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MORAVIAN GEOGRAPHICAL REPORTS

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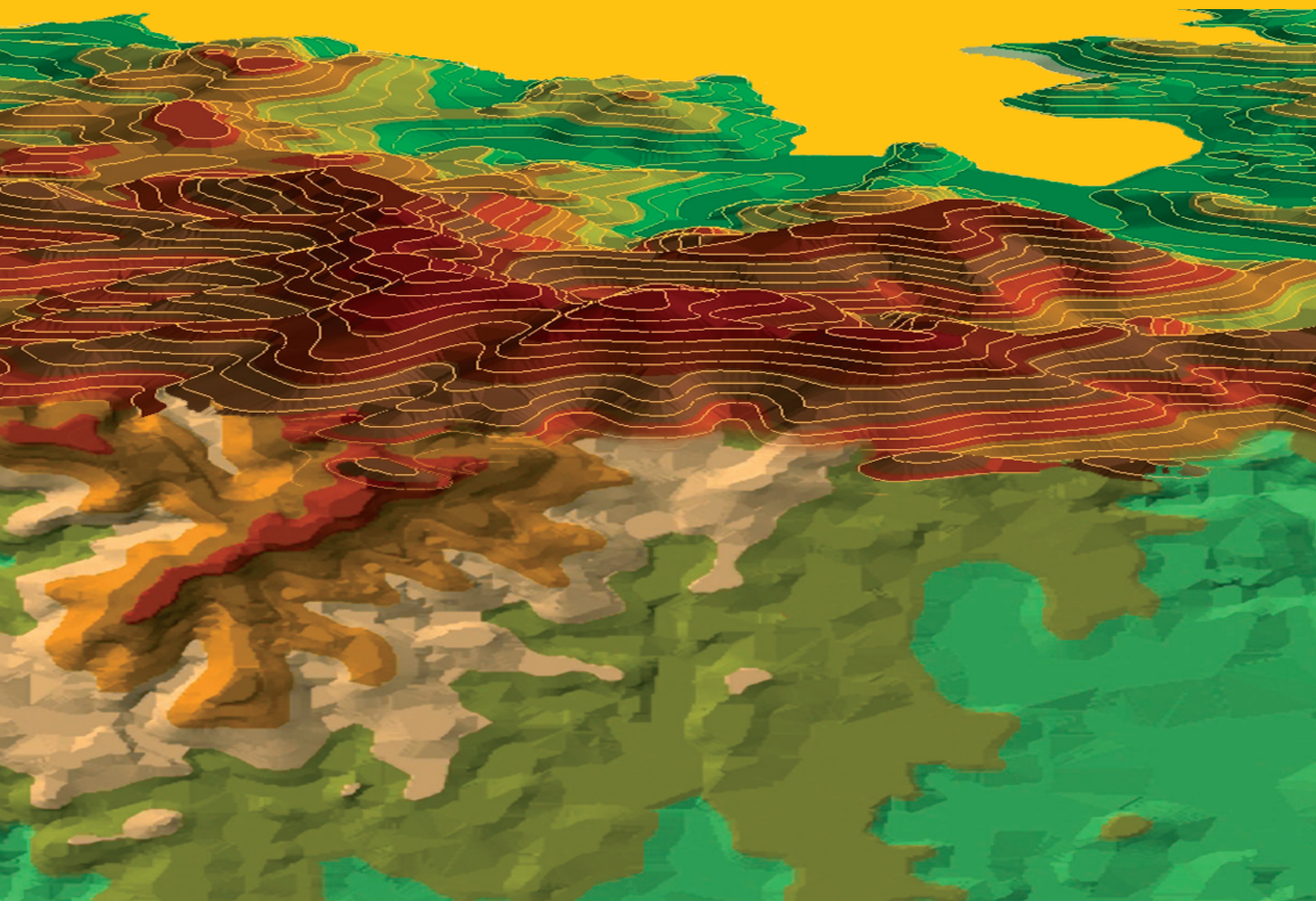

Fig. 5: Wind farm Kryštofovy Hamry, district of Chomutov, Czech Republic (Photo: P. Kučera)

Fig. 6: View of the Prunéřov coal-fired power plant from Hasištejn castle, district of Chomutov, Czech Republic (Photo: P. Kučera)

Illustrations related to the paper by B. Frantál a E. Nováková

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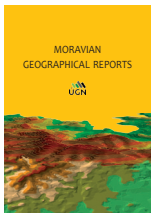

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Industrial clusters in a post-socialist country: The case of the wine industry in Slovakia

Jana NOVOTNÁ [a], Ladislav NOVOTNÝ [a *]

Abstract

Research on clusters, unlike cluster initiatives, has not been comprehensively addressed in European post-socialist countries. The aim of this paper is to explore and to analyse quantitatively the spatial organisation of economic activities in the wine industry in Slovakia, and to assess it in terms of the concept of an industrial cluster. The wine industry is considered as a production sector in which location is determined by geographical factors. The research is based on a case study of a wine region located north-east of Bratislava, Slovakia. The primary identification of the cluster potential is based on the assessment of geographic conditions and statistical analyses focused on the spatial concentration of the industry within the defined area. An extensive questionnaire survey provided data for assessing the spatial organisation of economic activities and their impact on regional competitive advantage. Despite the spatial distribution of economic activities and relations among business entities affected by socialist industrialisation and post-socialist transformation, the results show that the industrial cluster was formed in the wine industry and its performance converges with the wine clusters in traditional Western European wine regions.

Keywords: *industrial cluster, clustering, wine production, post-socialist, Slovakia*

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1. Introduction

Industrial clusters, as popularised by Porter (1990, 1998a, 1998b), have been addressed in many studies since the early 1990s, making them a subject of research at the conjunctions of the economic and geographical sciences. As a model of the spatial organisation of particular industries, clustering gained the image of a universal tool for regional development (cf. Drewello, Helfer and Bouzar, 2016), as well as in spatial planning and national politics.

The concept originates from the environment of the Western market economy, where it was also the most frequently and most thoroughly researched topic (cf. Lindqvist, Ketels and Sölvell, 2013; Porter, 1990). Less attention has been paid to this concept in the post-socialist Central and Eastern European countries (CEECs). The reason for that could be the implementation of socialist industrialisation and centrally-planned economies by these countries after the Second World War. The organisation and location of economic activities in such conditions often resulted from political decisions, regardless of geographical localisation potential, local competitive advantages or the economic history of a region. Socialist industrialisation policies preferred huge industrial estates at the expense of small business entities, that in turn considerably limited competition and cooperation (cf. Kulla, 2010). Several levels of territorial industrial units were delimited in Slovakia (Mládek, 1990) by the end of the socialist era, reflecting the spatial distribution of industrial production under the state rules.

Despite its different conceptual and methodological approach compared to Porter's concept of an industrial cluster, the thoroughly elaborated delimitation of industrial spatial organisation by Mládek (1990) can be considered an alternative to clusters in a broader sense. During the post-socialist transformation, the economic downturn was followed by a huge amount of foreign direct investments. Such actions contributed to considerable changes in the spatial distribution of economic activities (cf. Kulla, 2010). The regionalisation of industrial activities by Mládek (1990), however, was not followed by any similar and comprehensive research.

Geographical location in specific environments is one of the key features of industrial clusters (Porter, 1990) and certain industries are very strongly dependent on geographic conditions. Therefore, it is possible to assume that some naturally-developed industrial clusters exist even in CEECs. A certain potential for cluster formation

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(further referred to as cluster potential) was identified in the CEECs by Brodzicki et al. (2002), Dziemianowicz and Olejniczak (2002), Ketels and Sölvell (2006), and Szultka and Wojnicka (2003), particularly in modern industries such as information-communication technologies (ITC) or creative industries.

The identified research gap opens space for further scientific exploration, which we aim to fill in this paper. The objective is to explore and analyse quantitatively the spatial organisation of economic activities in the wine industry in Slovakia, and to assess it in terms of the industrial cluster concept. The wine industry is considered as a production sector in which spatial embeddedness is substantially determined by geographical conditions. Hence, we anticipate that its spatial organisation is less distorted by socialist industrialisation and post-socialist transformation than other industries. This research project is based on a case study of the territory comprised by the wine route association of Malokarpatská vínna cesta (MVC) (see Fig. 1). The study area will be further referred to as the MVC region. It is the core part of the wine-producing area of Malokarpatská vinohradnícka oblasť, in the foothills area of the Malé Karpaty Mountains north-east of Bratislava, Slovakia. The hypothesis is that due to specific geographical conditions, the wine industry formed an industrial cluster in the MVC region despite being influenced by socialist central planning and post-socialist transformation. The wine route association is perceived as a cluster initiative that could contribute to the emergence of a natural wine cluster. The study employs publically available statistical data for the identification and delineation of the research area, as well as the results of an extensive questionnaire survey designed for the exploration and assessment of the spatial organisation of economic relations within the area.

The post-socialist transformation in the CEECs happened in the same period when the global wine industry started to change. Traditional wine-producing regions and countries were challenged by the "New World" producers such as Chile, Argentina, California or South Africa (Bortoluzzi et al., 2015; Cusamo, Morrison and Rabellotti, 2010). Various organisations of wine production stimulated research addressing industrial clusters and business networks in traditional Western European countries (e.g. Aiassa et al., 2018; Bortoluzzi et al., 2015; Giuliani, 2007; Morrison and Rabellotti, 2009) or in the New World producers (e.g. Giuliani; 2010, 2013; Ruffoni et al., 2013). Comparative studies of both kinds of regions also originated (e.g. Cusmano, Morrison and Rabellotti, 2010; Zen, Fensterseifer and Prévot, 2011). The CEECs were omitted in such research, however. Hence, the contribution of this paper is towards a more comprehensive understanding of the development of wine clusters and their performance in various historical, economic and geopolitical conditions in the globalised wine sector, clearly with an emphasis on CEECs.

2. Theoretical background

There is frequent theoretical, terminological and methodological ambiguity in the research of industrial clusters. Researchers tend to adjust their perception of the term cluster to the purposes of their research (see Tab. 1), allowing them to study this issue in various conditions and circumstances on the one hand, but with deteriorating comparability of their research results on the other hand (cf. Brodzicki and Szultka, 2002).

The majority of definitions of (an industrial) cluster is consistent with respect to the existence of relations between actors involved in the cluster and in their geographic proximity. Several authors draw attention to the potential risks associated with excessive orientation to the local economy, to a single sector covered by a cluster, to too strong clustering and business network closure, and/or focus their criticism on the adoption of the cluster concept in policy making (e.g. Marshall, 1890; Martin and Sunley, 2003; Nemcová, 2004; Rosenfeld, 2002). Most scholars (cf. Nemcová, 2004; Bortoluzzi et al., 2015) agree that the formation of a cluster creates an opportunity for the benefit of all involved actors, as well as for a given locality or region. Current research on the development of specific industries in the United States during the Great Recession (2007–2009) confirms the finding that strong industrial clusters improve the growth of regional employment over time, and cluster agglomeration economies lead to resilience during negative economic shocks (Delgado, Porter and Stern, 2016). Evidence from Western Europe indicates that the positive effects of industrial clusters contribute to retain the competitiveness of the involved producers with the producers from the New World (cf. Bortoluzzi et al., 2015; Zen, Fensterseifer and Prévot, 2011).

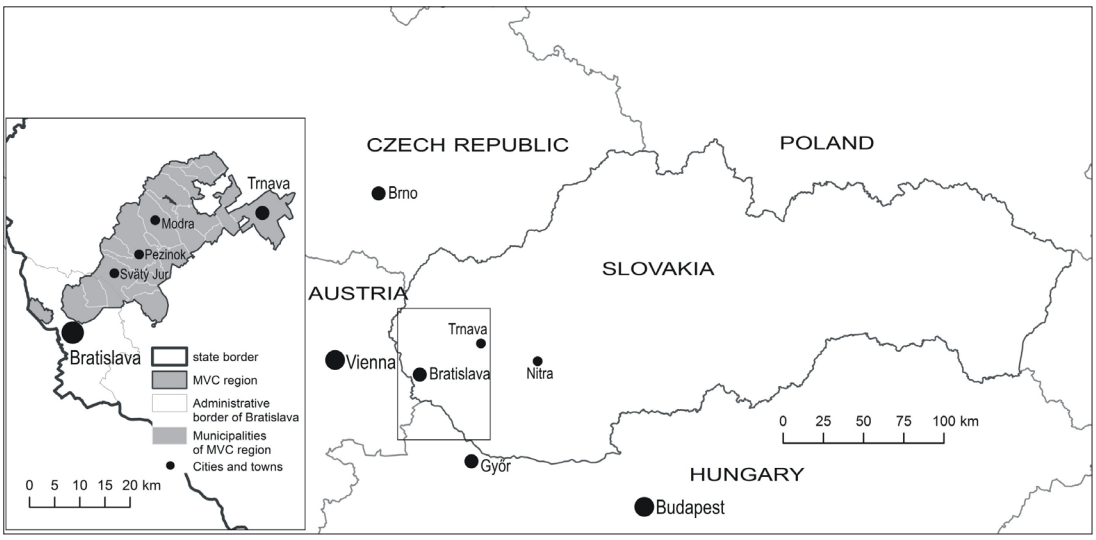

Fig. 1: Location of the study area – the Malokarpatská vínna cesta (MVC) region within Central Europe
Source: authors' elaboration

Source	Definition
Porter (1998a)	Geographic concentrations of interconnected companies and institutions in a particular field, encompassing an array of linked industries and other entities important for competition.
Bergman and Feser (1999)	A group of business enterprises and non-business organisations for whom membership within the group is an important element of each member firm's individual competitiveness.
Skokan (2002a)	Geographically concentrated industries that gain performance and competitive advantage from their location and related factors.
Ketels, Lindqvist and Sölvell (2006)	Group of companies and other institutions in related industries that are co-located in a specific geographic region.
Giuliani (2007)	Geographical agglomeration of firms operating in the same industry.
Székely (2008)	Relatively closed territorial unit that uses a specialised labour market for the migration of workers among the economic entities of the same or related industry.
Zen, Fensterseifer and Prévot (2011)	Grouping of companies and institutions linked to the same industrial sector in a given geographical area that establish relations of cooperation and competition.
Delgado, Porter and Stern (2016)	Group of closely related and complementary industries operating within a particular region.

