It also influences tourism enterprises in neighbouring areas, helping peripheral areas to be involved in tourism (Polo Peña et al., 2015). This can be presented as a spillover effect for neighbouring areas (Cater, 2002; Chen & Partridge, 2013; Gaile, 1980; Richardson, 2007). Areas with similar tourism activities have positive spatial dependence, and they have agglomeration effects on areas with similar tourism goods, providing positive spillover effects on neighbouring areas (Santos & Vieira, 2020). From the point of view of rural and peripheral areas, it is better to use redistribution to capture increments in the market than to compete with neighbouring regions. This emphasises that agglomeration tendencies in tourism can stimulate rural development and new understandings of regional policy (Álvarez-Díaz et al., 2017).

Tourism clusters in rural areas could also create spread and backwash effects for neighbouring areas. The spread effect is related to auxiliary income in rural areas, but the backwash effect is chained with the migration of capital and labour from rural to urban areas (Xu, 2021; Wang et al., 2022). New approaches for understanding spatial dependence and the spread and backwash effects on rural tourism areas require investigating rural policies using spatial concepts.

Spatial models for tourism in rural areas and tourist destinations mainly use economic, social, environmental, and infrastructural characteristics. Many researchers have used gravity models to explore interactions between origin regions and tourist destination regions (Salvati et al., 2017; LeSage & Pace, 2008; Marrocu & Paci, 2013; Nadal & Gallego, 2022; Tomej & Liburd, 2019; Xu, 2021). In some studies, gravity and spatial autoregressive models were used to explore the effects on intra-regional tourist flows, the dependence of distance between neighbouring regions and differences between origin and destination regions (Marrocu & Paci, 2013). Spatial models allow for an understanding of the effects of the internal determinants of tourism (natural resources, cultural resources, regional policy) and external factors activated by neighbouring territories, both directly and indirectly. Marrocu and Paci (2013) assumed that, at the macroeconomic level, tourism activity generates an agglomeration effect over territorial clusters with patterns of productive specialisation. This can be extended beyond administrative borders to generate spillovers on areas that are neighbouring touristic destinations.

Other studies investigated the multiple factors that affect rural villages' spatial distribution, including touristic resources (Qi et al., 2022; Qi et al., 2021; Zhu & Jian, 2021). Different methods in this strand of literature have been used, such as the neighbouring weights index, Moran's I, Getis-Ord or kernel density statistics, and SAR and GIS tools (Lee et al., 2013). The significant factors identified in these studies included tourism resources, environmental factors, the distance to the destination, and access to communication (Lee et al., 2013; Tomej & Liburd, 2019). A spatial polarisation of rural development with regard to tourism activity was also confirmed by Qi et al. (2021).

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Territorial disparities and spatial heterogeneity are presented in research by Salvati et al. (2017), who showed that a high level of spatial disparity concerns mostly economic indicators. These findings open discussion for applying a planning strategy oriented toward spatially balanced development in rural areas and the tourism sector.

Our study contributes to the latter thread by accounting for spatial disparities involving the endowment of cultural and natural public goods. The contribution is novel in that it juxtaposes the negative and positive effects of spatial dependence. This suggests that plans for spatial development in rural areas should consider the net effects of clustering and backwashing. In contrast to other studies cited above, we concentrate not on tourist flows or income from tourism but rather on touristic infrastructure proxied by accommodation facilities, as the basic infrastructure creates the possibilities for long-term tourism development. Furthermore, we distinguish between various standards of accommodation.

Research methods

Data sources and variables

Data for the analysis were collected at the municipal ("gmina" NUTS 5) and county ("poviat" NUTS 4) levels, with the status of country districts (2010–2020). The entire populations of country districts in Poland were considered. Three main public statistical sources were used: the Statistics Poland Local Data Bank (GUS, 2022), the General Directorate for Environmental Protection in Poland (GDOS, 2022), and the Institute of Soil Science and Plant Cultivation (IUNG, 2022). Poland has three administrative levels: municipalities, counties, and regions (voivodships). The vast majority of public policy expenditures are decided by local authorities at the municipal level. There are 380 counties in Poland. If we ignore cities possessing county rights (usually bigger or medium-sized cities), 314 counties are left[1]. We assume that assessing tourism in rural areas has no purpose in a city district, and measuring the environmental resources in larger cities and rural communes would be incomparable. Hence, we focused on rural areas, including small cities only.

For proxies for the development of tourism in rural areas, we use the following three measures of touristic infrastructure (dependent variables):

- AGRITOURISM, expressed as the average number of beds in guest rooms and agritourism accommodations,

[1] There are several reasons for which the city can obtain county rights. Cities with population above 100,000 inhabitants in 1998 have received this status automatically but also some smaller cities may receive it. However, the smallest city with county rights has approximately 40,000 of inhabitants.

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- SHORT-TERM ACCOMMODATION facilities, defined as the average number of beds in facilities, such as tour homes, hostels, campsites, campgrounds, holiday resorts and,
- HOTELS is defined as the average number of beds in hotels, motels, and guesthouses.

The importance of public policies for tourism development was raised, among others, by Baptista Alva et al. (2022) and Liu et al. (2020). Thus, for **public policies** at the municipal level, we consider all municipality budget sections that can affect tourism development and are proxies for spatial development planning. The expenditures are in PLN per capita (yearly average from 2010 to 2020; Statistics Poland, 2020). The following variables were used:

- ENV_POLICY includes municipal waste and city waste management; investment in green areas; protection of air and climate; management of sewage; and protection of water – Budget Section No. 600,
- TRANSPORT_POLICY covers expenditures on toll highways and national, provincial, county, and municipal public roads – Budget Section No. 900,
- TOURISM_POLICY includes current and property expenditures related to broadly defined tourism development – Budget Section No. 630,
- CULTURE_POLICY includes expenditures on broadly defined culture and protection of national heritage – Budget Section No. 921,
- SPATIAL DEV_ POLICY is the share of built-up and urbanised land according to planning documentation in the total county area (residential land, industrial land, transportation land, fossil land, urbanised undeveloped land, and other built-up land).

With regard to public goods, which are important factors in rural tourism development (Rigall-I-Torrent, 2008; Purwaningsih et al., 2017), we consider three variables:

- NATURAL_RESOURCES is the share of natural protected areas in the county (including ecological areas, reserves, national parks, Natura 2000 bird areas, and Natura 2000 habitat areas; GDOS, 2022),
- CULTURAL_HERITAGE (an anthropogenic variable) is an index of the density of cultural heritage facilities (including archaeological and immovable facilities, historical monuments, and UNESCO-listed sites; GUS, 2022),
- The high nature value agriculture index HNVA values landscape. It concentrates on species-rich grassland, extensively managed arable land, traditional orchards, and other landscape components (e.g., hedges, field margins and banks with woody vegetation, natural stone walls, ruderal and herbaceous plots and fringes, sedge and reedbeds, wetland elements, pools, ponds and weirs, eutrophied oxbows, ditches, waterways, and springs; European Commission, 2014, 2016, 2017; IUNG, 2022). The HNVA also proxies the Common Agricultural Policy environmental expenditures. Broadly defined environmental payments from the second pillar of the CAP are strongly collinear with HNVA, as their goal is to protect and preserve such areas. For this rea-

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son, we could not include both HNVA and CAP payments to the model. Hence, higher HNVA directly translates into higher environmental subsidies from the CAP; moreover, it can be assumed that the long-term durability of HNVA in agricultural counties results from the CAP transfers that have enabled maintaining the landscape up to date.

