

ANALIZA TURISTIČNIH INTERAKCIJ V PROSTORU V ČEZMEJNI REGIJI LITVE IN POLJSKE NA PODLAGI GRAVITACIJSKEGA MODELA

ANALYSIS OF SPATIAL INTERACTIONS OF TOURISM IN LITHUANIAN-POLISH CROSS- BORDER REGION USING GRAVITY MODELS

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IZVLEČEK

V prispevku predstavljamo rezultate analize turističnih dejavnosti v okrožjih in občinah čezmejne regije ob meji med Litvo in Poljsko, in sicer z vidika čezmejnega povezovanja. Cilj raziskave je bil izvesti analizo prostorskih interakcij turističnih tokov v navedeni regiji ter oceniti stopnjo čezmejne povezanosti na območju. Izbrana metodologija vključuje primerjalno analizo statističnih podatkov ter razvoj in analizo rezultatov dveh gravitacijskih modelov, pri čemer eden temelji na oceni turističnih tokov, kjer je predvidena prenočitev, drugi pa vključuje določitev mej lokalnih trgov, opredeljenih z glavnimi turističnimi središči, v obravnavani regiji. Rezultati analize so pokazali asimetrijo razvoja turizma v obmejnih regijah dveh držav, vendar je določitev mej območij lokalnih turističnih trgov pokazala na stalen proces povezovanja v tej čezmejni regiji. Izkazalo pa se je, da predlagan gravitacijska funkcija, ki temelji na oddaljenosti, ni najbolj primerna za modeliranje turističnih tokov iz večjih mest do turističnih središč zaradi pomanjkljivosti uporabljenih statističnih podatkov, kjer ni mogoče ločiti med enodnevni obiski in tistimi s prenočitvijo.

ABSTRACT

In the context of cross-border integration, this article analyses the tourism market in counties and municipalities in the Lithuanian-Polish cross-border region. The aim of the research has been to perform analysis of spatial interaction of tourist flows in this region and to evaluate the integration progress in that field. The methods chosen for this purpose comprised a comparative analysis of statistical data, and construction and analyses of two types of gravity models, one for estimation of the potential overnight tourist flows, and the other for the determination of market boundaries of the main centres of tourist attraction in the investigated region. The analysis revealed the asymmetry in tourism development in border regions of those two countries, but the determination of tourism market boundaries testified the ongoing process of integration of the tourism market in this cross-border region. However, using gravitational distance decay function for potential tourists flows modelling from the bigger cities to the resorts appeared to be inappropriate in this research due to the contradiction to the statistical data about the number of overnight tourists and the disability to separate the overnight tourists and one-day visitors in the model.

KLJUČNE BESEDE

čezmejno povezovanje, gravitacijski model, skupni trg

KEY WORDS

cross-border integration, gravity model, market sharing

1 INTRODUCTION

Travel and tourism activities have been playing a certain role in each countries economy for a number of years. Although it may vary along different countries and years, the travel and tourism as well as the related expenditures of this business, governmental spending and induced consumption of people employed there made up as much as 9.8% of GDP in the whole world economy in 2015, according to the World Travel Tourism Council data (Travel..., 2016).

According to Cárdenas-García et al. (2013), many scholars agree that tourism stimulates economic growth, although some scholars noted, that in some countries or regions tourism had a negative impact on the economic development, since it had lead to the loss of control over local resources and, consequentially, to a decrease of profits and vulnerability of tourism revenues. The study of data of 144 countries over 20 years have proved, that the economic growth experienced in some countries as a result of the expansion of tourism activity has raised the level of economic development of those countries, especially in more developed countries.

From the point of view of the national economy, scholars distinguish between domestic tourism within a country, and international tourism, where tourism services are provided with either for incoming foreign tourists and treated as an export (inbound tourism), or for local people going abroad and treated as an import (outbound tourism). Globally, in 2015 foreign visitors' spending made up as much as 27.7% or nearly one-third of GDP portion directly generated by travel and tourism (Travel..., 2016). This figure, calculated out of data of 184 countries, indicates the importance for national economies of people travelling and spending for business and leisure purposes abroad, which, on the other hand, makes it a subject of interest for national and regional development planning in many countries.

One possible way to increase export of tourism services is to ease access to tourism resources for foreign tourists in border regions or, in case of countries of the European Union (EU), to take advantage from benefits associated to the free movement of people and various programmes aimed for cross-border cooperation between local municipalities of neighbouring countries.

De Sousa (2013) in his article describes how the basic idea of European integration and globalisation has lead to the incentives to support and promote cross-border cooperation at several different levels and to the creation of INTERREG in the 1980s – a special financial instrument for stimulating interregional cooperation in the EU. Need for better administration of various financial programmes and projects lead to the emergence of Euro-regions and, later on, to the emergence of its standardised alternative for territorial cooperation arrangement, called the European Grouping of Territorial Co-operation.