Tab. 1: Selected definitions of industrial clusters. Source: authors' compilation from noted sources

Many authors (e.g. Ketels, Lindqvist and Sölvell (2006); Kowalski (2016); Kowalski and Marcinkowski (2012); Lindqvist, Ketels and Sölvell (2013); Sölvell, Lindqvist and Ketels (2003) and others) emphasise the difference between cluster and cluster initiative, although cluster initiative is often referred to as cluster (e.g. Hervas-Oliver, Lleo and Cervello, 2017; Kaźmierski, 2011; Turina et al., 2016), especially in regional development policies. In contrast, clusters have developed independently of political decisions or intervention (Ketels, Lindqvist and Sölvell, 2006; Porter, 2000), while cluster initiatives as defined by Sölvell, Lindqvist and Ketels (2003) are "organised efforts to increase growth and competitiveness of clusters within a region, involving cluster firms, government and/or the research community". Therefore, cluster initiatives (also referred to as constructed clusters) may be considered as top-down formed clusters (cf. Pavelková et al., 2009), while "natural" clusters are generated by market forces and so may be considered as bottom-up formed clusters (cf. Porter, 2000). Such defined cluster initiatives have been formed in the Central and Eastern European post-socialist countries during the later post-socialist transformation period as a tool to support development of specific industries (e.g. Ketels, Lindqvist and Sölvell, 2006; Kowalski, 2016; Marková, 2014; Soviar, 2009). These processes directed scientific attention to cluster initiatives, while natural clusters have been neglected in the research.

Our study perceives the cluster as a phenomenon naturally developed by market forces, as defined by Porter (1990, 1998a: Tab. 1). In this sense, the industrial cluster is characterised by cooperation, but also by the competition of involved entities. This stimulates the efficiency of production and thus increases competitiveness. Industrial clusters tend to develop in those regions providing a competitive advantage to the industry. Thus, the concept of clusters explains why the economy of some regions grows more rapidly than that in other regions.

Appropriate corporate strategy is important but it is not sufficient on its own to achieve competitive advantage for individual business entities (Porter, 1990; 2000). Cluster strength depends on a number of factors enabling success. Porter presented a model of the impact of localisation on competitiveness (see Fig. 2), known as Porter's Diamond, grouping these factors into four interconnected sources of a local competitive advantage.

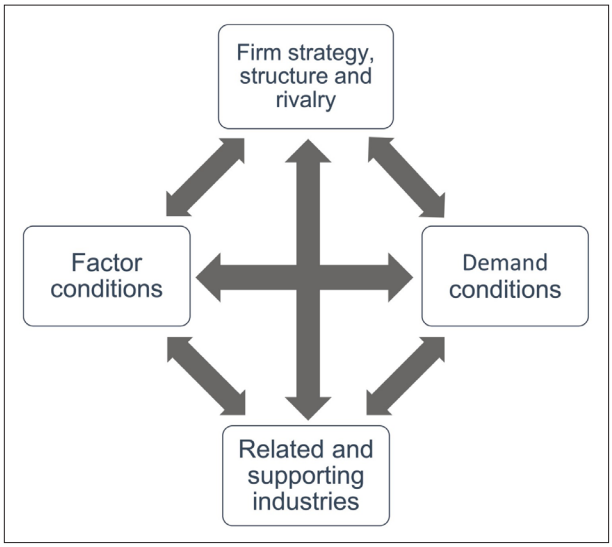

Fig. 2: Determinants of national competitive advantage known as the Porter´s Diamond
Source: Porter (1990), authors' sketch

The factor conditions represent factors of production such as skilled labour, infrastructure, natural resources, energy and/or capital necessary to make the area competitive in a given industry. Demand conditions refer to the nature of the home market (Porter, 1990). A sophisticated and demanding home market can also be a spur to innovations and improvement in the industry (cf. Riddle, 2016). Related and supporting industries refer to the presence of supplier industries and other related industries (Porter, 1990). Firm strategies, structure and rivalry also affect the achievement of competitive advantage, but Porter also notes that national features like education, culture and values can shape these factors (cf. Riddle, 2016). Porter (1990) introduced these sources of competitive advantage for the national level, but the same process is applicable for the sub-national or regional level (cf. Porter 1998b, 2000).

Stejskal and Hájek (2012) provide a comprehensive review on the approaches to identification and assessment of industrial clusters. This review shows that competitive advantage is the key feature of clusters. Therefore, they propose that analysis of 'competitive advantage' as a method for identifying the industrial cluster. Although

the method itself is novel, it is based on Porter´s Diamond model. Despite many modifications and extensions, and even certain criticisms, Porter's Diamond model has become the basis for the identification and exploration of clusters by many other scholars (e.g. Wilson, 2016). Therefore, Porter's model is also employed in our study as the basic theoretical background for exploring the question of whether the 'potential' turned into the real existence of an industrial cluster in the MVC wine-producing area.

The spatial dimension and the determination of boundaries is a frequently-addressed topic related to industrial clusters. Porter (2000) claims the clusters can range from local (individual cities) through regional and national to international. Moreover, the spatial extent of clusters tends to change over time (Ceccato and Persson, 2002; Porter, 1998b). Such a broadly conceived delimitation of cluster borders resulted in a wave of criticism (e.g. Cortright, 2006; Martin and Sunley, 2003; Simmie, 2004; Székely, 2008), which was often focused on problems with thresholds for the spatial concentration of potential cluster actors (entrepreneurs, companies, and institutions), and their interactions resulting from ambiguous guidelines for border delimitation (cf. Székely, 2008). Most attempts to identify clusters use various levels of higher administrative units (e.g. Ketels and Sölvell, 2006; Popovčić Avrić, Brkić and Šestović, 2016) due to the availability of statistical data. This may be misleading for the spatial extent of industrial clusters, which usually does not respect administrative divisions (cf. Cortright, 2006; Skokan, 2008). This is also the case in the wine industry, where clusters are based on the spatial concentration of vine growing and wine making and/or historically developed ties among local and regional actors. The spatial delimitation of such clusters, in many cases, does not respect the higher level regional administrative or statistical units (e.g. Giuliani, 2007; Morrison and Rabellotti, 2009; Ruffoni et al., 2017).

3. The wine industry in Slovakia and in the study area

The origin of wine production in the territory of Slovakia dates back to the era of the Celtic settlements in the 7th–8th century BC. A rapid development of vine growing and wine making was stimulated by the presence of the Romans in the 1st–4th century AD (Baďurík, 2005; Malík, 2005). Vine growing spread almost most of the contemporary Slovakia by the 15th century, but the spatial extent of vineyards started to decrease later (Kazimír, 1986). At the beginning of the 20th century, the vineyards were severely damaged by frost and vine diseases all over Europe, contributing to further shrinkage of their spatial extent in Slovakia (Malík, 2005). This crisis indirectly allowed for the improvement of wine production in some areas, including localities adjacent to Bratislava, as it induced improvements in cultivation and the mechanisation of wine production (Valúšková, 1998).

In the inter-World-War period, the total area of vineyards fell to an historical minimum – less than 10,000 hectares. Thanks to the launching of the large socialist wine factories, the spatial extent of vineyards had more than doubled by the 1960s. But these events, along with collectivisation and the establishment of agricultural cooperatives, led to vine growers' and wine producers' loss of personal relations to the soil, vineyards and wine production (Malík, 2005), which engendered an extremely strong violation of the historical continuities of agriculture and wine making in Slovakia (Popelková, 2016). The social and economic post-socialist transformation has also had temporal negative impacts. The wine producers had to deal with international competition in the market economy and the vine growers lost their state subsidies, and subsequently competitiveness in the international market (cf. Valúšková, 1998). After 1989, restitutions brought property and land back to the original owners and their heirs (Valúšková, 1998). Many of them had lost relationships with the industry, however, or they lacked the appropriate skills and knowledge. Unsettled ownerships complicated any development in the wine industry, even long after the restitutions (Hronský and Pintér, 2009). Addressing the development of the wine industry in the Czech Republic, Grabavčicová (2016, p. 26) emphasises the fact that post-socialist transformations also brought the need to re-establish economic relations between the vine growers on the one hand and wine makers on the other hand, under capitalist conditions.

Moreover, the post-socialist transformation years coincided with the period when the global wine industry became mature, and because of the rapid growth of the "New World" producers, global wine production exceeded global demand (Bortoluzzi et al., 2015; Thomas, Painbéni and Barton, 2013; Zen, Fensterseifer and Prévot, 2011). This created strong competitive pressures on production in traditional (European) wine regions, and made the transformation process in Slovakia even more difficult. A further decrease in the acreage of vineyards was recorded with the accession of Slovakia to the European Union, due to the adoption of the EU Common Agricultural Policy (Rovný, Dobák and Nagyová, 2010). The effect was only temporary, however, and the adoption of support measures later led to stabilisation in the spatial extent of vineyards, and even to a certain revival of the wine industry in Slovakia (Haluza, 2018).

A basic structure for the current regionalisation of viticulture in Slovakia was legally adopted in 1996. Since 2009 there have been six wine-producing areas (see Fig. 3), consisting of 40 districts involving a total of 503 municipalities (NCSR, 2009). In April 2018, another 199 municipalities were granted the status of wine municipalities, hence increasing their total number to 702 with the number of wine-producing areas and districts unchanged (CCTIA, 2018).

The Malokarpatská vinohradnícka oblasť (MVC) wine-producing area is the largest in Slovakia with respect to the acreage of vineyards. The area is spatially fragmented, however, and also heterogeneous when considering geographical conditions. Therefore, we focused on a smaller area with the largest concentration of wine firms, which is a prerequisite for the existence of strong personal and business networks. Based on the identification of cluster potential (see Section 5.1), the spatial extent of this research project was limited to the wine municipalities of the MVC region, with a relatively high degree of geographical and historical homogeneity, and under the assumption of the existence of inter-entity linkages encouraged by the 'Malokarpatská vínna cesta' (wine route association) operating in the MVC region. This is similar to the approach used by Morrison and Rabellotti (2009), who researched an Italian wine cluster historically developed in the Colline Novaresi wine route in the Piedmont region. Identifying the core areas of wine-producing regions with a wine cluster is common in research endeavours, in traditional as well as in New World wine-producing countries (e.g. Giuliani, 2007; Morrison and Rabellotti, 2009; Ruffoni et al., 2017).

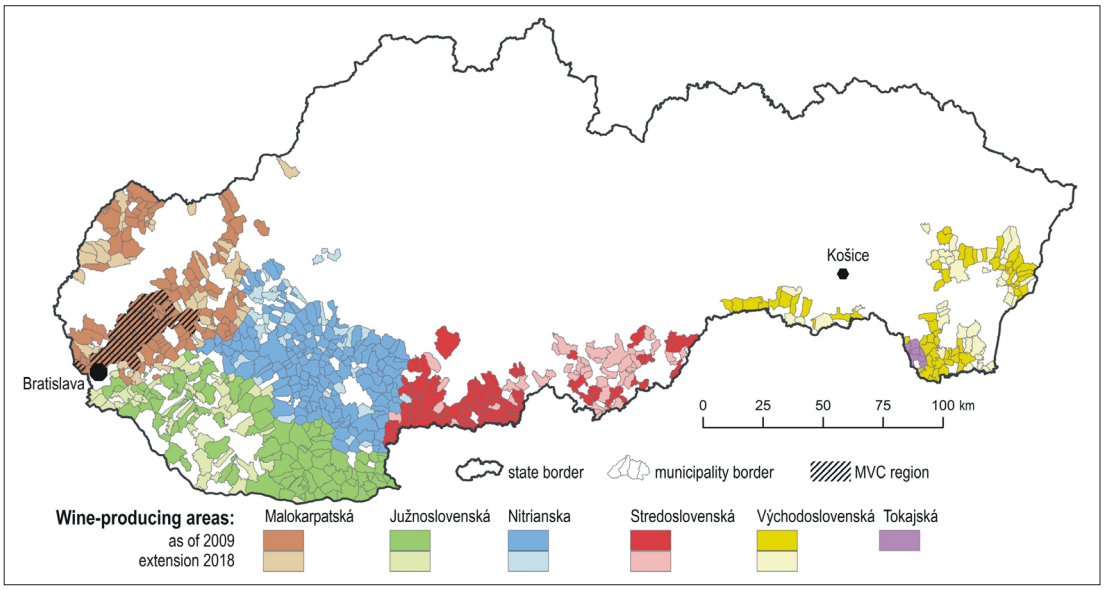

Fig. 3: Wine-producing areas in Slovakia
Source of data: CCTIA (2018), NCSR (2009); authors' elaboration

The total area of the MVC region is 652 km^2. It is located on the south-eastern slopes of the Malé Karpaty mountain range (the south-westernmost part of the Carpathians), interfacing the Danubian Lowland as a part of the Pannonian Plain. It consists of 27 municipalities, including four Bratislava city-boroughs (in the south-west) and the city of Trnava in the east. Therefore, the MVC region benefits from a location between the capital city and one of the major regional and economic centres in Slovakia in terms of economy and infrastructure. The wine industry has considerably influenced identity in the territory (Máryássyová and Gurňák, 2016) and it has been the subject of recent geographical research (e.g. Karlík et al., 2017; Hanušin and Oťaheľ, 2013; Hanušin and Štefunková, 2015) related to the wine industry.