The spatial effects of high nature-value agriculture are quite specific (Czyżewski et al., 2020) and locally limited. Thus, the assumption of linear spatial effects on tourism should be relaxed in this case. The pattern of agricultural development is Von Thunen circles, so development is concentric, and a county generally has one local centre. High nature value agriculture attracts tourists mainly from this local centre. The number of potential tourists and the demand for high nature-value agriculture is quite constrained. If there are two counties, A and B, around the agglomeration, and the high nature value agriculture is better developed in A than in B, the touristic facilities will develop better in A, adjusting to local demand, and they will wash out agritourism fans from county B. If high nature-value agriculture increases in the next neighboring county C (e.g., through extensive agricultural development), the washout effect over B will not strengthen proportionally to the development of high nature value agriculture in A and C (that is, there is decreasing marginal growth). This is because the number of tourists potentially interested in high nature value agriculture is locally limited, and its product is too homogeneous to attract new ones from other regions. Counties A and C, with rich, high nature value agriculture, will have to "share" this demand. The assumption of a linear effect of negative spatial dependence in the case of high nature value agriculture is therefore unrealistic because of the mutual competition between neighbouring counties with high nature value agriculture for a rather specific and locally constrained type of tourist.

Comparing the spatial dependence of high nature value agriculture and CULTURE, there is some analogy to the juxtaposition of perfect competition and monopolistic competition, bearing in mind the concentric model of agricultural development and the random distribution of cultural goods. To address these considerations, we subjected the high nature value agriculture _LAG variable to log-transformation to avoid overestimating the spatial effect of high nature value agriculture.

We added to the model an **economic development control variable, i.e., counties' own income per capita** (i.e., revenue from corporate and property taxes). The variable INCOME, along with local expenditures, reflects a county's economic performance that may affect the development of tourism in rural areas.

Table 1 presents the descriptive statistics for the above variables, including statistically significant spatial dependence effects.

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Table 1. Descriptive statistics (yearly average 2010-2020)

Variable	N	Mean	Std. Dev.	Min	Max
AGRITOURISM (number of beds)	314	124	493	0.00	6314
SHORT-TERM_ACCOMMODATION (number of beds)	314	1082	2828	0.00	22530
HOTELS (number of beds)	314	551	968	0.00	9229
CULTURAL_HERITAGE (index of density)	314	0.25	0.17	0.04	0.97
NATURAL_RESOURCES (share in total country area)	314	0.17	0.19	0.00	0.83
HNVA (index)	314	35.60	11.31	12.37	72.88
TRANSPORT _POLICY (PLN per capita)	314	308.25	95.12	127.77	654.03
TOURISM _POLICY (PLN per capita)	314	14.74	21.99	0.00	179.83
ENV_POLICY (PLN per capita)	314	333.46	99.35	128.89	1028.99
CULTURE_POLICY PLN per capita	314	135.32	36.93	71.16	326.01
SPATIAL DEV_POLICY (share in total county area)	314	0.05	0.03	0.02	0.24
INCOME PLN per capita	314	1696.74	486.68	911.85	4478.30
AVERAGE SPATIAL LAGS (an average value of the variables in neighbouring counties – contiguity matrix used)					
AGROTOURISM_LAG	314	75.38	129.12	3.06	1157.73
SHOR-TERM ACCOMMOD._LAG	314	774.49	1146.43	17.86	7861.85
HOTELS_LAG	314	449.82	326.32	69.85	2048.04
CULTURAL_HERITAGE_LAG	314	0.21	0.12	0.02	0.64
NATURAL_RESOURCES_LAG	314	0.15	0.10	0.00	0.54
HNVA_LAG	314	31.40	10.03	7.48	59.54

Notes: 1€ = 4.5 PLN (21.01.2023).

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Modelling strategy

To address the research questions raised in the introduction, we estimate Spatial Durbin Models (SDM) for three types of tourism facilities (Table 1) and various spatial matrices (48 models in total), which are constructed according to the procedure described in this section. It is worth recalling that the empirical goal of this study is to compare the effects of public goods (environmental and cultural) and local policies on touristic infrastructure development in rural areas, accounting for a spatial dependence of the variables under study. Hence, the specified model can have some missing variable bias, which we reduce by the control variable and spatial lags (pseudo-R2 in our models is between 50% and 82%).

First, we realised that the panel regression model is not suitable for this analysis because of time-invariant variables: i.e., environmental and cultural resources that barely changed in the studied period. This is why we calculated yearly averages for 2010-2020 for the variables under study and estimated the cross-sectional model.

Spatial effects are usually omitted from economic analysis. However, in geographically related data, such as processes of tourism development and the distribution of cultural or environmental resources, ignoring spatial interactions can lead to biased results. In his pioneering work, Manski (1993) defines three types of spatial interaction that theoretically may occur such that a location-related observation depends on observations in other locations:

- a kind of endogenous relationship in which the value of the dependent variable Y in one location interacts with the value of Y in another location,
- an exogenous relationship, if the values of Y in one location interact with an independent variable X from a location different from the one studied, and
- spatial interactions emerging from unobserved characteristics in another location.

The general Manski (1993) model addressing the above issues is as follows:

$$Y = \rho WY + X\beta + WX\delta + \varepsilon \tag{1}$$

$$\varepsilon = \lambda W\varepsilon + \xi, \tag{2}$$

where:

Y – is a *n x 1* vector of the dependent variable observations (e.g. AGRITOURISM in this study),

W – stands for *n x n* exogenous spatial matrices,

X – indicates the *n x k* matrix of the *k* explanatory variable (e.g. CULTURAL_ _HERITAGE in this study),

β – stands for the *k x 1* vector of regression coefficients,

ρ – denotes the endogenous spatial interaction effect,

δ – represents the exogenous spatial interaction,

ε – is the error term,
W·Y – is the spatially lagged dependent variable,
W·ε – is the spatially lagged vector of the error terms,
λ – stands for a parameter of the autoregressive effect,
ξ – denotes a vector of the uncorrelated error terms.

Based on the following assumptions, three general types of models are deduced from Manski's model. However, it cannot be assumed that ρ ≠ 0, λ ≠ 0, and δ ≠ 0 at the same time (Loonis, 2018):

- λ = 0 (SDM) when it is assumed that there is no spatial correlation resulting from unobserved characteristics,
- ρ = 0 (the Spatial Durbin Error Model) if no endogenous interaction is presumed, and a model relies on neighborhood externalities,
- δ = 0 (the spatial autoregressive confused model; Kelejian & Prucha, 2010) if no spatial interaction of explanatory variables is assumed.