Since the EU has undergone several phases of its expansion, the level of integration, as well as the extent of interregional cooperation, differed along the countries and years. The extent of various cross-border organisations or Euro-regions in Central and Eastern Europe countries prior to the EU accession, according to Turnock (2002), amounted to 30, covering the whole perimeter of such countries as Poland, Slovakia, the Czech Republic, Hungary, Slovenia, Croatia and western or northern borders of the rest of the countries in the region. Before the commencement of cooperation programs, i.e. in soviet times, the cross-border contacts among most of these countries were close to a minimum. After the contacts were established and the cross-border cooperation started, it involved such activities as production (by investing in manufacturing, agriculture or state-owned objects), commerce, transport and tourism (often

tourism involved shopping or selling various merchandise in the marketplace), environment protection (Turnock, 2002).

Nevertheless, issues related to integration and cross-border cooperation are still of great relevance in countries that joined the EU much earlier than the Central and Eastern Europe countries. Perkmann (2003) reckons more than 70 cross-border regions (CBR) in the EU, often overlapping. The interregional or cross-border cooperation there might take different forms. By geographical scope, there can be CBRs as contiguous territories or just interregional cooperation. Another dimension for classification is the scale of activities, so there can be Micro-CBRs (EUREGIO) and Macro-CBRs as contiguous territories, and interregional or inter-urban cooperation at a smaller scale and some peak associations at a larger scale. For more precise classification there can be used more characteristics, such as the cooperation intensity, or administration autonomy level which may be high or low, and the type of actors, i.e. whether they are local authorities or regional. Hence, it is possible to distinguish so-called integrated micro-CBRs with high cooperation intensity, and the emerging micro-CBRs with low cooperation intensity (Perkmann, 2003).

In respect of cross-border cooperation, Löfgren (2008) draws attention to the changes of country borders and changes of the ethnicity of the population that happens in history all the time and talks about cultural borders that do not necessarily coincide with the political boundaries of the state (which in case of Sweden are delineated by natural borders). Hence, talking about cross-border cooperation and performing case studies with three different situations in Sweden, he tries to find and illustrate similarities in their cultural processes (often due to their common past), but also differences that have to do with their history, economic profile or social and political organisation.

In all three studied cases, the analysed cross-border regions were once a part of the same state. The nowadays border lies along with the natural water bodies, constraining the interregional migration. Despite the bridges built to ease the access, the cross-border integration of those regions proceeded in a different way and with different success over time. The Löfgren's study presents a detailed description of each case, paying great attention to the social aspects of cross-border contacts, nature and direction of those contacts, emergence of new social behaviour or social groups that extend their live or activity over the cross-border region. Like in many other countries, a common phenomenon for Swedish border regions were foreign shoppers looking for bargains and goods on the other side of the border, and leisure tourists, but differences in housing prices, rate of unemployment or pension system also induced many people to commute across the border or to settle abroad (even if not permanently). Business contacts have lead to the emergence of shared markets for goods or services and industrial integration (Löfgren, 2008).

Another study of Swedish borderlands which focused on Swedish-Finish border territory has shown that the common development of tourism in a cross-border region could be a good instrument for inducement of cross-border integration by raising the knowledge and self-identification with that region on both sides of the border. Although the impact of this cooperation on tourism flows and revenues is unclear, it played its role in transforming national borderlands that once served as a barrier for tourist movement, into tourism landscapes or places for a tourist attraction (Prokkola, 2007).

The situation in the cross-border region at the Lithuanian-Polish border resembles that in the Nordic countries from the historical point of view, since this borderline and the composition of the population, its national and ethnic identity have also experienced many changes in the past.

Poland takes part in many cross-border cooperation initiatives, various aspects of which attracted the attention of many scholars. For example, Perkmann (2007) in his study of organisational aspects of cooperation in different Euroregions, as one of the study cases analyses the cooperation between Poland and Germany in the framework of Euroregion “Pro Europa Viadrina”. Kisielowska-Lipman (2002) analyses from the historical perspective the present inter-ethnic relations at the Eastern borderlands of Poland inhabited by ethnic minorities of Lithuanians, Belarusians, Ukrainians and the others. Kuemmerle et al. (2008) focus their research on problems of farmland abandonment in the border triangle of Poland, Slovakia and Ukraine. Walancik and Kurowska-Pysz (2015) focus their analysis on the cross-border cooperation of local governments concerning safety issues in common Polish-Slovak projects.

Economic, operational and sociocultural aspects of early cross-border integration in Polish-German border area and some peculiarities of ‘bazaar economics’ of those days in Poland close to the other bordering countries and in bigger cities were analysed by Krätke (1998). In more recent studies, Dołzbłasz (2015) draws attention to the issues of symmetry in putting efforts for the integration of customers and businesses from the other side of the border. After analysing of two twin towns located on both sides of the Polish-German and the Polish-Czech borders, she discovered a significant asymmetry for the former and relative symmetry for the latter. A study of integration processes at the Polish-Czech border region conducted by Kurowska-Pysz (2016) reveals the uneven development of integration in social and economic spheres. While effects of cross-border cooperation in the study region are clearly visible in the social sphere, primarily in the fields of culture, education sports and tourism, this cooperation developed to a much lesser extent in the development of cross-border entrepreneurship, i.e. in the economic sphere, which is the problem that she tries to solve in her paper.