4. Methods and data

The attention paid to clusters has resulted in a huge and diverse range of methods proposed for the identification of cluster potential and the cluster itself. Bergman and Feser (1999), Stejskal (2011) and Stejskal and Hájek (2012) provide comprehensive reviews of the methods.

Bergman and Feser (1999) and Stejskal and Hájek (2009) proposed a classification of the methods by the spatial level of the research. They conclude that the role of quantitative methods declines in favour of qualitative methods in the direction from macro-level (huge international clusters) to micro-level (one city cluster or clusters covering a limited number of cases (e.g. municipalities).

Cortright (2006), Pavelková et al. (2009) and Stejskal and Hájek (2012) identified two basic research approaches: (1) the "top-down" approach based on quantitative methods and statistical analyses, as these methods help to reveal industries and regions with cluster potential; and (2) the "bottom-up" approach focused on the exploration of relations and links among actors in a given region and industry. The latter is based on qualitative methods and data obtained by questionnaires and surveys, and so it helps to assess the exploitation of the cluster potential.

A combination of both approaches is the most appropriate way to obtain comprehensive knowledge about the industrial cluster (cf. Bergman and Feser, 1999; Cortright, 2006; Hofe and Chen, 2006; Pavelková et al., 2009; Stejskal and Hájek, 2012; Székely, 2008) and so it is employed by this study. Table 2 summarises an overview of the most frequently applied quantitative methods for the cluster potential identification.

The localisation quotient (LQ) is most frequently used for cluster potential identification (cf. Stejskal and Hájek, 2012). This is mainly due to the lack of sufficient and reliable data for the application of the other indicators, as is the case for statistical data in Slovakia (Székely, 2008). The

Method	Sources
Localisation (location) quotient	Akundi (2003), Griffith and Paelinck (2018), Oort et al. (2008), Öztürk (2009), Pavelková et al. (2009), Sambidi (2008), Skokan (2002b), Szymańska and Środa-Murawska (2013), Žižka (2010)
Shift-share analysis	Aihu and Guihua (2013), Akundi (2003), Sambidi (2008), Žižka (2010)
Input-output analysis	Bergman and Feser (1999), Duque and Rey (2008)
Herfindahl-Hirschman index	Möller and Litzel (2008), Stejskal (2011), Aihu and Guihua (2011)
Krugman index	Ezcurra et al. (2006), Marelli (2007), Möller and Litzel (2008)
Gini-coefficient	Audtretsch and Feldman (1996), Möller and Litzel (2008)
Ellison-Glaeser index	Ellison and Glaeser (1997), Feser (2000), Alecke et al. (2008)

Tab. 2: Most popular methods for identification of cluster potential
Source: authors' compilation

localisation quotient is used to evaluate the concentration of activities at a local or regional level against the activity at a higher (national) level (Gregory et al., 2009), which is represented by Slovakia as a whole in this study. The LQ threshold value indicating the concentration of a particular industry in a given region varies among researchers. It is usually 1 or it ranges from 0.85 to 1.2 (Griffith and Paelinck, 2018, p. 62; Potomová and Letková, 2011). The LQ is also applied in our study to assess the existence of a cluster potential in the MVC region.

With the application of LQ, it was necessary to cope with the choice of suitable data, given their limited availability in necessary spatial and sectoral details. To explore the cluster potential, employment is among the most suitable and the most frequently assessed phenomenon (Stejskal and Hájek, 2012). Data from the classification of economic activities issued by the European Commission (NACE) are often used for analyses of the LQ at the level of higher administrative or statistical units. They are not available for the LAU2 (Local administrative Unit), however. Also their reliability is disputable even for the LAU1, because they contain only data for entities with at least 20 employees. Therefore, we applied data on the employment of economically active persons in economic sectors from the most recent (2011) Slovak census (SOSR, 2011), which are available at the LAU2 level and contain all employed persons regardless of the employer size. A weakness of these data is that they show the employment structure of the population according to place of residence and not according to the place of work.

From a sectoral point of view, only data for beverage production generally are available. Considering that there is no major producer of other alcoholic or non-alcoholic beverages in the MVC region, the LQ results are unlikely to be overvalued against the actual concentration of the wine industry. To counter possible distortions, however, we decided in addition to analyse the data on the number of business entities in the wine industry at the LAU2 level, provided by the Statistical Register of Organisations (SOSR, 2012). The entities are recorded according to their official headquarters, which could mean that a subject is located in a certain LAU2 but operates in another LAU2. The overwhelming majority of business entities in the wine industry in Slovakia, however, are small entrepreneurs and family businesses, so we do not expect a statistically significant disproportionate effect between the official address and place of operation.

Although the LQ indicates cluster potential, it does not show interdependence between sectors and business entities, overlooking the character, strength and type of interconnections, such as company cooperation, material or information flows (Blažek and Uhlíř,2011; Pavelková et al., 2009; Skokan, 2002ab). Therefore, we conducted an extensive and detailed questionnaire survey among the wine-producing entities in the area of interest. Despite being time-consuming, this method has been used as the most reliable way to acquire information on inter-entity linkages and relationships in research on industrial clusters in western European and South American wine regions (cf. Bortoluzzi et al., 2015; Giuliani, 2007; Morrison and Rabellotti, 2009; Zen, Fensterseifer and Prévot, 2011). An interview survey was also employed by Grabavčicová (2016) to identify the potential and willingness for wine cluster (cluster initiative) establishment in the South Moravian region of the Czech Republic, but it suffered from the relatively small number of producers who responded.

We aimed the survey at collecting data on the perception of competition and various forms of cooperation, particularly business-to-business relationships. The success of clusters is also strongly associated with the presence of local networks, based on market, social and institutional relationships among the subjects participating in the cluster (Giuliani, 2007). Therefore, the availability of qualified labour and the linking of wine producers to research or educational institutions was also investigated by this survey. The questionnaire consisted of 22 items divided into four groups, reflecting the four sources of competitive advantage of Porter's diamond model (Fig. 2). Prior to the research phase, the questionnaire was piloted with representatives of several wine-producing entities in order to ensure the relevance, clarity and exactness of the questions. The survey was conducted in 2013 in person (in several cases by telephone), allowing the respondents to explain their answers or to express the wider context of the answer. These explanations also contributed to the understanding of local competitive advantage factors.

The respondents were divided into two basic categories – business entities (various legal forms) and micro-wine makers. The original purpose was to include only the wine producing business entities. It became evident, however, that micro-winemakers were an integral part of the wine industry business network; therefore we decided to interview also the micro-winemakers. In this paper, the term "micro-winemakers" refers to small wine producers who produce wine for their own consumption or for a limited range of consumers, and who are not obliged to be officially registered as a business entity by the authorities.

The aim was to reach as many wine makers as possible in the surveyed area. The database of potential interviewees comprised the 213 members of the MVC association. In addition, other subjects were identified based on the data from the Statistical Register of Organisations (SOSR, 2012), the Trade Register (MISR, 2013), and the Business Register of the Slovak Republic (MJSR, 2013). Only seven more subjects were identified in this way, however, indicating a very high level of involvement in the association.

Although there were 220 potential participants identified, some of them are listed as MVC association members or in other registers, but do not perform any economic activity in the wine industry currently. In total, we carried out 173 interviews. Based on these interviews, 117 (68%) respondents were categorised as business entities and 56 (32%) as micro-wine makers. Some respondents did not provide any or some responses, however, and they were thus excluded from the statistical evaluation. In total, we completed full interviews with 90 business entities, which indicates a response rate of 77% in the main category of respondents. In addition, 27 (48%) micro-wine makers provided responses to all questions and they were included in the analysis. Regarding the proportion of completed interviews from the total number of identified subjects in the MVC region, the survey was very successful even in comparison with studies from Western European and South American clusters (e.g. Bortoluzzi et al., 2015; Giuliani, 2007; Morrison and Rabellotti, 2009; Zen, Fensterseifer and Prévot, 2011), where the sample of respondents was much smaller.

In this exploratory and descriptive statistical analysis, we evaluated separately the resulting responses for micro-wine makers and business entities by the number of employees, which allowed for capturing differences in performance according to firm size, which tends to affect the intensity

of involvement in personal and business networks within as well as outside the cluster (cf. Morrison and Rabellotti, 2009). For simplification, we mostly report small business entities (up to 5 employees) and larger business entities (6 and more employees), unless stated otherwise. Small firms and micro-wine makers dominate in the MVC region, making it similar to traditional European regions (cf. Bortoluzzi et al., 2015; Giuliani, 2007; Morrison and Rabellotti, 2009).

5. Results

5.1 Identifying the cluster potential

The MVC region is located in the most developed part of Slovakia, with a diversified economic structure and the concentration of a considerable part of the employment of the whole country (Cerulíková et al., 2017). This indicates that a number of industries could be concentrated in the region. Nevertheless, based on the data on employment of economically active persons in economic sectors (SOSR, 2011), there are only three sectors with an LQ value greater than 1.5 in the MVC region. The highest value (LQ = 1.74) was recorded in printing and the reproduction of recording media (NACE – division 18), followed by the manufacture of coke and refined petroleum products (LQ = 1.56; NACE – division 19). Beverages production (NACE – division 11), which also includes wine production, reached an LQ = 1.52. The values for other sectors were considerably lower, which means that the beverages production is among the industries with the highest cluster potential in the area. This can be attributed in particular to the production of wine as there is no other major producer of beverages (beers, spirits, soft drinks) in the area.

Based on the 2011 census, the number of workers in the beverages production division in the MVC region was only 421, constituting 0.43% of all employed residents. This is quite a small number (comparable with the Coline Novaresi wine cluster in Italy, for example: Morrison and Rabellotti, 2009), in turn indicating the small size of the cluster. Many people who work in the wine industry, however, are not included in the statistics as they can work on a part-time basis and for the census they could indicate the economic division of their main job, and/or many of them could also indicate the sector of agriculture since it also contains vine-growing. Thus, it is possible to estimate that the number of jobs related to vine growing and wine making is higher than that indicated by the statistics. Nevertheless, the proportion of 0.43% is higher than the similar proportion for whole country (0.31%), indicating a certain concentration in the MVC region.

The data on the number of business entities in the wine industry at the level of individual communities make it possible to point to increased spatial concentration of business entities also in locations where employment in the sector under consideration does not reach high LQ values (cf. Szymańska and Środa-Murawska, 2013). To increase the relevance of the results, the LQ values for individual communities (Fig. 4) were supplemented by the spatial distribution of wine-producing business entities (Fig. 5). Both indicators show a significant concentration of the wine sector in the MVC region, thereby also confirming its suitability for research of an industrial cluster.

5.2 Factor conditions

Because natural and location factor conditions are themselves prerequisites for the development of the wine industry, this section is focused primarily on labour. In the first step, we investigated if respondents perceive the need for skilled labour. Surprisingly more than 1/3 of them declared that the qualifications of the labour force are not necessary (Fig. 6). The majority of them were micro-wine makers and small business entities. Many of them explained that they do not need "academic qualifications" as their wine making is based on family traditions and experiences. They perceive the latter as sufficient qualifications.