Two key methods can be applied to assess the selection of the model type: *bottom-up* (Florax et al., 2003) and *top-down* (Elhorst, 2010; LeSage & Pace, 2009), in which the presence of the spatial effect is tested with Moran's I and Lagrange multiplier statistics.

Considering the above remarks, the following **six-step modeling procedure** was adopted:

1. **Check of the dependent variables distribution** – touristic facilities distribution issubjected to a very strong right-skewness, which manifests in high standard deviations and maximum values in Table 1. This is the typical situation, as the touristic base usually concentrates around famous places, resulting in a high polarisation of the development of the tourism base. In such a situation, it is recommended to use Poisson regression with a robust variance–covariance matrix of the estimators [so-called "VCE (robust)"]. This is recommended even though there is no reason to believe that $E(y_j) = Var(y_j)$, which means there is no reason to suspect that the process is true Poisson (Silva & Tenreyro, 2006; Wooldridge, 2010). We have followed the advice of the cited authors, bearing in mind that Poisson's assumption, E(yj) = Var(yj), can be relaxed if we specify VCE (robust). Moreover, a Poisson regression has several additional advantages that are useful in our study: Poisson handles outcomes that are zero, and it understands that small nonzero values are indeed almost equal to zero. Finally, the robust Poisson Spatial Durbin Model turned out to be very well fitted to the distribution of touristic facilities (e.g., pseudo-R^2 = 81.4% for AGRITOURISM). This leads to the general conclusion that the proposed strategy might be useful in estimating various tourism-related models.
2. **Preliminary check for the presence of spatial effects** with regard to the regression of three indicators of tourism facilities over the policies, public goods, and control variables listed in Table 1. We perform Moran's I and Lagrange multiplier (simple and robust) tests for the regression with regard

to spatial error and spatial lag and Global Moran's I test for each variable separately. The results suggest the presence of both spatial error and spatial lag, with a maximum p-value = 0.06 for the spatial lag Lagrange multiplier referred to the AGRITOURISM model. We also note that in the case of the spatial lag test for HOTELS, only the robust Lagrange multiplier proved to be significant, with p = 0.029.

3. **Collinearity checks** with the use of variance inflation factor (VIF) statistics. For all modeled variables, including spatial effects, VIF does not exceed 3.39 (Tables 2-4). This is in line with the most rigorous rules of thumb. The meaning of this test is especially important with regard to the interactions between local policy spending and environmental and cultural resources. We can say that higher endowments in public goods do not imply higher expenditures from local budgets in the studied sample. Hence, local environmental and tourism policies are, to some extent, independent from the environmental and cultural resources that a county possesses in rural areas.
4. **Specifying and estimating base SDM models** (with a contiguity matrix). The SDM specification was chosen in accordance with the approaches of LeSage and Pace (2009) and Czyżewski et al. (2020). The procedure concludes that there is both endogenous and residual correlation, i.e., $\rho \neq 0$ and $\delta \neq 0$" (Floch & Le Saout, 2018):

$$Y_i = \rho W_j \cdot Y_i + \beta \cdot X_1 + \theta_1 W_j \cdot X_1 + \theta_2 W_j \cdot X_2 + \gamma \cdot X_3 + \theta_3 W_j \cdot \cdot X_3 + \gamma \cdot X_4 + \theta_4 W_j \cdot X_4 + \varepsilon, \quad (3)$$

where:

Y – is an *n x 1* vector of observations of the dependent variables *i = 1,2,3* i.e., AGRITOURISM, SHORT-TERM ACCOMMOD., or HOTELS,

W_j – is the *n x n* exogenous spectral-normalized[2] spatial contiguity matrix or inverse-distance matrix for consecutive distance bands,

X_1 – is the *n x k* matrix of observations of the *k = 1,2* national-scale public goods variables, including CULTURAL_HERITAGE and NATURAL_RESOURCES,

X_2 – is the *n x 1* matrix of local-scale public goods, i.e., HNVA,

X_3 – is the *n x m* matrix of observations of the *m = 1,2,...,5* policies variables,

X_4 – is the *n x 1* matrix of observations of the control variable, INCOME,

ρ, β, θ,and γ – are vectors of regression coefficients; and ε is the vector of the error term.

To ensure the model goodness of fit and stability, first, we apply stepwise backward regression (only on significant variables with $p < 0.1$ left in the model). Second, we insert the successive groups of variables (public goods, polices, control variables) in a forward stepwise manner (Tables 2-4). Neither coefficients

[2] In a spectral-normalized matrix, each element is divided by the modulus of the largest eigen value of the matrix (Drukker et al., 2013).

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nor standard errors were inflated by adding the next group of explanatory proxies. Although local policies and economic development proxies are likely to be affected by spatial interactions (Czyżewski et al., 2020), their spatial lags turned out to be insignificant in our estimation.

Defining distance bands for spatial interactions based on the spatial correlograms of Moran's I (Figures 1-4). The contiguity (neighboring) matrix used to estimate the base models is quite general, and it may cause some distance-related patterns of spatial interactions to be overlooked. There is evidence that distance and related transportation costs are decisive factors for valuing public goods by tourists and making decisions about vacation destinations (Groot et al., 2002). The correlograms depicted in Figures 1-4 allow us to distinguish the distance band for which the spatial interactions of Y_i and X_1 are significant. A common distance band with significant spatial correlations for Y_i and X_1 is equal to 0.3-2.8 and 3.4-3.8 planar units (at 90% confidence level; 1 planar = 80 km; c.f. Figures 1-4).

It is worth noting that the correlogram for the HOTELS variable shows that two distance intervals of spatial dependence should be considered: Moran's statistics indicate a significant spatial autocorrelation effect in the interval 0.3-2.8 planars (24-224 km) and then above 3.4 planars (272 km). This suggests that one can distinguish two types of spatial dependence patterns: let us say "short-distance" and "long-distance" dependence. We discuss this idea later.

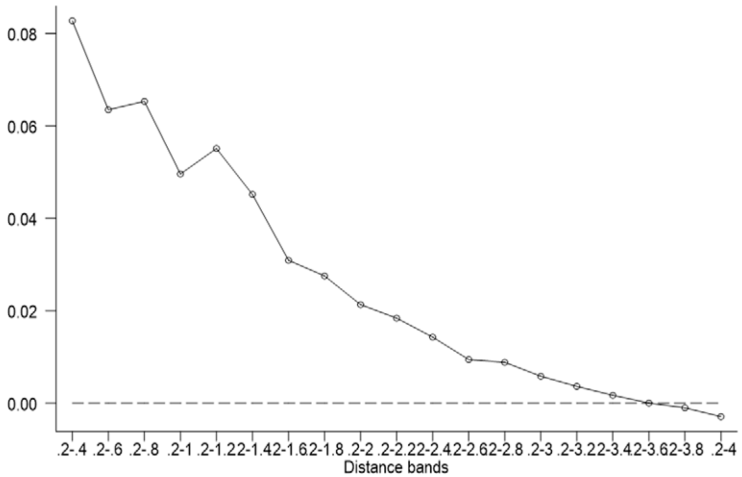

Figure 1. Moran's I spatial correlogram for AGRITOURISM

The general characteristics of the distance matrix are as follows: the "longest minimum distance" is 0.49 of a planar unit, and the "shortest maximum distance" equals 4.89 planars (between counties' centroids). Hence, a distance shorter than 0.49 makes islands; a distance longer than 4.89 causes a county to become