Bar-Kořelis and Wiskulski (2012) investigated the cross-border shopping tourism in Poland and noticed that the most active shopping tourists at that time came from outside the European Union, namely from Russia, Belarus, and Ukraine. In that context, the study was focused on the shopping tourists who came from the Kaliningrad Oblast, the Russian exclave between Lithuania and Poland, to the urban area of Tri-City consisting of Gdansk and Gdynia cities and the Sopot resort in Northern Poland. Anisiewicz and Palmowski (2014) carried out a detailed analysis of cross-border tourism between Poland and the Kaliningrad Oblast of Russia in territory favoured by small border traffic agreement between those two countries. They noticed a positive effect of the agreement for the number of shopping tourists in both countries and for the number of leisure tourists in Poland, although this agreement failed in trying to attract Polish tourists to the most attractive tourist locations and resorts in Kaliningrad Oblast.

However, among all those numerous studies, studies in respect of the Lithuanian-Polish cross-border region are rather scarce, which makes it a good subject for the research. A particular interest in the light of cross-border integration and experience of the Nordic countries represent issues concerning tourism market sharing and impacts on tourism development in this cross-border region since it experiences large flows of international traffic and people moving in both directions.

Many theoretical models can illustrate tourism development in a region from an economic point of view (Streimikienė and Bilan, 2015). However, the land use and transportation models give a better understanding of the spatial dimension in respect of those economic driving forces of tourism. Usually,

they deal with a number of tourists or visits, or a number of second homes (houses for weekend, summerhouses, etc.) and other facilities for an overnight stay in a spatial context (Hall, 2005, 2006), but some of them deal with individual choice of a tourist and model tourist behaviour, i.e. their movement patterns or trip preferences (Lew and McKercher, 2006; Flognfeldt, 1999).

The earliest form of models of spatial interaction between various zones is the gravity model (Iacono et al., 2008; Hall, 2012). Such models, although in different mathematical form, were also applied in econometrics for modelling of various international trade flows between different countries. In addition to the distance, they could involve various economic and non-economic indicators. Keum (2010) states that the gravity model is indispensable for analysing the flows of spatial interactions which could involve both flows of goods, and flows of humans. Many researchers (Petit and Seetaram, 2019; Porto et al., 2018; Marti and Puertas, 2017; Kaplan and Aktas, 2016; Santeramo and Morelli, 2016; Malaj and Kapiki, 2016; Keum, 2010, etc.) were using it for modelling the international tourist flows between countries, generally using national GDP as a measure of each country's economic size or mass, and the geographical distance as the distance, and also including some other variables following their hypotheses. While most of them carried out their analyses from the perspective of one country or in respect of the bilateral exchange of tourists between single countries, the others, like Porto et al. (2018), were also modelling tourist flows between a block of several countries and the rest of the world.

Hence, the gravity model could be the appropriate model to start with for the analysis of spatial interaction of tourism in the Lithuanian-Polish cross-border region, too. However, the use of the econometric model would be inappropriate in this case due to the absence of statistical data about inter-regional and intra-regional tourist flows within a country and in the study region.

The main objective of this paper is to perform analysis of spatial interaction of tourist flows in the Lithuanian-Polish cross-border region and to evaluate the integration progress in that field. It embraces the following tasks:

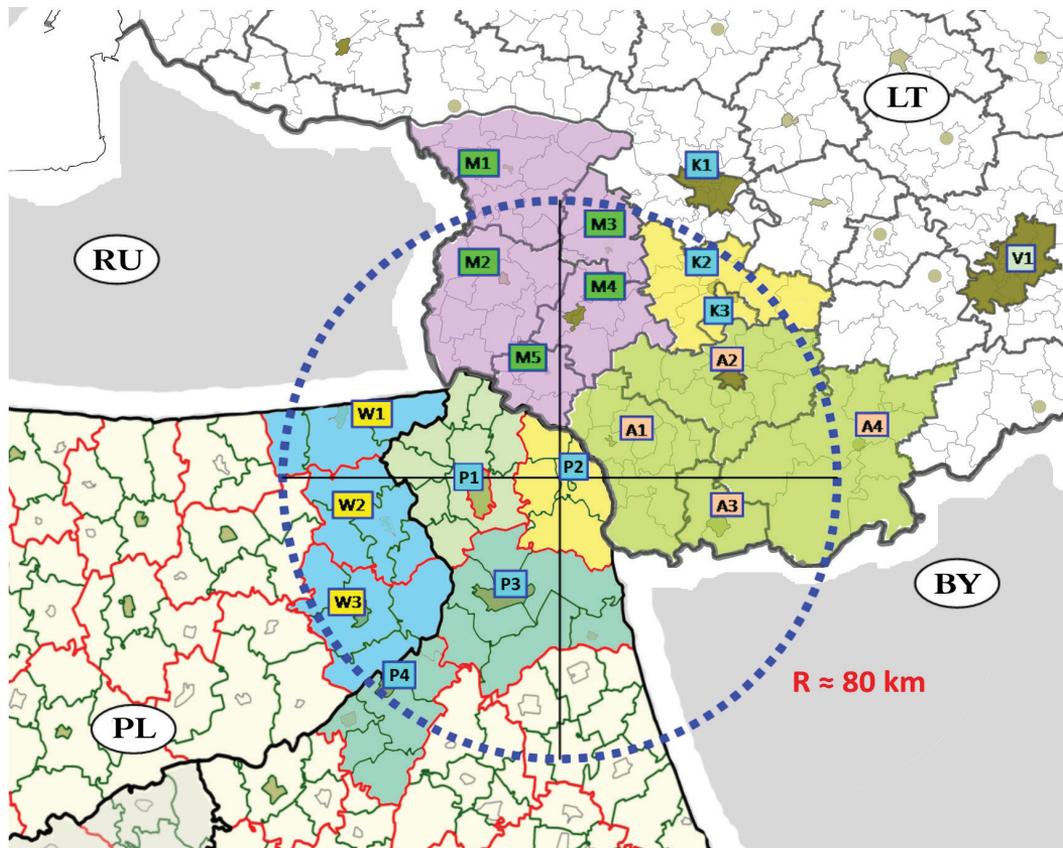
1. To verify the suitability of gravity models for tourist flows modelling in the selected cross-border region using the aggregated data from other researches or statistics;
2. To estimate a possible asymmetry in tourism development across the Lithuanian-Polish border;
3. To evaluate the integration of tourism in the cross-border region, by looking for evidence of market sharing using gravity models.