On the other hand, over 60% of respondents declared the necessity of qualifications. In addition to qualification in viniculture (vine-growing) and enology (wine-making), they expressed a need for qualification in associated fields (marketing and sales). In general, the larger the employer, the greater need for qualified labour and versatility. Subsequently, almost 50% of respondents agreed that there

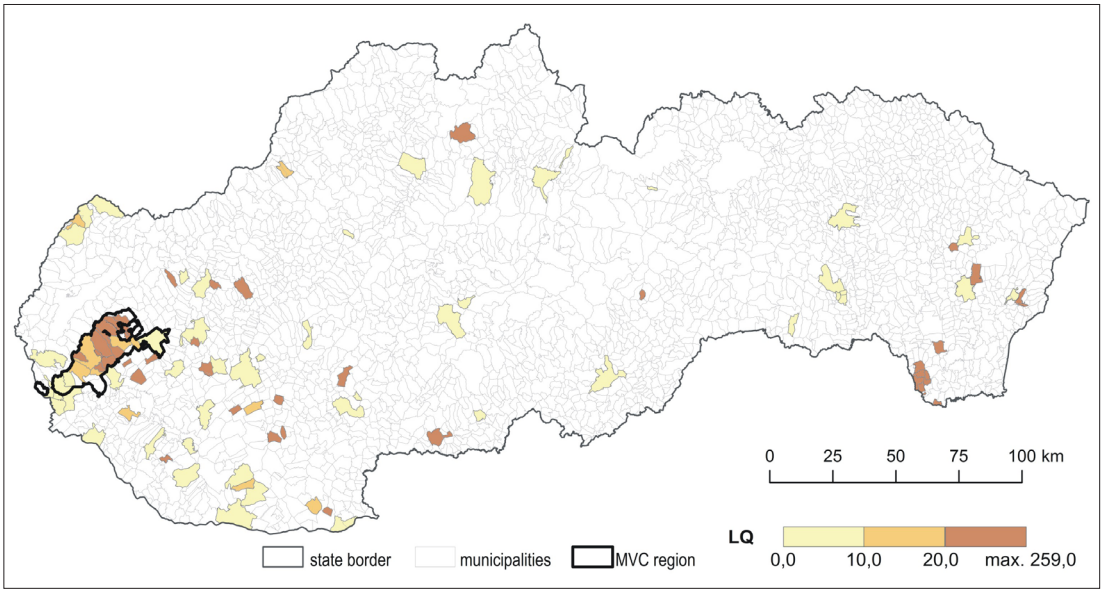

Fig. 4: The spatial distribution of wine-producing business entities indicated by the localisation quotient (LQ) at the level of municipalities
Source of data: SOSR (2012); authors' elaboration

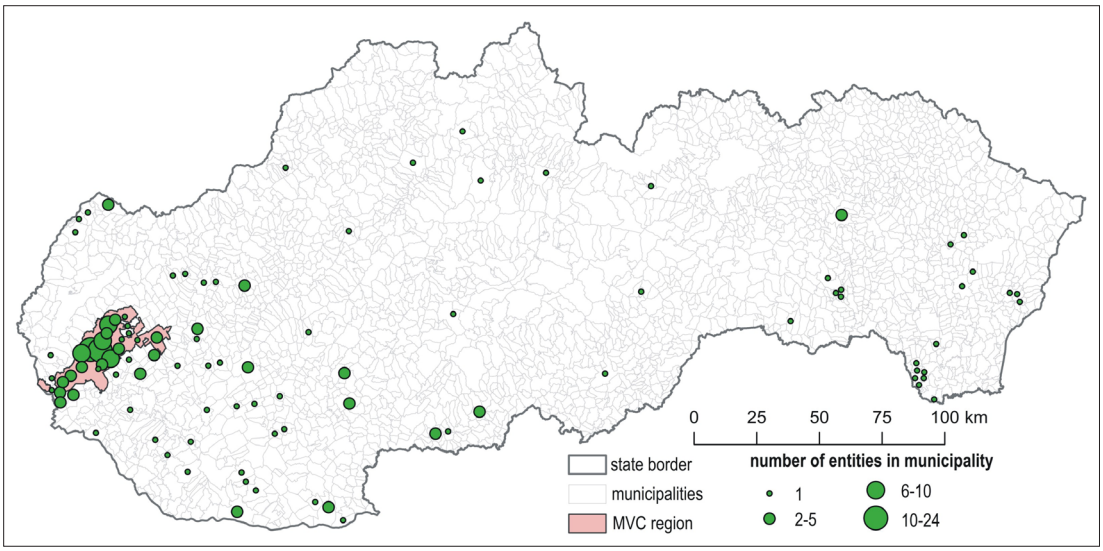

Fig. 5: The spatial distribution of wine business-entities in Slovakia
Source of data: SOSR (2012); authors' elaboration

is enough available qualified labour force, but the proportion of positive responses was much lower among larger firms (see Fig. 7), who in a previous question had declared greater need for qualified labour. This question is not applicable to micro-winemakers. As emphasised by one respondent, thanks to the secondary vocational school focused on wine making and fruit production located within the MVC region (in the town of Modra), there are enough people educated in the wine industry, but many graduates perceive work in this sector as unattractive.

The question concerning whether the employees of the surveyed entities had work experience in the wine industry due to previous employment in competing entities was mostly responded to negatively (66.3%). This may result, however, from a certain share of family companies among the surveyed entities as, in the categories of subjects with six or more employees, the proportion of positive responses was 50%.

Cluster actors tend to address employee training needs together through the organisation of seminars and training activities. Thus, further education of employees reflects specific needs of the businesses (Pavelková et al., 2009). We therefore assumed that if the cluster potential was transformed into a natural cluster, the staff of cluster actors is supposed to take part in educational activities organised either by the MVC association, or some other institution.

Nearly three-quarters of respondents declared that they and/or their staff take part in educational activities. The lowest proportion of positive responses was among micro-wine makers (61.5%), followed by small business entities (72.4%), while all of the larger business entities were involved in educational activities. Educational activities are mostly organised by other business entities, in particular, supply companies (47.7%). It shows that in addition to supplier-customer relations, educational relations are also established between wine makers and their suppliers. As much as 40% of trainings are organised by various associations, with the dominant position of MVC covering almost one-third of all educational activities mentioned by respondents. Some 15.4% of schoolings are organised by other institutions, particularly secondary schools and universities. One in ten of the manufacturing entities involved in the cluster also provide educational activities. These results indicate the existence of the cluster, which is confirmed by the spatial distribution of educational

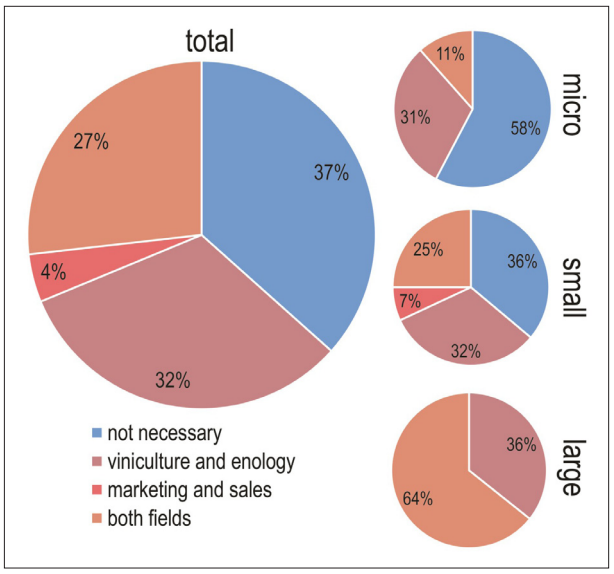

Fig. 6: Requirements on the qualification of employees perceived by winemakers in the MVC region
Source: authors' survey

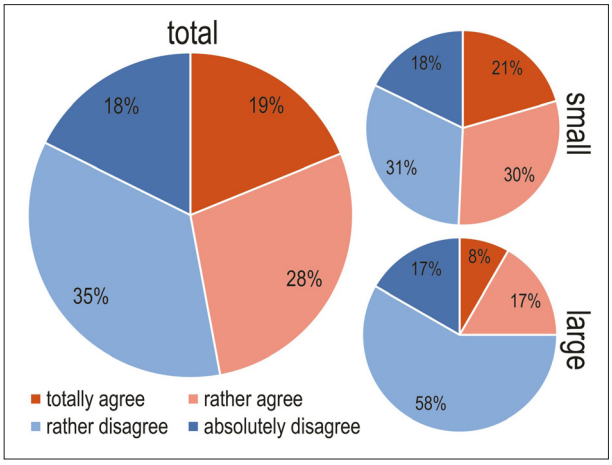

Fig. 7: Responses to the statement: There is a sufficient amount of qualified labour in the regional labour market
Source: authors' survey

activities providers mentioned in the survey. Out of 25 providers, 16 are located directly in the MVC region. Another six providers are located in Bratislava but beyond the border of the MVC region.

Although very important, educational activities are only one of several ways that the survey respondents obtained new knowledge and information. Among other sources labelled as very or more important are professional journals and books (90.4%), followed by feedback from customers (87.3%), informal meetings with managers and experts from other businesses (81.4%), wine routes, expositions and open cellars days (75.0%), and other sources.

These findings show that common activities within the MVC association, as well as formal or informal cooperation among business entities, play important roles in knowledge improvement and information distribution among the actors in a potential cluster. Together with previous findings, it indicates that the state of factor conditions corresponds to the existence of a natural industrial cluster in the MVC region.

5.3 Demand conditions

In this section we focus on the innovativeness of the potential cluster actors and its causes, including the role of market demand and the demands of local customers. We also assessed customers and the forms of distribution of production outputs.

More than nine in ten (92.2%) of respondents invested in innovations in the decade prior the survey (2004–2013). All of those who did not invest were small businesses with up to 5 employees. All larger employers invested in innovations, as well as 66.7% of micro-wine makers. In this survey, the respondents could choose from several reasons for introducing innovations, many of which are related to each other. The most often chosen options were: improving the quality of existing products (88.6% very important, 7.1% rather important); strong competition in the region (55.6% very important, 31.5% rather important); and the demands of customers (53.1% very important, 29.7% rather important). These were followed by introducing new products to the market, reducing costs, and saving time and labour.

Almost one-third (30%) of the producers sell their product in only one way, mainly by sale in their own cellar, shop or yard sale. In addition to this form of retailing, 42.4% of respondents distribute the products to the customers by themselves. These entities do not directly establish cooperative links with others for the purpose of sales, but indirectly these kinds of sales are considerably supported by events and marketing activities provided by the MVC and other associations. The remaining 27.6% of respondents also declared cooperation with third-party subjects, including the customers themselves (see Fig. 8). Among these third-party subjects, the most frequently mentioned were two companies (CORNER SK and MonVin), located in Bratislava in the city boroughs which are not included in the MVC region but located in its vicinity, so they can be connected to the nearby cluster and benefit from it.

To assess cluster existence, the spatial pattern of wine distribution is very important. Thus, we focused on the locations of the largest customers. Due to the number of questions on this issue and the high variability in responses, we generalised the results as follows: the majority of wine makers (84.4%) distribute their product only within Slovakia. This is largely due to the limited size of Slovak vineyards, and the national market is large enough to sell almost all the product. At a lower geographic level, more than half of the respondents (56.7%) distribute at least 50% of their production within the Malokarpatská vinohradnícka oblasť wine-producing area, including 20% who sell all of their product in this area. Only 4.4% of respondents sell all of their production within the municipality (LAU2) where they produce it. The rest of the respondents (15.5%), mainly smaller wine producers, declared exports also to countries outside Slovakia (particularly the Czech Republic and Germany). Surprisingly, the largest proportion of entities exporting abroad is among the small entities of up to 5 employees. These results indicate that the distribution of production from the MVC area is strongly regionally concentrated, but is able to withstand international competition abroad as well.

5.4 Firm strategy, structure and rivalry

Rivalry that pushes producers into innovation is among the decisive factors affecting increased competitiveness (Pavelková et al., 2009). A majority of respondents (57%) agree that competition among wine producers in the MVC region is strong (see Fig. 9), and almost the same proportion perceive the high number of competitors. On the other hand, they do not see distance between producers as a major source of competition. There are no considerable differences among categories of respondents by size, so the perception of the intensity of competition is roughly equal.

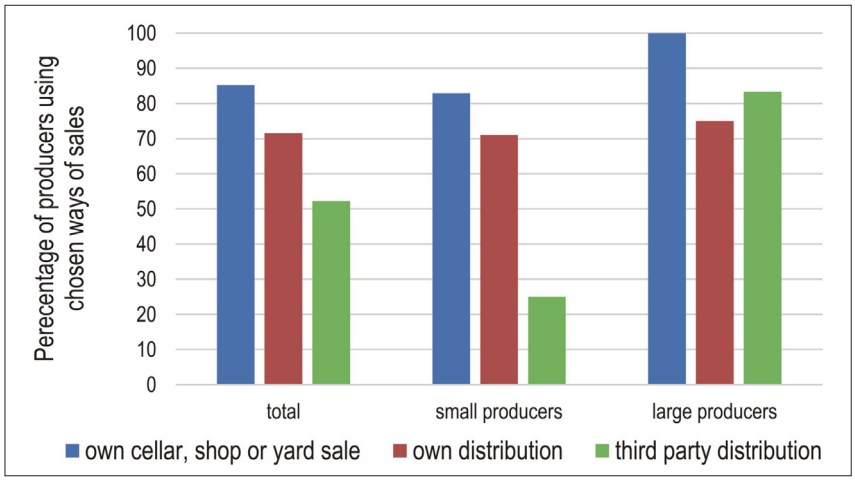

Fig. 8: Means of wine sales in the MVC region, depending on the size of the producer
Source: authors' survey