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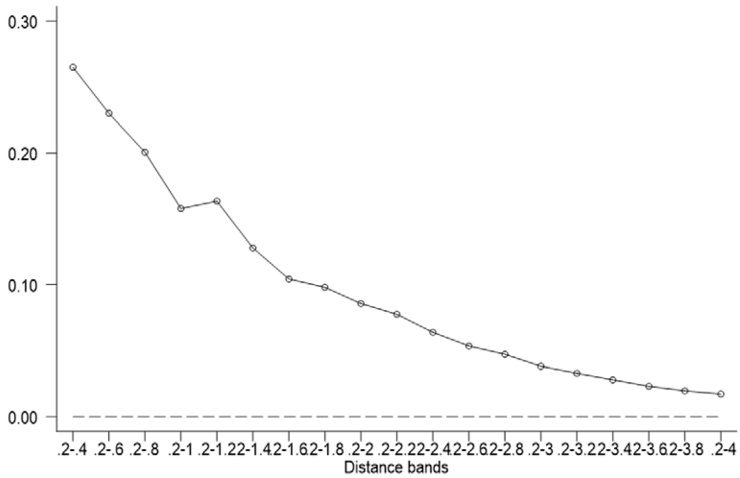

Figure 2. Moran's I spatial correlogram for SHORT-TERM ACCOMMODATION

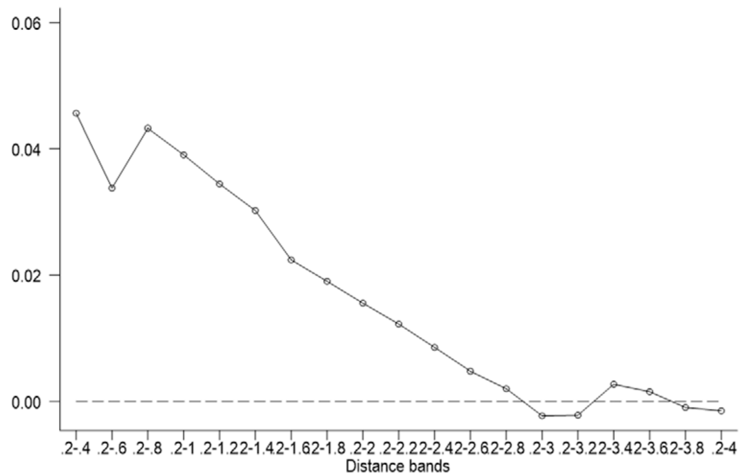

Figure 3. Moran's I spatial correlogram for HOTELS

a neighbor for all the others. For the considered 0.3 planar distance, as the shortest range of spatial dependence, there are 98 islands. However, for the second threshold of 0.4 planar, the number of islands decreases to 16.

Estimating standardised spatial effects (spatial dependence coefficients) for distance matrices with regard to: i) endogenous *Yi* interactions, ii) HNVA, and iii) cultural heritage within different distance bands (0.3-2.8 and 3.4-3.8 planar

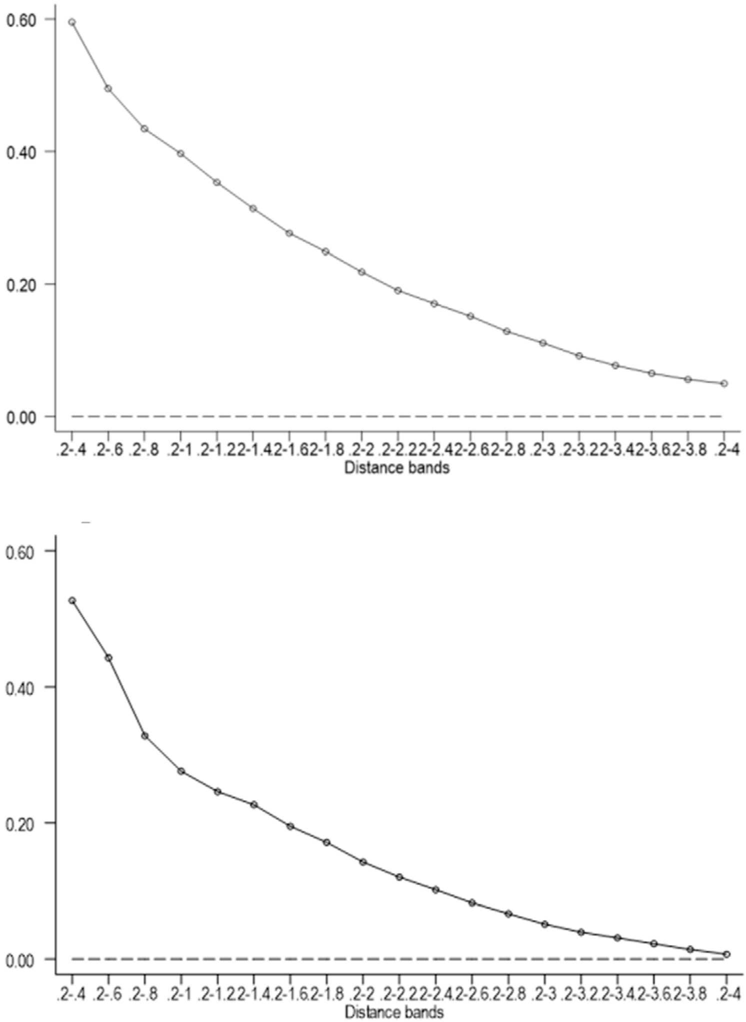

Figure 4. Moran's I spatial correlograms for CULTURAL_HERITAGE (left side) and HNVA (right side)

units). Spectral-normalized inverse-distance matrices were created for every 0.2 planar (16 km) increase in distance from a county centroid, and a separate SDM for each matrix was estimated. When the dependent variables matrix is standardised, it is possible to compare the marginal *ceteris paribus* effects of positive and negative spatial dependence. Then, each type of spatial dependence can be depicted as a function of distance (Figures 8-10).

Results of the research

Poland's tourism in rural areas infrastructure is dominated by SHORT-TERM_ACCOMMODATION facilities, with an average of 1082 beds per county. This is followed by HOTELS with 551 beds and AGRITOURISM with 124 beds (Table 1). However, the average values do not allow us to see that tourism in rural areas in Poland is subject to a very strong polarisation, and its development is not even. Rather, it is concentrated in selected regions depending on the type of infrastructure studied (Figures 5-7). The distribution of facilities for AGRITOURISM and SHORT_TERM_ACCOMMODATION is quite similar and concentrated in such regions as Pomerania (central and western), Masuria, Podlasie, Lower Silesia (mountain areas), Podkarpacie (mountain areas), and Wielkopolska (western and eastern parts). Interestingly, these regions contain the most famous tourist destinations and the areas at the forefront of agricultural development, such as Greater Poland. However, the development of SHORT-TERM ACCOMMODATION is clearly weaker in poorer regions, such as Podlasie, or in the northern part of Mazovia (north of the capital, Warsaw) (see Figure 6). In turn, the distribution of the variable HOTELS is much more polarised (point-wise) and concentrated mainly around large agglomerations.