2 METHODOLOGY OF RESEARCH AND MATERIALS

This article represents a comparative analysis of domestic and foreign tourist flows data in Lithuanian-Polish cross-border region in relation to their demographic and geographic characteristics.

The analysis makes use of regional statistics data of 2015 in Warmian-Masurian and Podlaskie voivodeships in Poland and in Marijampolės, Alytaus and Kauno counties ('apskritis') in Lithuania. Although various cross-border cooperation programmes involved up to five counties in Lithuania (except for Vilnius city municipality) and 3-4 subregions of variable composition in Poland, the analysis embraced only those municipalities and counties that were in closer proximity to the state border. On the Polish side, these were the counties of Gołdap, Olecko, Ełk, Suwałki (rural), Suwałki city, Sejny, Augustów, and Grajewo. On the Lithuanian side, these were the municipalities of Šakiai, Vilkaviškis, Kazlų

Rūda, Marijampolė, Kalvarija, Prienai, Birštonas, Lazdijai, Alytus (rural), Alytus city, Druskininkai, and Varėna. The geographical location of those territorial units and their arbitrary notation is shown on the map (see Fig.1).



Selected counties and municipalities:

In Poland

- *counties in Warmian-Masurian voivodeship:*
W1 – Gołdap, **W2** – Olecko, **W3** – Elk
- *counties in Podlaskie voivodeship:*
P1 – Suwałki and Suwałki city (two counties),
P2 – Sejny, **P3** – Augustów, **P4** – Grajewo

In Lithuania

- *municipalities in Marijampolė county:*
M1 – Šakiai, **M2** – Vilkaviškis, **M3** – Kazlų Rūda,
M4 – Marijampolė, **M5** – Kalvarija
- *municipalities in Kaunas county:*
K1 – Kaunas city, **K2** – Prienai, **K3** – Birštonas
- *municipalities in Alytus county:*
A1 – Lazdijai, **A2** – Alytus, **A3** – Druskininkai,
A4 – Varėna
- *municipalities in Vilnius county:*
V1 – Vilnius city

Figure 1: Geographic situation of territorial units used in the analysis.

In this study region, both Polish counties and Lithuanian municipalities usually have a smaller town as their administrative centre which can not be characterised as a place of big tourist attraction. However, some of these centres represent larger cities, namely, Suwalki (P1 on the map) and

Elk (W3) in Poland, and Alytus (A2) and Marijampolė (M4) in Lithuania. Such cities could be attractive for business travellers or for transiting tourists, but not that much for leisure tourists. However, they themselves could be treated as major sources of visitors for the tourism services providers. Among those administrative centres, there are also the resorts, namely, Augustów (P3), with its size close to a city, and Gołdap (W1) in Poland, and Druskininkai (A3) and Biržtonas (K3) in Lithuania. They are the places of tourist attraction whose influence extends even beyond the study region.

Overall, the study region is exposed to transiting road traffic of two types, one passing through the Lithuanian-Polish border on two main roads to the Northern part of the EU, not crossing its outer borders, and the other passing through over different routes through Poland or Lithuania from Kaliningrad Oblast of Russia to Belarus. This implies large flows of international travellers, a possible source of tourists, moving in both directions there.

Most of the investigated counties (in Poland) and municipalities (in Lithuania) lie within a circle with an approximate diameter of ~160 km and have a noticeable percentage of Lithuanian or Polish tourists among their foreign visitors. However, statistical data provides accurate numbers only for those visitors who have stayed over-night, but the number of one-day trip visitors remains unclear. In the context of cross-border integration, this might be a serious limitation of the analysis, since it prohibits the comparative analysis of one-day cross-border visitors' and local one-day visitors' flow, which otherwise would have been a possible indicator of the degree of integration. Another limitation is the inconsistency of data originating from different sources. For example, figures provided by EUROSTAT might imply other components than those published by national statistics offices at the national or regional level.