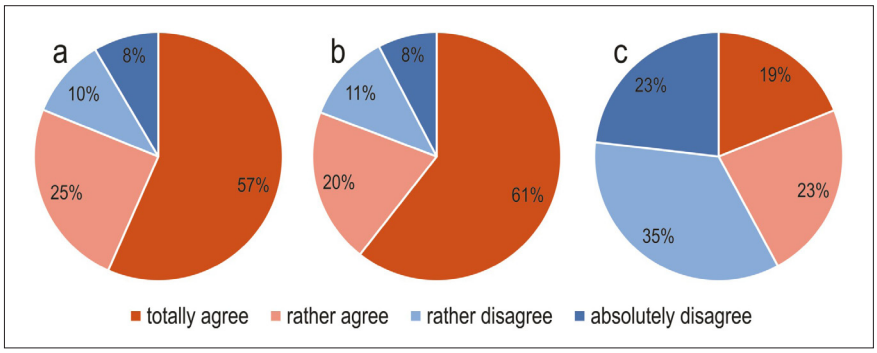

Fig. 9: Responses of participants to the statement: a) The competition among wine producers in the MVC region is strong; b) The number of competitors is high in the MVC region; c) The intensity of competition decreases with the increasing distance between competitors. Source: authors' survey

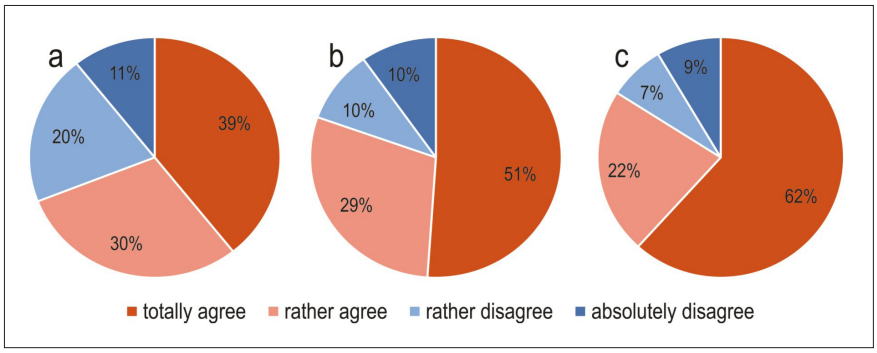

Fig. 10: Main forms of competition declared by respondents: a) Introducing new wines to the market; b) Price; c) Quality of wines. Source: authors' survey

The rivalry between wine producers is stimulated mainly by a combination of non-price (wine quality) and price competition (Fig. 10). In this context, several producers criticised the forms of competition that they consider to be often beyond wine making ethics (i.e. price dumping). Introducing new products to the market also plays a considerable role in competition. Among other non-price forms are the introduction of new technologies in processing grapes, and branding.

Marketing activities are among the more important corporate strategies. Pavelková et al. (2009) emphasise that common marketing activities contribute to a common identity of the entities involved in the cluster, providing added value to the entire cluster and subsequently to all its actors. Concerning the competitive environment in the MVC area, it is interesting that over three quarters of subjects cooperate with their competitors on marketing activities (Fig. 11). The involvement in common marketing activities is higher among smaller business entities and micro-wine makers (totally and rather agree to the cooperation statement).

Customer satisfaction and positive references are clearly perceived as the most important forms of marketing in the MVC area (see Fig. 12). Although it is a rather individual form of marketing, it suggests that almost all the producers sensitively perceive the preferences of the (demanding) customers and reflect them, thus contributing to a good image of the wine industry throughout the region. Respondents also attribute great importance to participation in exhibitions, open door and open cellars days.

Business strategies are naturally differentiated by company size. Small businesses can sell all production because of good customer references. Large producers need to reach a wider range of potential customers, so they mainly focus on mass

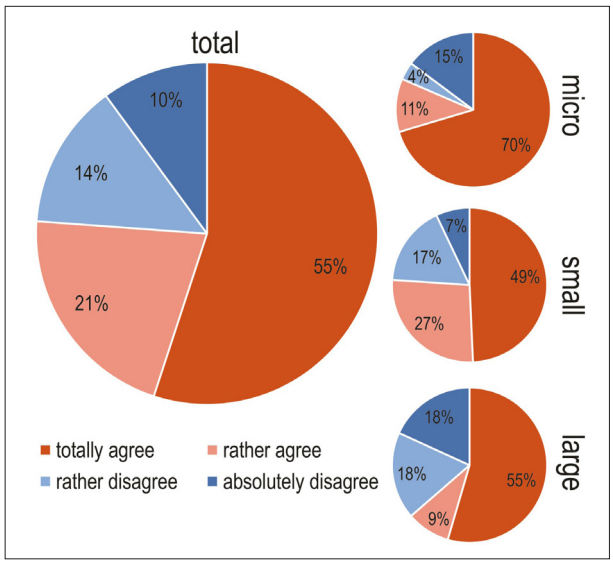

Fig. 11: Responses of the participants to the statement: We cooperate with our competitors on promotional activities. Source: authors' survey

marketing, particularly mass media (cf. Porter, 1998b). To certain extent, this is also the case in the MVC area, where customer satisfaction is important for all size categories of subjects, but media advertising is mainly used by larger enterprises (83.3%).

Membership in a trade association contributes to a common identity for members, which can be considered as one of the highest levels of marketing (Stejskal, 2011). The wine organisations operating in the MVC region range from the local (a wine association in almost every LAU2), through regional and national and even to an international level

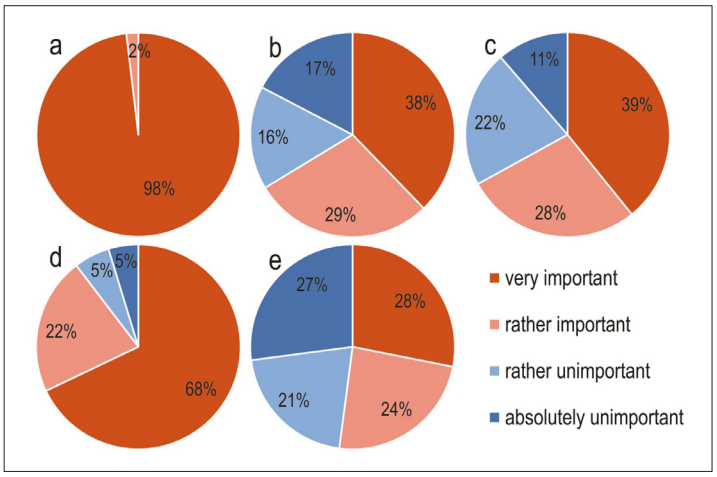

Fig. 12: Perceptions of the importance of chosen marketing forms: a) Customer satisfaction; b) Participation in exhibitions, open door and open cellars days; c) Membership in association; d) Web site; e) Advertising in media
Source: authors' survey

(European Wine Knight Status). Almost all respondents declared membership in at least one association. Only 2.2% of business entities and 3.8% micro-wine makers were not members of any such organisation. Almost all (95.6%) of the respondents are members of the MVC association.

The wine associations organise exhibitions, competitions, tastings, wine tours and various social events, where wine makers have an opportunity to present themselves. Beside many other forms of marketing, membership in an association itself is important for almost two thirds of respondents. Over 91% of them expect the association to provide effective marketing and company presentation (see Fig. 13). Nevertheless, marketing is not the only motivation for membership in a wine association. It enables vine growers and wine makers to acquire new and important information and share experiences and good practices, as associations organise various professional trainings, schoolings or seminars (90%). The motivation for membership in the association does not differ significantly among the various kinds of entities.

Almost nine in ten (86%) respondents perceive memberships as an opportunity to gain new business contacts and as many as 75% to gain new and regular customers, pointing to the important role of an association in business networking in the region. Among other motivations, the respondents declared interests in an even higher number of promotional events, the opportunities to discuss problems, or to influence legislation. These responses identify the importance of associations in overcoming the barriers in competitiveness, which is the key attribute of an industrial cluster. The legal framework was most often (82.5%) stated by respondents as a barrier to improving competitiveness (namely low subsidies, increased excise duty on wine, more profitable imports than domestic wine products), followed by the closely related problem of strong foreign competition in the form of cheap subsidised foreign wines (68.7%).

5.5 Related and supporting industries

Since the relations between wine producers and customers were assessed in terms of the demand conditions, this section is focused on relations between producers and their suppliers. These linkages are among the most important features of an industrial cluster. A large number of specialised suppliers that are concentrated in a cluster territory is beneficial to producers as it results into lower entry costs, faster delivery, reduced inventory and subsequently general cost reductions (Pavelková et al., 2009).

The basic raw material for wine production is the grape. Only 11.1% of the wine producers get all of their grapes from external sources. On the other hand, 42.2% of wine-makers process only grapes from their own vineyards. The remaining producers (45.6%) use both their own grapes and supplies from other vine growers. This means that more than half of the wine makers establish cooperative ties with vine growers or other wine makers, who also grow vines to obtain grapes for their own wine production.

Although not as substantial as vine, other materials are also important for wine production and sale. In the survey, we analysed the spatial distribution of suppliers of chemicals, cork and plastic bottle stoppers, bottles, labels

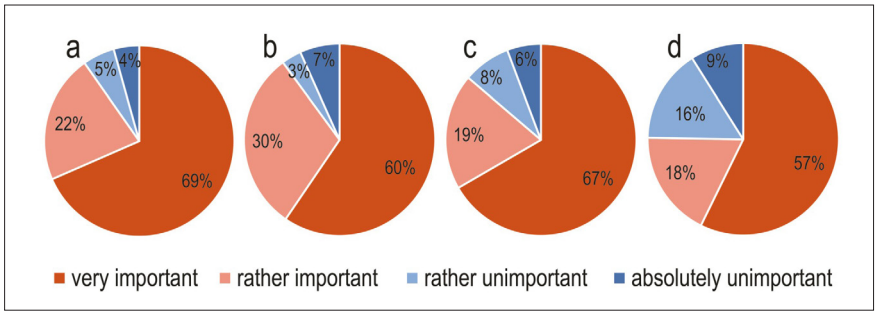

Fig. 13: The most important motivations for membership in a wine association: a) Effective marketing; b) Gaining up-to-date information; c) Establishing new contacts; d) New customers
Source: authors' survey

and packaging. As shown in Fig. 14, the majority of supplies are bought from local or regional entities, and imports from other regions or from abroad are rather the exceptions.

Respondents were asked how they choose the supplier. Among the most important were quality of supplies (98.7% of respondents) and adherence to delivery dates (91.9%), followed by price, completeness of supplies (both above 85%), and supplier references. The distance from supplier was the least frequently declared reason among all options (61.8%). This finding indicates that a certain spatial concentration of supplier-customer relations in the region is not only the result of spatial proximity of suppliers, but rather one result of a competitive advantage based on regional specialisation in the wine industry.

6. Discussion

To identify the primary potential of industrial cluster emergence, we employed the localisation quotient, because it is among the most frequently used indicators of the spatial concentration of certain economic activities (cf. Griffith and Paelinck, 2018; Öztürk, 2009; Szymańska and Środa-Murawska, 2013; Žižka, 2010). Its value for beverages production in the MVC area is 1.52, based on the data on employment of economically active persons. It importantly exceeds even the highest threshold values commonly used by scholars (Potomová and Letková, 2011). Regarding the structure of the beverage industry in the region, we assume that the result also indicates the concentration of the wine sector. This is confirmed by the high level of concentration of wine-producing business entities in the studied area.

Since the beginning of the 20th century, the wine industry in Slovakia has suffered from several natural disasters and grapevine diseases (Malík, 2005), as well as social and economic transitions related to the establishment of the socialist centrally-planned economy and the post-socialist transformation (Hronský and Pintér, 2009; Popelková, 2016; Valúšková, 1998). During the post-socialist transformation, the region between Bratislava and Trnava recorded a rapid development of new industries and non-agricultural and non-industrial economic sectors (cf. Cerulíková et al., 2017). Despite these changes, analysis of the primary potential for industrial cluster emergence confirmed the increased concentration of the wine industry in the area of interest, hence the cluster potential. This shows strong relations of the wine industry with the physical geographic determinants of the area referred to as terroir (Ailer, 2010; Dominé, 2008), which persisted through substantial political and economic transitions. It also agrees with the Porter's (1990) idea that location in a specific environment is one of the key features of industrial clusters.

Several authors (e.g. Marshall, 1890; Nemcová, 2004; Rosenfeld, 2002) have emphasised the potential risks associated with the excessive orientation of a local economy to a single sector covered by a cluster. Geographic conditions in the MVC area and the well-developed and diversified economy of the wider region, however, are supposed to diminish the potential impact of a wine industry decline on the regional economy. The presence of a wine industry cluster should be beneficial for all of the involved actors and for the individual municipalities and the whole region. In brief, it does not make the regional economy dependent on the wine sector.