The more highly polarised distribution of tourist facilities in rural areas suggests the presence of spatial effects: clusters or negative spatial dependence. Hence, these are the focus of our analysis. An additional rationale for the uneven development of tourism may be the prevailing pattern of regional development, which in Poland fits the classic "center–periphery" paradigm. In this paradigm, rural space occupies a peripheral or semi-peripheral position, and the development of tourism in rural areas is closely linked to external factors. This is mainly the demand of the population living in the "center" for tourism products and services in the "periphery" (Zarycki, 2011). Hence, even destinations that are the most saturated with natural and cultural attractions will develop better in terms of the supply of tourism services if they are relatively close to the rich center. On the other hand, less tourist-attractive rural areas are more likely to develop tourism near richer centers. Therefore, we consider the possibility that per capita public spending affects tourism, and we examine the role of local policies in generating tourism demand in relation to the importance of the endowment of natural and cultural resources.

A comparison of the maps in Figures 5–7 indicates the potential presence of two types of spatial effects. The green arrow indicates the classic clustering effect when the level of the explanatory variable in a county and its average level in neighboring counties are high (Figure 5). The red arrow shows a different juxtaposition, i.e., when the level of the explanatory variable in a county is low and the level in neighboring counties is high (Figure 5).

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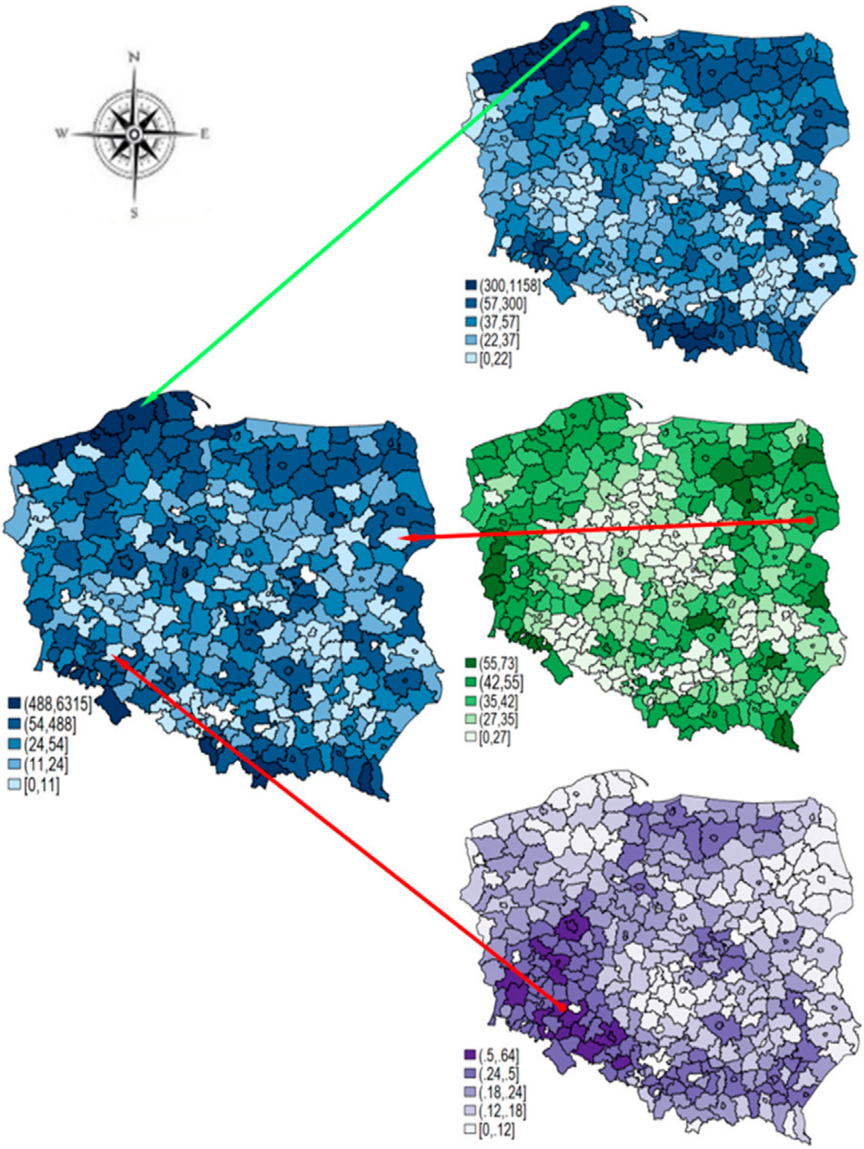

Note: Illustrative interpretation of the maps at the right side: more intensive color indicates the higher average value of the respective variable in neighboring counties; red arrows point at the counties where negative spatial dependence is likely; green arrows suggests positive spatial dependence; To compare with the official full-detailed administrative map of Poland, see Statistics Poland (2020).

Figure 5. ARITOURISM facilities distribution at the left side; AGRITOURISM spatial lag distribution in blue, NATURAL_RESOURCES spatial lag distribution in green and CULTURAL_HERITAGE spatial lag distribution in purple at the right side (i.e. $\rho W_j \cdot Y_i, \theta_1 W_j \cdot X_2$ and $\theta_1 W_j \cdot X_1$ respectively); adjusted quantile method with the distribution over 5 classes based on histogram: 4 · 24%, 1 · 4% of counties

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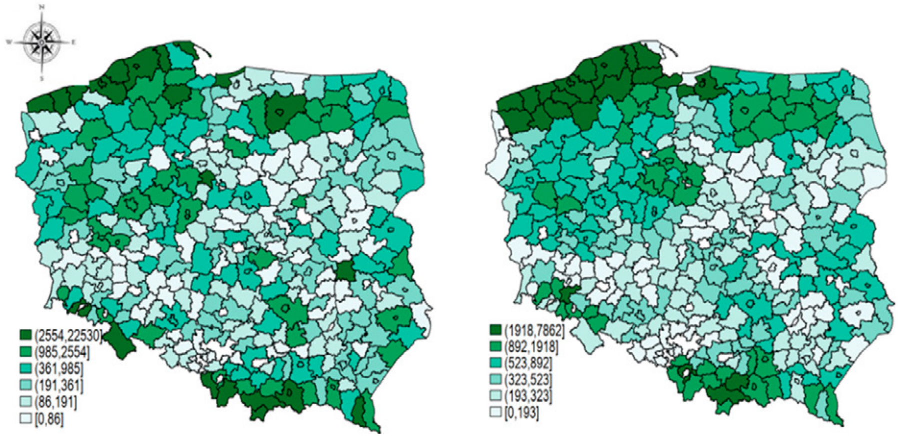
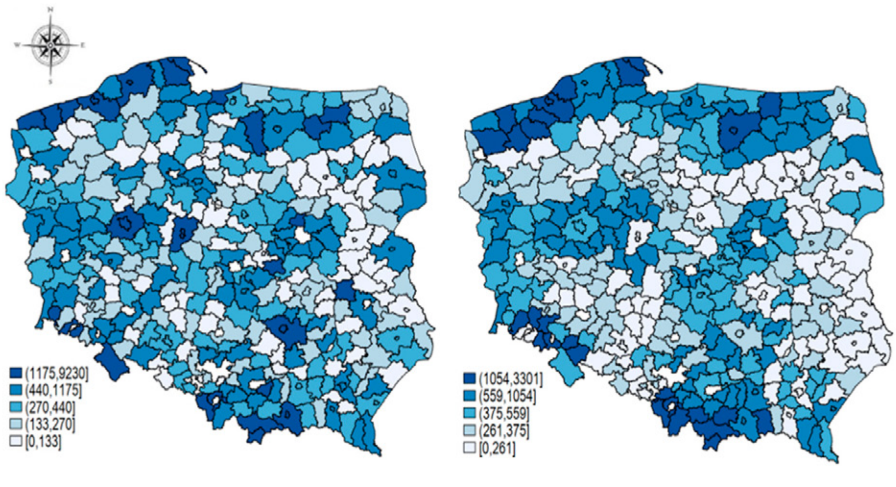