The main indicators used for the analysis and comparisons along different counties (in Poland) or municipalities (in Lithuania) were as follows: density of population, the density of tourist accommodations, the density of overnight tourists (in the area and per 1,000 inhabitants), number of domestic tourists, the composition of foreign visitors by the country of origin, and travelling time and distance between the major cities or resorts estimated by Google maps interactive services.

Analysis embraced the investigation of spatial interaction between the major cities and resorts that have an attraction power for local, inland and foreign visitors. As Hall (2012) states, one of the most common ways to express the decay of various spatial flows in the distance is the Pareto function, which takes the form:

$$F = a \cdot D^{-b}, \quad (1)$$

where F denotes the flow, D is the distance, and a and b are empirical constants. A special case of this model at $b=2$ represents the gravitational concept of spatial interaction model:

$$F = a \cdot \frac{1}{D^2}. \quad (2)$$

This article also employs the gravitational form of distance-decay function for modelling and analysis of two possible types of spatial interaction concerning tourism in the investigated region. The first modelling function provides a basic distance-adjusted indicator of possible resorts' visitors flow from the cities

or major towns:

$$F = a \cdot \frac{P}{D^2}, \quad (3)$$

where P denotes the number of inhabitants in cities or major towns which are close enough to resorts for exploiting their recreational assets, and $a=1$ for the simplicity reasons. Although the number of people returned by the function does not represent the actual number of visitors from each particular city, it is applicable for the comparison of different, and presumably competing among themselves, resorts, and for the analysis of the spatial preferences of their potential visitors.

The second function represents the results of competition between two competing places of local tourist attraction, i.e. resorts or bigger cities, by estimating the distance at which their target market boundaries meet. Like in Reilly's law of retail gravitation (Reilly, 1931) and in Converse's Breaking-Point model (Converse, 1949), this estimation makes use of the gravitational form of interaction between the number of visitors and the distance or travelling time, except for it considers only the customers, but not the whole population. Directly at the market boundary, the following equality should hold:

$$\frac{V_1}{D_1^2} = \frac{V_2}{D_2^2}, \quad (4)$$

where V_1 and V_2 denote the number of tourists in two competing places, and D_1 and D_2 represent the distance (or time) from the corresponding place to the market boundary, thus the total distance between those two places is $D_1 + D_2$. This representation implies the presence of a common market area in which two places compete for the same local customers from that area. In other words, this function might indicate the presence of market sharing in the tourism market across the border, which makes it a good indicator of cross-border integration, too.

3 RESULTS AND DISCUSSION

The number of people living in the area of research on both sides of the border is of similar range (~17% greater in Polish side), although the area of selected for the research Polish territories is considerably smaller than in Lithuania (see Table 1).

This reveals the first difference in population structure of these territories, namely, that the density of population on the Polish side is a way bigger (~70% higher) than that on the Lithuanian side. Consequently, such a situation should have lead to uneven development of tourism infrastructure intended for local population.

However, looking at the statistics we might notice that the density of tourist accommodation providers in total is pretty much the same if calculated per 100 km², or even bigger on the Lithuanian side if calculated per 1,000 of inhabitants (see Table 2).

Table 1: Population density in selected counties and municipalities in 2015.

Territorial unit	Population, persons	Area, km ²	Density, per 1 km ²	Territorial unit	Population, persons	Area, km ²	Density, per 1 km ²
Counties in Warmian-Masurian voivodeship (Poland)				Municipalities in Marijampolė county (Lithuania)			
Goldap	27,280	772	35.3	Šakiai	30,007	1,454	20.6
Olecko	34,745	874	39.8	Vilkaviškis	39,030	1,262	30.9
Elk	90,080	1,113	80.9	Kazlų Rūda	12,436	555	22.4
Counties in Podlaskie voivodeship (Poland)				Municipalities in Kaunas county (Lithuania)			
Suwałki	35,932	1,307	27.5	Marijampolė	57,565	755	76.2
Suwałki city	69,370	66	1,051.1	Kalvarija	11,397	440	25.9
Sejny	20,606	855	24.1	Municipalities in Alytus county (Lithuania)			
Augustów	59,103	1,659	35.6	Prienai	27,929	1,032	27.1
Grajewo	48,357	968	50.0	Birštonas	4,351	122	35.7
In total	385,473	7,614	50.6	Municipalities in Alytus county (Lithuania)			
In average (without Suwałki city)			41.9	Alytus	26,978	1,403	19.2
				Alytus city	55,023	40	1,375.6
				Druskininkai	20,564	453	45.4
				Lazdijai	20,626	1,306	15.8
				Varėna	23,268	2,216	10.5
				In total	329,174	11,038	29.8
				In average (without Alytus city)			30.0

Table 2: Density of tourists accommodated in selected counties and municipalities, in 2015.