Locational advantage and the concentration of industry are necessary but not sufficient conditions for the emergence of a cluster as introduced by Porter (1990, 1998a, 1998b). Similarly, the establishment of a cluster initiative, which is represented by the MVC wine route association covering the entire area under observation, may stimulate but does not necessarily lead to the emergence of a natural industrial cluster. This is indicated also by Grabavčicová (2016), addressing the South Moravian region of the Czech Republic, where the vast majority of Czech wine production is concentrated, giving it the potential for cluster emergence. Attempts to establish a cluster initiative to support the cluster emergence (in 2005), however, failed due to the negative attitudes of the majority of potential actors. Such

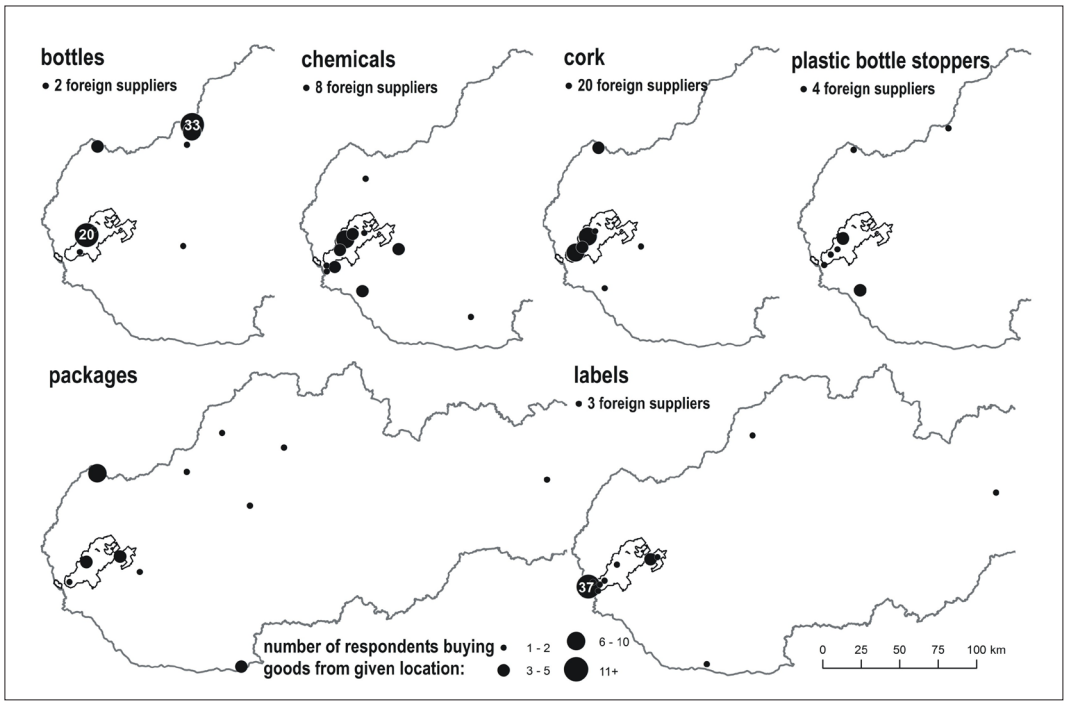

Fig. 14: Spatial distribution of suppliers of materials for wine production in the MVC region
Source: authors' survey

an industrial cluster has to provide competitive advantages to the involved actors, as well as to the whole industry in the cluster area. This advantage arises from a number of factors which Porter (1990) grouped and arranged into the scheme known as Porter's diamond. Based on this scheme, the interviews with wine makers operating in the MVC region were conducted to assess if the identified cluster potential was transformed into the existence of an actual industrial cluster. Such approach to cluster analysis is preferred by many scholars, e.g. Giuliani (2007), Huber (2012), Markusen (1996), Potter and Doug Watts (2011).

The identified linkages and relations among wine makers on the one hand and between wine makers and other entities on the other, take various forms. The supplier-consumer relations are very important, but cooperation in marketing or in educational activities is also significant for the existence of the cluster. The cooperation of wine producers and research and scientific institutions is very rare, however. The spatial range of these linkages is mainly regional. A wider spatial range of linkages has been identified in case of large wine producers.

Increasing the quality of production is being pursued by the majority of wine makers as a basis for competitiveness. Nevertheless, price is also perceived as an important instrument of competition. Competition and cooperation among individual entities in the MVC region stimulate innovations, and hence contributes to the competitiveness of the industry as a whole. These findings are largely consistent with the findings of Baptista and Swann (1998), Giuliani (2007) and Porter (1990) that involvement in the cluster tends to spur innovations. In this way it provides competitive advantage for the involved firms in comparison with isolated producers. While the majority of firms in the MVC region address innovation in wine quality, however, Bortoluzzi et al. (2015) indicate that the most successful firms in traditional Italian wine clusters are those with wide innovation scope (including marketing, business models), while narrow investments in improvement of products and production do not bring sufficient returns.

Competitive advantage for actors involved in the cluster arises also from other factors that are commonly perceived as industrial cluster features (e.g. Öztürk, 2009; Pavelková et al., 2009; Porter, 1990; Riddle, 2016). Among them, the producers highlight reduction of transaction costs for individual cluster members, and exploiting external economies of scale by sharing necessary information, knowledge of technologies and production inputs. This is closely related to easier and faster access to information, technologies and inputs. The particularly small entities with limited financial resources, appreciate the opportunity to increase their image and attract new customers by joint promotion and marketing activities, which they could barely perform as isolated entities.

The transfer of knowledge among business entities is among the important agglomeration effects in a cluster (Bortoluzzi et al. 2015; Markusen, 1996; Morrison and Rabellotti, 2009). This should also contribute to competitiveness by stimulating innovations (Pavelková et al., 2009). Such transfers take place by hiring employees with knowledge and experience from previous workplaces in the same industry. This was not identified in the MVC region, but the transfer of knowledge takes place because of meetings, discussions and workshops organised by local and regional associations, including the MVC association. There are also important informal meetings of vine growers and wine makers, which agrees with Bortoluzzi et al. (2015) who indicate that the most successful companies are these with more intimate relationships with other firms and institutions inside the cluster. Smaller wine makers highlight also an intergenerational transfer of knowledge in the MVC region.

Another agglomeration effect of a natural cluster (Markusen, 1996) is a specialised labour market. Although the majority of respondents consider qualified employees to be necessary for a successful business, they perceived the lack of such labour. This may be a reason for the low transfer of knowledge by employees, and about one half of respondents see it as an obstacle for increasing competitiveness. Such results indicate that the specialised labour market as described by Marshall (1890) was not developed in the MVC region. Nevertheless, it does not necessarily refute the existence of the cluster, but regarding other agglomeration effects and relations within the entities in the MVC region, it rather demonstrates that here is a cluster in the stage of growth as described by Potter and Doug Watts (2011). This idea is supported also by all kinds of proximity as defined by Boschma (2005) that were identified in the MVC region in the wine industry, namely cognitive, organisational, social, institutional and geographical effects. The MVC association then operates as a cluster initiative as defined by Lindqvist, Ketels and Sölvell (2013) and Sölvell, Lindqvist and Ketels (2003), contributing to the development of a natural industrial cluster.

7. Conclusions

The wine industry in the Malokarpatská vínna cesta (MVC) region was chosen as a case study based on the hypothesis that the strong dependence of the wine industry on specific geographical conditions could help this traditional wine region to overcome the effects of socialist industrialisation and the post-socialist transformations on the spatial distribution of economic activities in the CEECs.

The region of interest is located within the most developed part of Slovakia, in an economic sense. This region has recorded rapid economic development induced mainly by the automotive industry and non-industrial and non-agricultural sectors. Nevertheless, the concentration of the wine industry in the MVC region is still evident and it exceeds even the highest threshold values used by scholars to indicate the spatial concentration of an industry in a given area. These circumstances reveal the potential for industrial cluster formation and they confirm that location in a specific environment is one of the key features of an industrial cluster.

Further analysis demonstrates the mutual relations among wine makers in the region and other business entities and institutions. The concentration of wine makers and also suppliers and consumers, leads to a strong competition which stimulates innovations. Beside the competition, wide cooperation was identified among the wine industry entities within the region of interest. The cooperation is focused mainly on common marketing and educational activities. Thus both competition and cooperation boost the competitiveness of the individual wine makers and the wine industry in the MVC region.

The results confirm that the primary potential for an industrial cluster formation led to the development of a wine industry cluster in the MVC region. In comparison with established wine clusters in Western Europe and even

South America, some aspects were not fully developed. This is particularly the case for a specialised labour market based on knowledge transfer by the inter-entity fluctuation of employees, and a relatively narrow focus on innovations to improve the quality of wine production. Such conditions result in neglecting investments in branding, marketing and export networks to sell product outside the region and abroad. It does indicate, however, that unlike mature Western European clusters, the case study MVC cluster is still in the stage of growth, and there is potential for the formation of a specialised labour market and shifts in the focus of investments in further stages of development. While the wine industry formed an industrial cluster as perceived by Porter (1990, 1998a, 1998b) in the MVC region, the MVC association acts as the cluster initiative that clearly contributed to the formation of the cluster.

These results provide important evidence on the formation of industrial clusters in post-socialist Central and Eastern European countries, contributing to the comprehensive research of wine clusters under various historical, political and economic conditions. Recognising the emergence of a wine industrial cluster is also a challenge for further in-depth research. The focus should be on the identification of the specifics with respect to the clusters formed under capitalist conditions without a socialist past, and to more accurately assess the cluster's economic performance.

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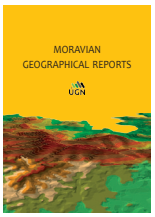

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On the spatial differentiation of energy transitions: Exploring determinants of uneven wind energy developments in the Czech Republic

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Abstract

Wind energy research is dominated by studies of local acceptance (or not) of wind farms and comparative studies at a national level. Research on the spatial differentiation of wind energy developments at the regional level is still insufficient, however. This study provides new empirical evidence for the extent to which regional differences in the deployment of wind energy are related to specific environmental and socioeconomic factors, by a statistical analysis of data for districts in the Czech Republic. Unlike previous studies, we found that the installed capacity of wind energy cannot be well predicted by wind potential, land area and population density in an area. In the Czech Republic, wind farms more likely have been implemented in more urbanised, environmentally deprived coal-mining areas that are affected by economic depression. It seems that in environmentally deprived areas, wind energy is more positively accepted as an alternative source to coal, and the economic motivation (financial benefits for municipalities) can have a greater effect on local acceptance, while public opposition is less efficient due to lower social capital and involvement in political matters. Based on these results, some implications for the planning and spatial targeting of new wind farms are discussed.

Keywords: *wind energy; spatial differentiation; uneven development; energy geography; Czech Republic*

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1. Introduction

Geographers can significantly contribute to understanding sustainability transitions by paying attention to particular settings (places), spatial configurations and the dynamics of the networks within which the transitions are embedded (Hansen and Coenen, 2015). Generally, the ongoing low-carbon energy transition, particularly the development of renewable energy production systems, can be considered a process of the diffusion of innovations or the process of spreading new ideas transferred into the forms of technologies, products, processes and organisations in space and time (Wolsink, 2012). The diffusions of innovations are in principle spatially uneven at all spatial levels (Hägerstrand, 1968). The differences in the deployment of renewable energy facilities cannot be explained simply by physical-geographic and infrastructural conditions of specific areas (i.e. the available land, wind resources, nature and landscape protection limits, transmission grid capacity, etc.), but also (and perhaps most importantly) by political-institutional and socio-economic factors which affect the perceptions, motivations and acceptance of policy makers and stakeholders entering the "games" in planning and decision-making processes (Aitken, 2010; Fournis and Fortin, 2017; Rand and Hoen, 2017).

Comparative studies analysing political-institutional contexts, different outcomes and in-time diffusion patterns of wind energy development at the national level are numerous. As well, studies focusing on the factors affecting perceptions and acceptance of wind turbines by local communities are quite common. Research focusing on differences in wind energy deployment at the regional level, however, is still inadequate to confirm or reject hypotheses about the role of environmental and socio-economic characteristics of areas in accounting for such differences (see the overview of literature in Section 2). Balta-Ozkan and colleagues (2015) pointed out that the nature of the low-carbon energy transition and its socio-economic outcomes at different scales have not been fully understood to date because the focus of most energy research and analysis is at the national and/or the local level.

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The aim of this paper is to contribute to existing research by analysing the extent to which regional differences in the deployment of wind energy are related to geographical, environmental, and socio-economic factors, by analysing selected statistical data (some 35 variables) for districts in the Czech Republic - a country with one of the lowest rates of the deployment of wind energy potential in Europe. In addition to extending theoretical knowledge, the results have implications for wind energy developers: where to focus their interest and energy in promoting new projects; and for politicians: where to encourage and stimulate new investments by supportive land-use policy frameworks.

2. Spatial differentiation and the uneven development of renewables: Literature overview

Geographers have long been interested in the study of the diffusion of innovations (Howells and Bessant, 2012; Diebolt et al., 2016). Changing energy production systems with a distributed generation of renewables have brought new challenges to Geography as a discipline, and gave rise to new "Energy Geographies" (Frantál, Pasqualetti and van der Horst, 2014; Calvert, 2016). One of the most important geographical concepts applied in energy research is spatial differentiation or the production of geographical difference (Bridge et al., 2013). Since the capacity to take up different renewable energy technologies is related to geographical conditions and prevailing conceptions of landscape quality, the locations, landscapes and territorialisations associated with energy transitions generate new patterns of uneven development amongst others (cf. Bridge et al., 2013, p. 337).

A growing number of studies across Europe has confirmed the presence of spatial patterns in the uneven adoption of renewable energy technologies. The most recent studies have focused on the adoption of small-scale (domestic) technologies at the level of households (Balta-Ozkan et al., 2015; Dharshing, 2017; Heiskanen and Matschoss, 2017; Palm and Tengvard, 2011, etc.). Schaffer and Brun (2015) suggest that factors such as house density, homeownership, per-capita income and neighbourhood effects are equally or even more important than solar radiation for understanding the uneven diffusion of PV installations in Germany. In the UK, Balta-Ozkan and colleagues (2016) found that the diffusion of PVs is determined by density of buildings, pollution levels, education level and housing types. Several studies then confirmed the effect of social spill-overs and clustering of adoptions of residential PV installations (e.g. Graziano and Gillingham, 2015; Bollinger and Gillingham, 2012).