Note: Illustrative interpretation of the map at the right side: more intensive color indicates the higher average value of the SHORT-TERM ACCOMMODATION variable in neighboring counties; To compare with the official full-detailed administrative map of Poland, see Statistics Poland (2020).

Figure 6. Distribution of SHORT-TERM ACCOMMODATION facilities in rural areas at the left side and its spatial lag distribution at the right side (i.e. $\rho W_j \cdot Y_i$); adjusted quantile method with the distribution over 6 classes based on histogram: 4 · 20%, 1 · 7%, 1 · 13% of counties



Note: Illustrative interpretation of the map at the right side: more intensive color indicates the higher average value of the HOTELS variable in neighboring counties; To compare with the official full-detailed administrative map of Poland, see Statistics Poland (2020).

Figure 7. Distribution of HOTELS facilities at the left side and its spatial lag distribution in rural areas at the right side (i.e. $\rho W_j \cdot Y_i$); adjusted quantile method with the distribution over 5 classes based on histogram: 4 · 23%, 1 · 8% of counties

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In that case, it is likely that we are dealing with a negative spatial dependence, which causes a backwash effect with regard to the number of tourists magnetized by more attractive natural resources or cultural objects in neighboring locations. In other words, the clustering effect is distinguished by the fact that the distributions of dependent variables and their spatial lags look quite similar (Figures 6 and 7). In the case of negative spatial dependence, the distributions of dependent variables and their juxtaposed spatial lags look very different (e.g., the spatial lag between AGRITOURISM and CULTURAL_HERITAGE in Figure 5).

Table 2. Public goods and public policies effects on AGRITOURISM (robust-VCE Poisson SDM with contiguity matrix, standardized IRR)

	M1		M2		M3		M4		
	IRR	SE	IRR	SE	IRR	SE	IRR	SE	VIF
Control var.									
INCOME			1.666***	0.146	1.506***	0.164	**1.318****	0.172	3.39
Public goods									
HNVA					1.684***	0.218	**1.627*****	0.134	1.42
CULTURAL_HERIT.					1.617***	0.199	**1.808*****	0.214	2.16
NATURAL_RES.					1.258***	0.062	**1.208*****	0.049	1.11
Public policies									
TRANSPORT_ POLICY							**1.165***	0.107	1.60
TOURISM_POLICY							**1.323*****	0.053	1.26
ENV_POLICY							**1.236****	0.111	1.74
CULTURAL_POLICY							**0.829***	0.088	1.67
SPATIAL_ PLANNING							**0.676*****	0.071	1.97
Spatialdependence									
AGRITOURISM_LAG	1.463***	0.077	1.514***	0.069	1.433***	0.109	**1.355*****	0.061	1.14
CULTURE_LAG					0.635***	0.115	**0.750****	0.113	2.23
HNVA_LAG					0.694***	0.085	**0.744*****	0.079	1.75
_cons	106.845***	24.604	86.185***	17.498	48.329***	5.428	**43.927*****	3.473	-
Pseudo R2	0.162		0.299		0.693		**0.814**		

Notes: Illustrative interpretation: e.g. IRR 1.318 means that an increase in income by 1 standard deviation (see Table 1) causes 31.8 % percent increase of agritourist facilities, IRR 0.676 for spatial panning – an increase of urbanized areas share by 1 standard deviation causes 32.4 % percent decrease of agritourist facilities; SE are robust standard errors: 'vce(roubust)'; *** p<0.01, ** p<0.05, * p<0.

Table 3. Public goods and public policies effects on SHORT-TERM ACCOMODATION (robust-VCE Poisson SDM with contiguity matrix, standardized IRR)

	M1		M2		M3		M4		
	IRR	SE	IRR	SE	IRR	SE	IRR	SE	VIF
Control var.									
INCOME			1.525***	0.128	1.398***	0.140	**1.282****	0.165	2.81
Public goods									
HNVA					1.531***	0.178	**1.542*****	0.114	1.26
CULTURAL_ HERIT.					1.199**	0.109	**1.420*****	0.114	1.42
NATURAL_ RES.					1.231***	0.058	**1.170*****	0.049	0.89
Public policies									
TOURISM_ POLICY							**1.377*****	0.052	1.23
ENV_POLICY							**1.185***	0.113	1.73
CULTURAL_ POLICY							**0.820****	0.083	1.58
SPATIAL_ PLANNING							**0.697*****	0.078	1.95
Spatial dependence									
SHORT-STAY_LAG	1.583***	0.102	1.506***	0.077	1.554***	0.091	**1.435*****	0.074	1.16
HNVA_LAG					0.655***	0.050	**0.737*****	0.044	1.26
_cons	885.003***	120.761	791.492***	96.064	590.583***	59.657	**531.255*****	42.939	-
Pseudo R2	0.252		0.354		0.565		**0.721**		

Notes: see Table 2.

Referring to the first research problem, local policies, spending, and spatial planning can quite easily compensate for the lower endowment of public goods by increasing, for example, per capita expenditure on specific purposes. Of course, one cannot simply add the marginal effects of policies (ceteris paribus), but such an action provides a point of reference. When the effects of policies are estimated together, they may approach or even exceed the strength of the effects of public goods. Hence, public policies may play a key role in the development of any form of tourism in rural areas, especially in regions where the endowment of public goods is lower.