Territorial unit	Tourist accommodation providers		All tourists, per km ²	Domestic tourists, per km ²	Territorial unit	Tourist accommodation providers*		All tourists, per km ²	Domestic tourists, per km ²	
	per 100 km ²	per 1,000 inh.				per 100 km ²	per 1,000 inh.			
Counties in Warmian-Masurian voivodeship (Poland)				Municipalities in Marijampolė county (Lithuania)						
Goldap	1.3	0.36	19.6	18.7	Šakiai	0.2	0.10	0.6	0.5	
Olecko	1.0	0.26	10.4	10.2	Vilkaviškis	0.3	0.10	5.8	5.5	
Elk	1.5	0.19	21.0	18.6	Kazlų Rūda	0.2	0.08	0.5	0.5	
Counties in Podlaskie voivodeship (Poland)				Municipalities in Kaunas county (Lithuania)						
Suwałki	2.0	0.72	14.1	12.1	Marijampolė	2.4	0.31	23.3	11.4	
Suwałki city	15.2	0.14	655.6	516.8	Kalvarija	0.2	0.09	0.6	0.6	
Sejny	2.2	0.91	12.7	12.2	Municipalities in Alytus county (Lithuania)					
Augustów	2.1	0.59	31.6	25.8	Prienai	1.6	0.57	20.4	19.7	
Grajewo	1.1	0.22	15.0	14.9	Birštonas	13.9	3.91	478.8	430.9	
In total	1.8	0.36	24.6	21.2	Municipalities in Alytus county (Lithuania)					
Without Suwałki city	1.7	0.40	19.1	16.9	Alytus	0.4	0.19	1.0	1.0	
					Alytus city	37.5	0.27	225.8	153.7	
					Druskininkai	20.1	4.43	654.0	426.2	
					Lazdijai	0.7	0.44	3.0	2.8	
					Varėna	0.5	0.47	3.6	3.5	
					In total	1.7	0.58	38.4	27.3	
					Without Birštonas and Druskininkai resorts and Alytus city	0.7	0.27	5.8	4.8	

Note: * Based on data from national statistics office, which do not correspond to the EUROSTAT data

If we look at the density of all accommodated tourists, we might notice one municipality in Poland, the Suwalki city, and three in Lithuania, namely Alytus city, Birštonas resort, and Druskininkai resort, featuring abnormally high figures in comparison to the rest of the municipalities. As a result, the average figures become bigger than they should be and no more reflect the true situation in ordinary municipalities. Therefore, the table also presents the average figures which were calculated without taking into account data of the abnormal municipalities.

Exclusion from the calculations of two resort municipalities and Alytus city reveals just the opposite to the aforementioned preliminary findings, namely, that the density of tourist accommodation providers in the rest of selected Lithuanian municipalities makes less than a half of that figure on the Polish side, or is about 33% less if calculated in relation to the local population.

In the selected counties in Poland, the exclusion of Suwalki city has little impact on the density of tourist accommodation providers, but it diminished the density of all accommodated tourists in the research territory by ~22% (from 24.6 to 19.1) and the density of accommodated local tourists by ~20% (from 21.2 to 16.9). However, the density of tourists in the remaining counties (19.1 tourists per km²) is still very high, if compared to the Lithuanian municipalities after the exclusion of the resorts and Alytus city, where it makes only 5.8 tourists per km². This suggests that, unlike in Lithuania, on the Polish side all the counties are an integral part of the tourism landscape, having developed the entire necessary infrastructure for tourism attraction.

On Lithuanian side, the main tourism activity is not that evenly spread across the territory and concentrates in Druskininkai and Birštonas resorts and, to a lesser extent, in Alytus city. The rest of the territory presumably attracts mainly one-day visitors or local tourists not reflected in the statistics. This means that those two resort municipalities having the biggest attraction power for local, inland and foreign visitors should suit the best for testing gravitational interactions of tourist flows. Only there the number of accommodated tourists exceeds the number of local inhabitants, judging by the density figures provided in Table 1 and Table 2.

A closer look at the statistics reveals that Druskininkai being about five times bigger town than Birštonas also has a better-developed tourism infrastructure, since the density of tourist accommodation providers there is ~45% higher than in Birštonas, and the density of all tourists accommodated in the area of the municipality is also ~37% bigger.

The density of domestic tourists, however, in both resorts is almost identical, featuring about 430 tourists per km², which indicates the different preferences in target market selection of those resorts. Although both spa resorts have evenly distributed domestic visitors, Druskininkai gets a greater share of foreign tourists flow.

Presumably, resorts should benefit more from the cities in closer proximity. However, the analysis of Druskininkai and Birštonas contradicts to that assumption. The distance decay functions that relate population in cities and travelling distance or time to the selected resorts suggest that Birštonas should experience a significantly greater than in Druskininkai overall tourist flow from cities in Lithuania, with just slightly worse results from Polish counties (see Table 3). The tourism statistics, however, proves just the opposite, that it is Druskininkai where the number of tourists is significantly greater. It is, however, possible that a

part of estimated potential visitors were one-day tourists who are not reflected in the statistics, and that a portion of one-day tourists in Birštonas is considerably larger than in Druskininkai due to the proximity of Kaunas city. Nevertheless, this can not be testified by the available data without a more thorough analysis, which makes the gravitational function hardly usable in this research for modelling of potential visitors' flow.

Table 3: Modelling of possible tourist flow from larger cities towards Druskininkai and Birštonas resorts using the gravitational distance decay function.