As concerns wind energy development, researchers have examined broadly the diffusion dynamics and differences in wind energy deployment outcomes in different countries (e.g. Buen, 2006; Breukers and Wolsink, 2007; Petterson et al., 2010; Davies and Diaz-Rainey, 2011; Dalla Valle and Furlan, 2011; Bauwens et al., 2016). A widely-cited study by Toke et al. (2008) pointed out the role of political-institutional factors, such as political-cultural traditions, energy policies, land-use planning systems, landscape protection norms and organisations, financial support mechanisms and ownership patterns. Most studies have been concerned with the local acceptance of wind energy projects (e.g. Jobert et al., 2007; Janhunen et al., 2014; Fast and Mabee, 2015; Firestone et al., 2015; Rand and Hoen, 2017). Research to date demonstrates the complex and multi-faceted dimensions of 'acceptance', as factors range from personal characteristics, perceived side-effects, process-related variables, and technical and geographical issues (Langer et al., 2016). Among other findings, the results suggest that lower levels of local resistance is found in areas of low landscape value, in polluted areas with heavy industries, areas with low political efficacy, and in areas with a low concentration of second-home owners escaping from the city for a 'rural idyll' (see e.g. van der Horst, 2007, Frantál and Kunc, 2011).

The research literature dealing with regional differences in wind energy development is scarce, however, involving only a few countries – basically those with the largest installed capacities, such as China, USA, Germany, India, Canada and Sweden. Ferguson-Martin and Hill (2011) and Rao and Kishore (2009) followed the approach of Toke et al. (2008) and examined the impact of political-institutional factors on the uneven development of wind energy across provinces in Canada and India. Various studies, largely quantitative in nature, that have explored the relationships between wind energy development and area characteristics are summarised in Table 1.

The two earliest studies from Europe (Tab. 1) investigated differences between areas with accepted wind farms and rejected wind farms – in England and the Czech Republic (van der Horst and Toke, 2010; Frantál and Kunc, 2010, respectively). The areas that were the most likely to refuse planning permission for wind farms in England are characterised by a local population which has a higher life expectancy, a higher likelihood of voting, and a lower exposure to crime. In the Czech Republic, wind farms were accepted to a greater degree in small municipalities with low populations (up to 500 inhabitants) and located in more polluted areas. Limitations of these studies are that they did not account for projects in the whole country but chose selected cases (77 projects in England; 118 projects in the Czech Republic), and only used a binary dependent variable (accepted or rejected).

Mann et al. (2012) reported that wind energy development in Iowa is negatively related to population density within a 50 km radius of the development and distances from transmission lines and highways, but positively related to the amount of cropland and population density within a 200 km radius. Staid and Guikema (2013) reported similar results, pointing out that wind resources, the available share of land, and the amount of cropland are the strongest predictors of wind energy development in the US states. Ek et al. (2013) analysed differences in the installed wind capacity in Swedish municipalities in two time periods (before and after 2006). In the early period, the projects were implemented more likely in large and sparsely populated municipalities with a positive population trend, and - in the later period - the municipalities with existing wind power plants and good wind resources were more likely to continue to exploit wind energy.

A comparative study by Lauf et al. (2018) found that regional variations in wind power deployment in Sweden and Germany, to a significant extent, can be attributed to land-use policies, not least in the form of priority areas and the designation of restricted areas. This study also confirmed a positive correlation of wind capacity with the land area and a negative correlation with population density. Another study from Germany (Goetzke and Rave, 2016) verified that the wind energy capacity is higher in larger counties and in counties with suitable land with fewer hills and mountains. They also found a significant correlation between Green Party votes and wind energy development, which seems to

Authors	Country / level of analysis	Method	Independent variables tested
van der Horst, Toke (2010)	England/Lower layer Super Output Areas	Mann-Whitney test, Univariate regressions	More than a hundred variables related to education, health, demography, employment and housing
Frantál, Kunc (2010)	Czech Republic/Municipalities	Bivariate correlations	Proximity to protected landscape area, natural attractiveness, tourism potential, recreational areas ratio, air pollution, municipal budget, population, and ageing index
Mann et al. (2012)	Iowa, US/One square kilometer cells	Logistic regression model	Wind potential, distances to power line, highway, airport and railroad, land cover types, conservation area, population density, education, and household value
Staid, Guikema (2013)	USA/States	Eight different regression models	Wind potential, land area, amount of cropland, median income, electricity rate, renewable portfolio standards, tax, rebate, loan and other incentives, and the share of Democrats in the State government
Ek et al. (2013)	Sweden/Municipalities	Cragg specification of the Tobit model	Land area, population density, population trend, unemployment, environmental index, and classification according to national interest for wind energy
Goetzke, Rave (2016)	Germany/Counties	Poisson regression model	Wind potential, land area, share of suitable area, relief measure, lagged property value, per capita gross regional product, unemployment, green party votes, and orientation of state government
Xia, Song (2017)	China / Counties	Partial adjustment model	Wind potential, land area, population density, local economy indicators, transmission grid density, presence of other energy sources, tax and price policies
Lauf et al. (2018)	Germany & Sweden / Districts & Municipalities	Tobit regression model	Wind potential, land area, share of protected areas and priority areas, population density, unemployment, participation of green party in state government, and state´s installed capacity

Tab. 1: Summary of recent quantitative studies analysing regional differences in wind energy development
Source: authors' compilation following annotated sources

be facilitated when the state government is left-of-center. A counterfactual analysis revealed, however, that the effect of votes significantly varied in different states. It rather seems that in states with less favourable geographical conditions, fewer additional wind farms would be built, even if the support for Green Party is high, and vice versa (cf. Goetzke and Rave, 2016). Xia and Song (2017) confirmed that wind energy development shows an agglomeration effect (i.e. existing installed capacity attracts new addition of capacity), while they found local economic indicators and transmission capacity insignificant for the location choice for wind farms in China.

To summarise this research, these studies have largely confirmed that geographical characteristics, such as wind resources, the availability of not restricted sparsely populated land, and access to infrastructure facilities, best predict wind energy development in an area. The hypothesis that regions characterised by economic decline will be more likely interested in attracting new investments in wind energy has not been fully confirmed. A significant correlation between unemployment and wind capacity growth was shown only in Germany. Lauf et al. (2018) question this relationship, however, by claiming that districts with high unemployment rates are not more likely to host wind investments, but in the presence of such investments they tend to experience higher capacity additions. The hypothesis about the relationship between votes for left-wing parties (particularly the Green Party) and their participation in regional governments has been supported only by Goetzke and Rave (2016); however, they point to considerable regional variations in the effect of these variables.

As Balta-Ozkan and Le Gallo (2017) emphasise, we cannot claim that the revealed relationships between environmental and socio-economic factors and the rate of adoption of renewable energy technologies are linear; rather, that our understanding of these interactions is still limited and should be further investigated.

We aim to contribute to the existing literature in two ways: First, we provide the first complex quantitative analysis[1] of regional differences in the deployment of wind energy in post-socialist East-Central Europe, a region which is still characterised by some pecularities concerning the energy transition (a prevailing carbon lock-in, high public support for nuclear power, lack of trust and social justice in energy planning processes, etc. – see for example: Piria et al., 2014; Martinovský and Mareš, 2012; Suškevičs, et al., 2019); and – Second, we include in the analysis, among other variables, indicators of environmental deprivation (see e.g. Pearce et al., 2010; Richardson, 2013) that have been mostly neglected in previous regional studies.

3. Geographical context of the study

The current energy policy of the Czech Republic remains highly dependent on traditional resources. Overall, electricity generation is based primarily on thermal or

[1] The study by Frantál and Kunc (2010) has been significantly limited by the sample of implemented wind energy projects and the lack of proper statistical data for municipalities (Local administrative units – LAU2)

combined-cycle power plants burning brown coal [42%], black coal [5%], gas and other fuels [8%], nuclear power plants [33%], with a mix of renewable energy sources at a mere 12% (ERU, 2018). While the Czech Republic is among the EU leaders in the production of solar energy and biogas (particularly in agricultural AD plants), they are laggards in the implementation of wind energy (Roth et al., 2018). The realisable wind potential in the country (soberly estimated between 2,500–3,500 MW: see Hanslian et al., 2008; Chalupa and Hanslian, 2015) is far from being effectively utilised. At the end of 2018, the total installed capacity reached only 310 MW and the spatial diffusion of implemented wind farms is characterised by marked regional differentiation (see Fig. 1).

The Czech Republic still has one of the highest levels of public support for nuclear energy in the EU, on the one hand, but distrustful and partly utilitarian attitudes towards renewables on the other (Frantál and Prousek, 2016; Frantál et al., 2017; Martinát et al., 2017). The public image of and political attitudes to renewables have been adversely affected by the unrestrained boom of the 'solar business' (due to a cheaper technology and overly-generous support schemes, the installed capacity of PVs increased from only 3 MW in 2008 to 2,000 MW in 2011, with most plants installed on agricultural land). Some (but few) 'bad-practice' examples of wind farms and biogas plants have been publicised, often presented in the media as common standards. As a result, the government subsequently destabilised the business environment by making retroactive changes in the form of a solar tax and, in 2014, practically cut off any support for new solar, biogas and wind installations.

Potential landscape impacts are definitely the bone of contention and a major limiting factor for further development of renewables in the Czech Republic. It is a small country with a wide variety of natural conditions and landscape structures, which make it quite difficult to set simple rules for the planning and authorisation process. In 2009, the Ministry of the Environment issued a 'Methodological guide to the assessment of the location of wind and photovoltaic power plants in terms of the protection of nature and landscape', which has set out a procedure for the preparation of preventive studies identifying the interests

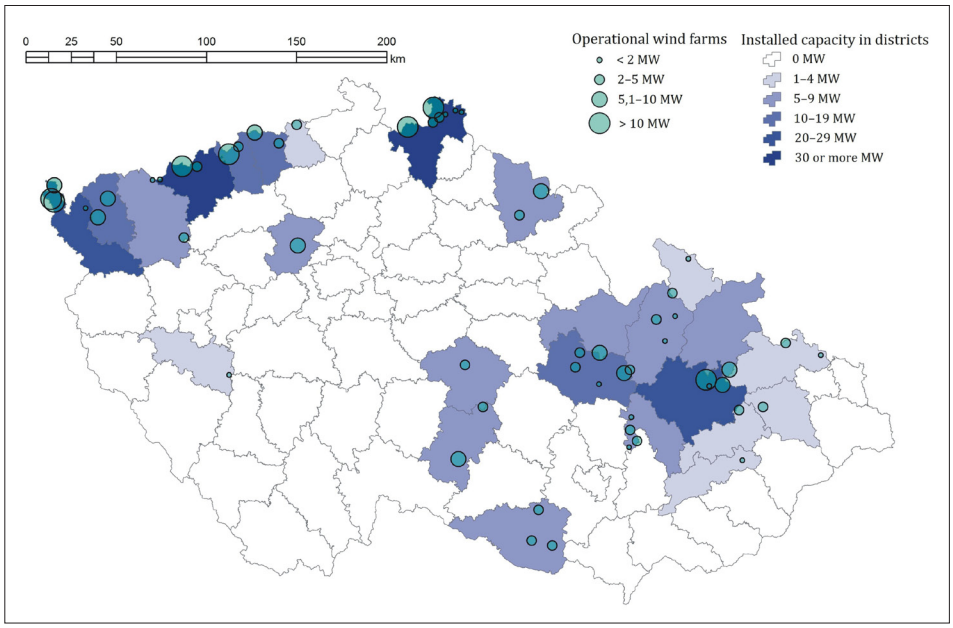

Fig. 1: The location of implemented wind energy projects (circles) and total installed capacity (MW) in districts of the Czech Republic. Source of data: Czech Wind Energy Association (2018); authors' elaboration

of nature and landscape protection at the regional scale, and determining the inappropriateness or potential suitability of power plants in a particular territory. The individual regions vary in their rigidity and approaches, however, and most of them commissioned their own methodological studies as a base for regional territorial planning documentation (see for example, van der Horst, 2009).

Although government subsidies (feed-in-tariffs and green bonuses) for renewables are the same for all regions, differences in the attitudes of regional authorities towards wind energy projects caused (together with other factors) significant spatial differences in the implementation of wind farms (see Fig. 2).