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Table 4. Public goods and public policies effects on HOTELS (robust-VCE Poisson SDM with contiguity matrix, standardized IRR)

	M1		M2		M3		M4		
	IRR	SE	IRR	SE	IRR	SE	IRR	SE	VIF
Control var.									
INCOME			1.417***	0.096	1.366***	0.100	**1.170***	0.110	2.78
Public goods									
HNVA					1.366**	0.180	**1.403*****	0.116	1.25
CULTURAL_ HERIT.					1.312***	0.141	**1.390*****	0.113	1.30
Public policies									
TRANSPORT_ POLICY							**1.248*****	0.095	1.55
TOURISM_ POLICY							**1.254*****	0.049	1.09
ENV_POLICY							**1.143***	0.082	1.72
CULTURAL_ POLICY							**0.761*****	0.067	1.53
Spatial dependence									
HOTELS_LAG	1.321***	0.110	1.306***	0.108	1.146	0.114	**1.137***	0.076	1.17
_cons	522.900***	50.329	481.318***	41.695	449.012***	30.143	**409.419*****	26.650	-
Pseudo R2	0.094		0.224		0.317		**0.503**		

Notes: see Table 2.

What's more, local authorities must still consider negative spatial dependence for public goods in neighboring locations. This can significantly reduce tourist inflows, and the power of clustering will not compensate for this. Therefore, natural and cultural resources without proper management and spatial policy often give rural areas an apparent and fragile competitive advantage in tourism. Other studies also focused on solving this problem: Andraz et al. (2015) and Santos and Vieira (2020) concluded that public policies for the development of tourism in rural areas can reduce regional asymmetry by establishing business networks of tourism. This involves neighboring regions in tourism activity, reducing this unequal local development. The value of public goods involved in tourism activities increases with the cohesion of policy in socioeconomic and environmental dimensions (Genovese et al., 2017; Salvati et al., 2017).

As for high nature value agriculture, it only seems to be the most important issue in rural areas. These utilities are very homogeneous and are thus aimed at a narrow group of tourists, as explained earlier. The power of public policies is especially notable with regard to HOTELS and SHORT-TERM ACCOMMODATION in second place. Inserting policies variables into the HOTELS model increases its explanatory power by almost 20%, and it increases it 17% in the case of short-term accommodation facilities.

Addressing the second research question, the presence of negative spatial dependence was confirmed by the modelling results for AGRITOURISM and SHORT-TERM ACCOMMOD (the "spatial dependence" section of Tables 2 and 3), and it applies to two variables: CULTURAL_HERITAGE and HNVA.

The negative spatial effects exceed the positive effect of clustering in almost all distance bands (Figures 8 and 9). It may happen that spatial effects that were not significant over a continuity matrix turn out to be significant within a particular distance band. This is because of the irregular shapes of counties, which sometimes results in a very short border between counties and dispersed distances between the centers of neighbouring administrative units.

Investigating spatial dependence within consecutive spatial bands provides important clues for local development strategies and the creation of spatial development plans. In the case of a dominant backwash effect, land use patterns that assume the development of tourism-related services will be difficult to realise. However, it would be useful in such a situation to analyse the precise distance of spatial effects. Other authors have suggested using spatial tools for redesigning tourism policies to reduce backwash effects on neighbouring areas (Blancas et al., 2011; Polo Peña et al., 2015).

This point is addressed by Figures 8-10: in the case of AGRITOURISM, the total effect of negative spatial dependence is strongest at around 30 km. Then it steadily weakens up to about 130 km. From this point, long-distance spatial dependence is revealed when attractive destinations over 130 km come into play (Figure 8). The distinction between short-distance and long-distance negative spatial dependence is even more pronounced in the case of short-term accommodation (Figure 9). However, it is worth noting that the long-distance negative effect does not concern the HNVA spatial lag, as the latter occurs only in the 32-112 km band, and it is most remarkable with regard to short-term accommodation facilities.

The positive spatial effect of clustering is quite specific and stable over distance with regard to agritourism, although its dynamics change visibly beyond 130 km with regard to short-term accommodation. The positive spatial dependence of tourist facilities in rural areas is shaped according to the regional pattern of agriculture development, which mainly depends on the natural conditions of soil quality and relief. Similar natural conditions usually cover up to 300 km. This is why the positive effects of clustering in rural areas may be stable over such distances and relatively far-reaching. This means that a region with relatively poor soil but interesting relief can generate positive and stable agritourism clustering for its entire area.

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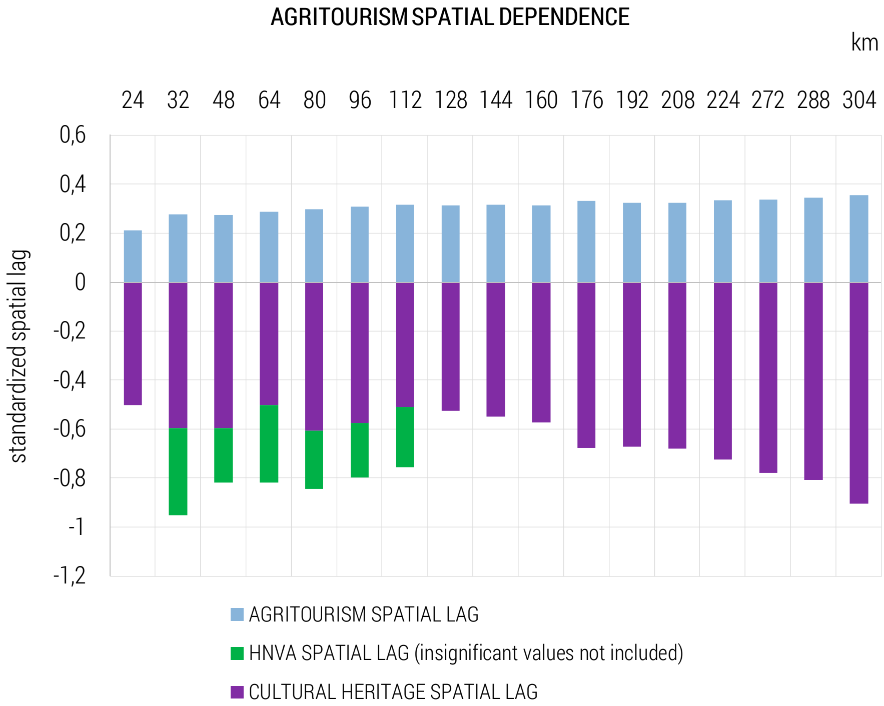
In the case of the HOTELS variable, spatial dependence patterns are the most simplistic: negative and positive spatial dependence concerns only a relatively short distance, up to around 30 km (Figure 9). Then, they disappear. Nevertheless, a negative spatial effect overwhelms the clustering. The HOTEL variable is less dependent on the influence of natural factors than AGRITOURISM, which was also noticed by Polo Peña et al. (2015) and Zhang et al. (2021). Hotels in rural areas are often located around suburbs of mid-sized cities (Truchet et al., 2016; Leśniewska-Napiera & Napierała, 2017), so they are less affected by natural public goods.



Note: Only significant coefficients at a 90% confidence level are presented. If the bar on the negative part of the vertical axis is bigger than a bar on the positive side, it means that the negative spatial effects exceed the positive effect of clustering in a given distance band – the backwash effect is stronger.