Cities (possible source of visitors)	Population (2015)	Modelling for Druskininkai (LT) resort				Modelling for Birštonas (LT) resort			
		Travelling distance or time (on roads)		Flow modelling (number of potential visitors)		Travelling distance or time (on roads)		Flow modelling (number of potential visitors)	
		in km	in min	using travelling distance	using travelling time	in km	in min	Using travelling distance	using travelling time
Cities in Lithuania (LT)									
Vilnius (V1)	532,336	130.0	108	31.5	45.6	93.5	88	60.9	68.7
Kaunas (K1)	299,602	130.0	102	17.7	28.8	46.1	45	141.0	148.0
Alytus (A2)	55,023	58.6	48	16.1	23.9	35.9	31	42.7	57.3
Marijampolė (M4)	37,972	94.3	81	4.3	5.8	50.5	44	14.9	19.6
Average distance / total flow		103.2	85	69.5	104.1	56.5	52	259.4	293.6
Cities (and towns) in Poland (PL)									
Suwałki (P1)	69,370	97.8	88	7.3	9.0	105	90	6.3	8.6
Augustów (P3)	32,807*	107.0	85	2.9	4.5	139	110	1.7	2.7
Elk (W3)	60,462*	152.0	122	2.6	4.1	167	150	2.2	2.7
Olecko (W2)	16,460*	133.0	121	0.9	1.1	142	125	0.8	1.1
Gołdap (W1)	13,726*	154.0	137	0.6	0.7	151	139	0.6	0.7
Grajewo (P4)	27,241*	151.0	120	1.2	1.9	183	146	0.8	1.3
Average distance / total flow		132.5	112	15.4	21.3	147.8	127	12.4	17.0
Cities in Lithuania and Poland in total		120.8	101	85.0	125.4	111.3	97	271.8	310.6

Note: * All urban population in the county; The code in parentheses is the notation of the spatial unit on the map, as in Fig. 1; The flow of potential visitors was estimated using the equation (3)

Hence, we can conclude that the distance from bigger cities does not play a big role in overnight tourist flows to Druskininkai and Birštonas resorts in Lithuania, at least for domestic tourists. Being nationwide resorts, those two attract their visitors perhaps for other reasons, and from the whole country. However, differences in foreign tourists' structure of those two resorts, which could be observed from the statistics, might have something to do with the distance from the state border, which needs a closer examination in the context of the whole cross-border region.

According to the statistics, all counties on the Polish side of the cross-border region have a certain number of foreign visitors, although their share in the total tourists' structure is insignificant for Grajewo, Olecko, Sejny and Gołdap counties (see Table 4).

Table 4: Number and country of origin of foreign tourists in selected counties and municipalities, in 2015.

Territorial unit	Foreign tourists		Composition of foreign tourists by country of origin, in %								
	number	% of total tourists	LT	RU	BY	PL	LV	DE	EE	FI	The rest
Resorts in Lithuania (LT)											
Druskininkai (A3)	103,207	34.8	-	22.4	21.5	19.6	15.9	6.7	1.8	ND	12.2
Birštonas (K3)	5,850	10.0	-	16.6	7.6	6.3	14.2	37.8	2.1	ND	15.4
Counties (and resorts) in Poland (PL)											
Suwałki (P1)	2,621	14.2	17.2	11.2	2.6	-	9.0	7.6	20.6	8.2	23.5
Suwałki city (P1)	9,165	21.2	13.7	6.6	3.8	-	9.0	9.7	15.9	13.8	27.5
Sejny (P2)	402	3.7	10.9	10.2	2.5	-	8.2	5.2	1.2	0.7	60.9
Augustów (P3)	9,618	18.3	19.5	7.9	6.8	-	8.0	9.1	15.0	7.6	26.1
Grajewo (P4)	74	0.5	10.8	0.0	0.0	-	0.0	74.3	0.0	0.0	14.9
Gołdap (W1)	717	4.7	10.9	30.0	18.7	-	3.2	20.9	2.2	0.0	14.1
Olecko (W2)	113	1.2	5.3	31.9	0.0	-	0.0	19.5	0.0	0.9	42.5
Elk (W3)	2,636	11.3	14.2	3.5	7.6	-	6.0	27.9	3.4	3.5	34.0

Note: A country codes in the table mean: LT – Lithuania, RU – Russia, BY – Belarus, PL – Poland, LV – Latvia, DE – Germany, EE – Estonia, FI – Finland; ND in the table stands for “no data” if a national statistics office does not provide such figures; The code in parentheses is the notation of the spatial unit on the map, as in Fig.1

Territories around Augustów, Suwałki and Elk cities in Poland have attracted a significant number of tourists from Lithuania. This might indicate a merging of tourism area across the border, but similar figures for Estonian tourists and slightly smaller for Latvian, German and Finnish tourists suggest that this might as well be just overnight stay of transiting people, since all the transiting road traffic to Lithuania, Latvia, Estonia and Finland not crossing the EU borders goes through that region.

Elk has a noticeable percentage of foreign tourists, and Lithuanian tourists as well, but the closer analysis reveals that the most significant portion of foreign tourists came from Germany, like in two other counties that once were part of former Eastern Prussia, Gołdap and Olecko, where German tourists are on the second place after the Russian, and also in Grajewo county. Counties close to the Russian border, especially Gołdap and Olecko, also have a significant portion of Russian and Belarusian tourists, which is a good indicator of integration of tourism areas going on there, although the total number of foreign tourists there is rather small.

Although local cross-border tourists at Polish-Lithuanian border are not traceable in the statistics, especially if they choose short one-day trips, the statistics can reflect inland tourists from both countries attracted by compound tourism assets across the border. In this sense, it seems rational to determine the tourism market boundaries of the main centres of tourist attraction and check if they extend across the state border.

Modelling the spatial interaction between two centres of tourists' attraction in Lithuania and three in Poland based on the simple gravitational determination of boundaries between any two competing markets showed that market boundaries indeed extended across the border from both the Lithuanian and the Polish sides (see Table 5).

Table 5: Determination of tourism market boundaries for two Lithuanian resorts in relation to centres of tourist attraction in Poland, in 2015.

Centres of tourism attraction	Market size (all tourists)	Foreign tourists from PL/ LT	Modelling for Druskininkai (LT) resort			Modelling for Birštonas (LT) resort		
			Route distance to the Polish city, km	Market boundary extent, km	Route distance from the resort to the state border,	Route distance to the Polish city, km	Market boundary extent, km	Route distance from the resort to the state border,
Resorts in Lithuania (LT)								
Druskininkai A3)	296,278	20,275						
Birštonas (K3)	58,418	369						
Cities and resorts in Poland (PL)								
Suwałki city+county (P1)	61,765	1,704	97.8	67.1	55.7	105	51.8	79.6
Augustów (P3)	52,419	1,874	107.0	75.3	55.7	139	71.4	88.6* (79.6)
Ełk (W3)	23,323	373	152.0	118.7	55.7	167	102.3	88.6* (79.6)

Note: * Distance to the state border on the shortest route to the corresponding foreign cities; The code in parentheses is the notation of the spatial unit on the map, as in Fig.1; The market boundary extent was calculated by solving the equation (4) from the perspective of Druskininkai (LT) or Birštonas (LT) resorts in respect of the corresponding Polish cities so that it could be compared to the distance from these resorts to the state border

In the case of Suwałki city with its surroundings (PL) and Birštonas resort (LT) interaction, the modelled market boundary extends inwards Lithuania along the route by almost 28 km. In the case of Augustów (PL) and Birštonas (LT), it extends in a range of about 8–17 km. Consequently, the number of Lithuanian tourists in Suwałki (PL) and Augustów (PL) is by 4.6–5.1 times bigger than that of Polish tourists in Birštonas (LT). Nevertheless, in case of interaction with Ełk (PL), the Birštonas resort (LT) attraction extends beyond the border inwards Poland by about 14–23 km, although the quantity of Polish tourists in Birštonas (LT) and Lithuanian tourists in Ełk (PL) is almost equal.

A different situation is with Druskininkai resort (LT). The number of Polish tourists there is akin to that of Polish domestic tourists in Ełk (PL) and is close to half of the domestic tourists in Augustów (PL). These quantities indicate that this resort should have a strong influence that extends beyond the border. The modelling suggests that the market boundary of Druskininkai resort (LT) in relation to Suwałki city with its surroundings (PL) lies inward Poland by about 11 km, in relation to Augustów (PL) by about 20 km, and in relation to Ełk (PL) even by 63 km.

Hence, the analysis proves the bidirectional character of cross-border interaction at the Lithuanian-Polish border concerning the number of accommodated tourists and their country of origin, despite the structural differences of tourism in that region and different level of development of tourism accommodation providers.

4 CONCLUSIONS AND PROPOSALS

Overall the use of two chosen forms of gravity models for the analysis ended up with different success. The assessment of potential tourist flows from bigger cities by using the gravitational distance decay function did not suit well for the tested resorts in Lithuania, Druskininkai and Birštonas, since neither the distance nor the size of the closest cities had an impact on the actual overnight tourist flow in these

resorts. However, using the gravity model for the determination of market boundaries between the competing centres of tourist attraction proved to be a successful choice, which has provided interesting data for the analysis.

The analysis has revealed the essential differences in the structure of tourism across the border in the Lithuanian-Polish cross-border region. On the Lithuanian side, the main activity of overnight tourists in terms of density of tourist accommodation providers and density of accommodated tourists concentrates in Alytus city and in two resorts, Druskininkai and Birštonas, while the rest of the territory lacks overnight visitors. On the Polish side, the highest density of tourist accommodation providers and accommodated tourists are in Suwałki city, but in the rest of the examined counties, these figures are also high and rather evenly distributed.

In respect of tourism market sharing across the border, the analysis has confirmed the presence of Lithuanian and Polish tourists in the study region on both sides of the border. Moreover, the amount of Polish tourists attracted to one of the Lithuanian resorts (Druskininkai) resembled that in some centres of a tourist attraction on the Polish side. Judging by the market size expressed in the total number of overnight local, domestic and foreign tourists, five centres of tourist attraction could be identified within the study region, two on the Lithuanian and three on the Polish side. The determination of market boundaries between the Lithuanian and the Polish centres of tourist attraction by using the gravity model revealed that their target markets extended across the state border in both directions, which also had a relation to a quantity of Polish tourists on the Lithuanian side and Lithuanian tourists on the Polish side.

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