Figure 8. Marginal effects of spatial dependence for AGRITOURISM as a function of distance (standardised units)

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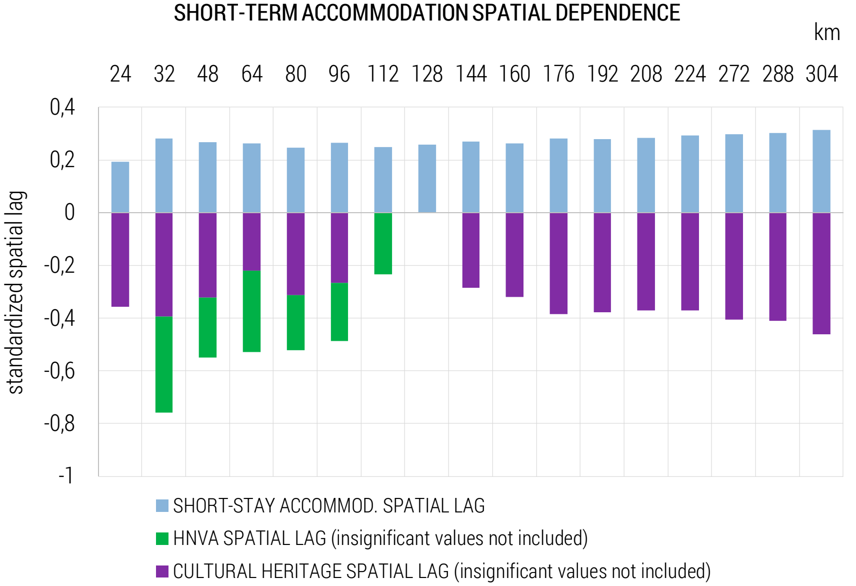
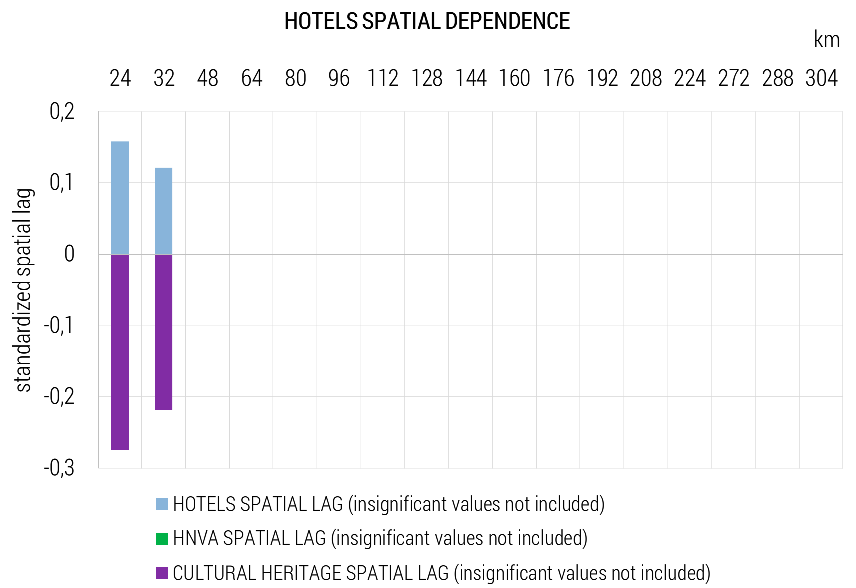


Note: see the explanation for Figure 8.

Figure 9. Marginal effects of spatial dependence for SHORT-TERM ACCOMODATION as a function of distance (standardised units)



Note: see the explanation for Figure 8.

Figure 10. Marginal effects of spatial dependence for HOTELS as a function of distance (standardised units)

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Conclusion

The main finding of this study is that it identifies a negative spatial dependence related to public goods, HNVA and cultural heritage based on evidence from Poland. This is a prevailing spatial pattern in the development of tourism in rural areas (counterweighting the clustering effect). However, this affects agritourism and short-term accommodation facilities to a greater extent than hotels.

We confirmed the first part of the hypothesis that a scarcity of public goods in rural areas can be compensated for by public policies. However, we reject the statement that clusters are the basic spatial development pattern of tourism in rural areas in favor of the backwash effect.

The total effect of negative spatial dependence related to public goods in rural areas is strongest in shorter distances (about 30 km). Then it steadily weakens up to 130 km. The research also revealed a kind of "long-distance" negative spatial dependence when tourists consider attractive destinations over 130 km away. Meanwhile, positive spatial dependence (i.e., the clustering of agritourism and short-accommodation facilities in rural areas) seems to be more stable over distance. Some limitations of the analyses carried out are the assumptions made about how the neighbourhood and distance matrices are defined and normalised. As previously mentioned, we used a spectral-normalized spatial contiguity matrix or inverse-distance matrix for consecutive distance bands.

Local policies are crucial for developing tourism in rural areas. Not only can they compensate for a lower endowment of public goods, but they can also balance the backwashing effect. Investigating spatial dependence for different bands provides useful clues for local development plans and strategies. In the case of a dominant backwash effect, planning tourism-related services may be difficult without well-tailored balancing policies. This means that the development of rural tourism and the expenses incurred should be coordinated between counties and also at the regional level. This will make it possible to limit negative spatial effects and to better compensate for the scarcity of public goods through public spending.

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The contributions of the authors

Conceptualization, B.C.; literature review, S.I. and Ł.K.; methodology, B.C.; formal analysis, B.C.; writing, B.C., S.I. and Ł.K.; conclusions and discussion, B.C., S.I. and Ł.K.

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WPŁYW LOKALNEJ POLITYKI GOSPODARCZEJ I WYSTĘPOWANIA DÓBR PUBLICZNYCH NA ROZWÓJ TURYSTYKI NA OBSZARACH WIEJSKICH: ANALIZA WZORCÓW ZALEŻNOŚCI PRZESTRZENNYCH

STRESZCZENIE: Głównym celem artykułu jest ocena znaczenia dóbr publicznych na obszarach wiejskich dla rozwoju bazy turystycznej w kontekście wysokości wydatków samorządu terytorialnego związanych z rozwojem turystyki. Cel szczegółowy koncentruje się na identyfikacji wzorców zależności przestrzennych i analizie zakresu, w którym występują efekty przestrzenne, ze szczególnym uwzględnieniem negatywnej korelacji przestrzennej, tj. efektu „wypłukiwania" zasobów (tzw. „backwash effect"). Analiza daje szczegółowy wgląd w autokorelacje przestrzenne, które są zazwyczaj pomijane przy konstruowaniu miejscowych planów zagospodarowania przestrzennego. Posłużono się odpornym modelem Durbina (SDM) dla rozkładu Poissona estymowanym na próbie wszystkich powiatów w Polsce. Ustalono, że lokalna polityka gospodarcza, wydatki samorządowe i odpowiednie planowanie przestrzenne mogą zrekompensować mniejszą zasobność powiatu w dobra publiczne. Negatywny efekt przestrzenny występowania dóbr publicznych na ogół przewyższał jednak pozytywny efekt tworzenia klastrów turystycznych.

SŁOWA KLUCZOWE: agroturystyka, efekty przestrzenne, dobra publiczne, polityka środowiskowa, efekt wypłukiwania, SDM

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