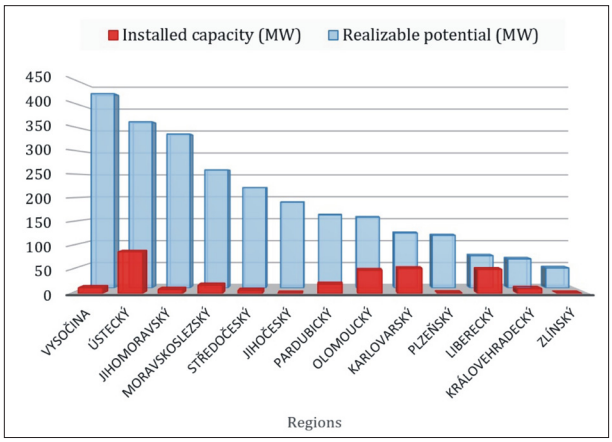

Fig. 2: Regional differences in the deployment of wind energy in the Czech Republic as of 2018
Sources of data: Czech Wind Energy Association (2018); Hanslian et al. (2008); authors' elaboration

4. Data and methods

We hypothesise that socio-political acceptance, the attitudes of regional politicians and officers, the perceptions, motivations and attitudes of mayors of

municipalities and residents, and finally the extent of wind energy implementation, can be affected by geographical, environmental and socio-economic factors, and specific regional and local living conditions and experiences. Thus, we carried out statistical tests of the relationships between the level of implementation of wind energy projects and selected area indicators.

As the spatial level of analysis, we have chosen districts (Local Administrative Unit – LAU1)[2] for which proper statistical data are available and, at the same time, they exhibit a high degree of variance in terms of the realisable potential and installed capacity of wind energy. We used the registry of the Czech Wind Energy Association (CWEA, 2018) as the source of implemented projects, counting the installed capacity of wind energy for each district.

Then we used the study of the Institute of Atmospheric Physics, Czech Academy of Sciences (Hanslian et al., 2008), which assessed the technical potential of wind energy and (considering the environmental, infrastructural and other limitations and constraints) calculated a realisable potential of wind energy for all Czech regions and districts (see Fig. 3). Based on these data, we were able to calculate the degree of utilisation of the realisable potential for districts (Fig. 4).

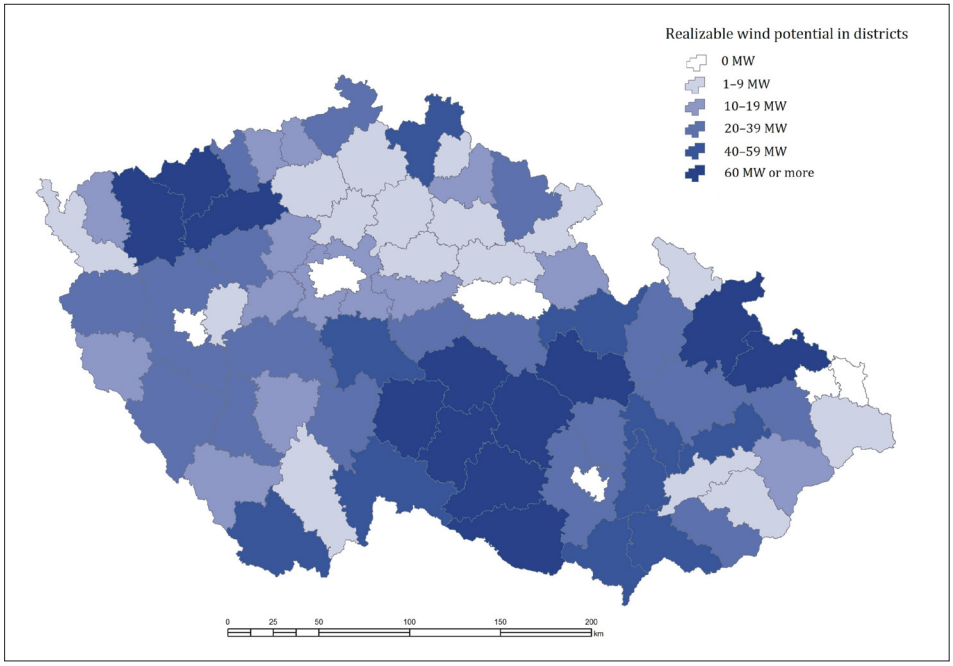

Fig. 3: Regional differences in the realisable wind potential. Source of data: Hanslian et al. (2008); authors' elaboration

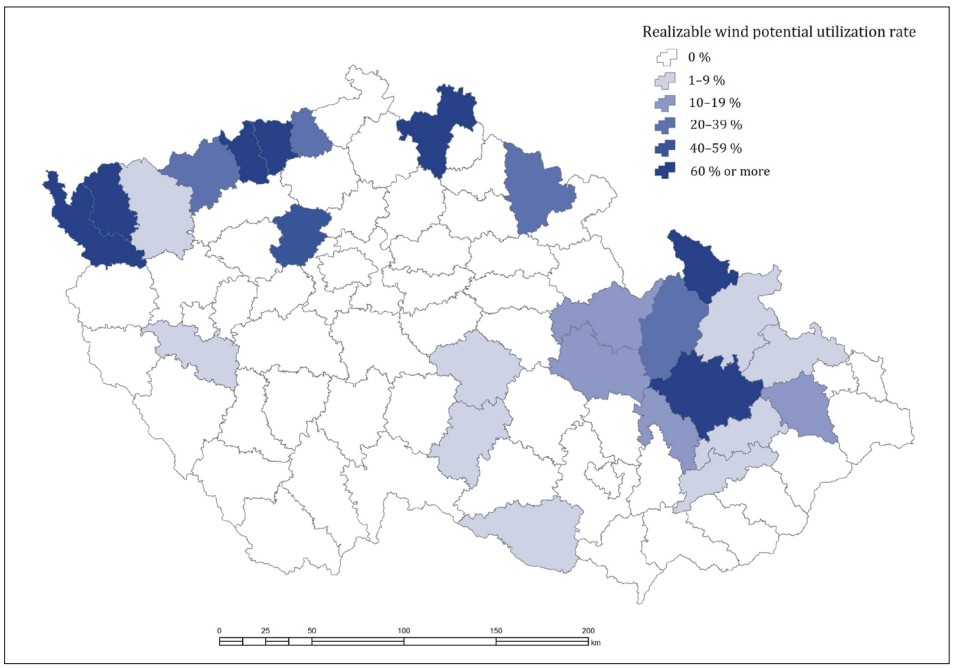

Fig. 4: Regional differences in the utilisation rate of the realisable wind potential as of 2018
Source of data: Hanslian et al. (2008); authors' elaboration

[2] There are 76 districts in the Czech Republic, the capital city of Prague does not belong to any of them. The area of districts ranges between 230 and 1,946 km^2 (the mean value is 1,031 km^2).

While some districts (especially in Northern Bohemia and Northern Moravia and Silesia on the borders with Germany and Poland) have already achieved a high degree of utilisation of estimated realisable potential (60% or more), others that have a high potential (particularly in the Southern part of the country, including Vysočina Region, South-Moravian and South-Bohemian Regions) do not use this potential almost at all.

Variable	Measure
Geography	
Wind resources	Realisable potential of wind energy (MW)
Area	Total area (km^2)
Borderland	District is located on the country´s border (yes = 1/no = 0)
Agricultural land	Share of agricultural land on total area (%)
Forests	Share of forests on total area (%)
Landscape protected areas	Share of protected landscape areas on total area (%)
National parks	Share of national parks on total area (%)
Environmental deprivation	
Air pollutant emissions I	Concentration of SO_2 emissions (SO2 tones/km^2)
Air pollutant emissions IÍ	Concentration of NO_x emissions (NOx tones/km^2)
Air pollutant emissions III	Concentration of CO emissions (CO tones/km^2)
Coal mining	Active coal mining in district (yes = 1/no = 0)
Surface coal mining	Extensive surface coal mining in district (yes = 1/no = 0)
Coal power plants	Installed capacity of coal power plants in district (MW)
Population and health	
Population density	Population per km^2
Population increase	Annual population natural increase per 1,000 population
Net migration	Number of immigrants less number of emigrants
Urbanisation rate	Share of urban population (%)
Ageing index	Number of persons older 60 years or over per 100 persons under age 15
Life expectancy	Male life expectancy at birth (years)
Respiratory diseases	Deaths per 100,000 population of respiratory diseases
Infant mortality	Infant mortality (‰)
Abortion rate	Abortions per 1,000 population
Congenital anomalies	Congenital malformation per 10,000 live births
Economy and labour market	
Structural depression	Classified as structurally depressed region (2007–2013) (yes = 1/no = 0)
Unemployment	Unemployment rate (%)
Business activity	Total business units registered per 1,000 population
Job vacancies	Job applicants per vacancies
Tourism potential	Number of overnight stays in tourist accommodation (2006)
Social capital & cohesion	
Education level	Persons with basic or no formal education (%)
Proportion of natives	People with permanent living at the place of their birth (%)
Ethnic minorities	Number of Roma ethnic people per 1,000 population
Homelessness	Number of homeless people per 1,000 population
Crime rate	Ascertained offences per 1,000 population
Internet availability	Percentage of inhabited flats with PC/internet connection
Political involvement	Turnout in regional elections in 2012 (%)
Green party votes	Share of people voting for Green Party in regional elections (%)

Tab. 2: List of variables included in statistical analysis (Notes: i) The categorisation of variables is only indicative as some variables may belong to several categories; ii) Data are relevant for 2011 unless otherwise indicated) Sources of data: Czech Statistical Office (2011); Ministry of Agriculture (2011); Public Register of Land (pLPIS); State Administration of Land Surveying and Cadastre (2011); Share of forests in districts in the CR; Government of the Czech Republic (2006); Government decision No. 560/2006, on the Definition of regions with concentrated state support for 2007–2013; Vystoupil et al. (2006)

Subsequently, we created a database of selected variables representing the most relevant geographical characteristics of districts, environmental deprivation indicators, population vital and health statistics, local economy and labour market data, and social capital and social cohesion indicators (see Tab. 2). The selection of indicators was determined by the availability of statistical data at the spatial level of districts in the Czech Republic.

Statistical model testing of the relationships was then carried out: the installed capacity of wind energy within districts was the dependent variable, and the above-listed indicators served as independent variables. We also tested if there is a correlation between those indicators and estimated realisable potential of wind energy to reveal possible multiple-correlation (with both the realisable potential and installed capacity). Statistical procedures were carried out using the SPSS program version 24, with bi-variate cross-correlation analyses of all independent variables against values of the realisable potential and the installed capacity. The strength of association and statistical significance was tested using Pearson's r correlation coefficient, and examining the p-value for each pair of variables. Basic results of the bi-variate correlation analyses were published in the form of a short working paper in the Czech language (Frantál and Nováková, 2017).

In addition, we carried out Analysis of Variance (ANOVA) procedures for different groups of districts, as well as estimating multiple linear regression models that included only those selected variables that showed stronger correlations with the installed wind capacity. Considering the exploratory nature of this case study, we put less emphasis on the complexity of the analysis (e.g. in not using any structural modelling, as in some of the previous studies) and more emphasis on the interpretation of findings that were the most statistically significant.

5. Results and discussion

First, we examined how much the regional development of wind energy in the Czech Republic is determined by the available wind resources. The correlation between realisable potential of districts and their installed capacity is $r = 0.42$ ($p < 0.01$). In other words, the linear regression model showed that wind energy potential accounts for only 18% of the variance in the installed capacity of districts; hence, there must be other important factors that affect the differences. We have found statistically significant correlations with the installed capacity of wind energy for 16 indicators, of which only two (education level and unemployment rate) correlate also with the realisable potential (see Tab. 3).

The analysis shows that the estimated realisable potential of wind energy correlates positively with total area and negatively with population density. This seems to be logical and these variables were taken into account by Hanslian et al. (2008) as constraints in the calculation of the realisable potential from a technical potential. But, surprisingly, neither land area nor population density correlate with the installed capacity. This finding is in contradiction to most existing studies (e.g. Goetzke and Rave, 2016; Lauf et al., 2018), which confirmed land area and population density (together with wind potential) best predict the installed capacity. Significant correlations have not been found between installed capacity and the intensity of landscape protection and the use of land in the area (the share of nature and landscape protected areas, forests and agricultural land in

Independent variables[1]	**The values of correlation**[2]	
	with installed capacity	with realisable potential
Surface coal mining	0.510**	n/s
Coal power plants	0.468**	n/s
Coal mining	0.381**	n/s
Urbanisation rate	0.363**	n/s
Green party votes	0.357**	n/s
Structural depression	0.317**	n/s
Abortion rate	0.308**	n/s
Infant mortality	0.303**	n/s
Ethnic minorities	0.296**	n/s
Education level	0.286*	0.354**
Unemployment rate	0.265*	0.386**
Life expectancy	− 0.260*	n/s
SO_2 emissions	0.260*	n/s
NO_x emissions	0.256*	n/s
Borderland area	0.250*	n/s
Political involvement	− 0.231*	n/s
Area	n/s	0.437**
Population density	n/s	− 0.248*

*Tab. 3: Relationships between district characteristics and the installed capacity and realisable potential of wind energy (Notes: 1) Independent variables are listed according to their descending correlation r-value; 2) correlations are significant at the levels of **0.01; *0.05; n/s = non-significant correlation*
Sources of data: see Table 2; calculations by authors

the total area of districts). This result can be affected by a generally very low rate of utilisation of the potential and suitable land availability in most Czech regions, however, compared to countries such as Germany or Denmark, where there is already almost no space for new onshore wind farms in some regions (see e.g. Roth et al., 2018).

The strongest correlations were found between the installed capacity of wind energy and the presence of coal mining and the installed capacity of coal-fired power plants within the district. Table 4 shows the significant differences between districts with and without coal mining in the use of wind energy. The districts do not differ significantly in average realisable wind potential, but coal mining districts have an average utilisation rate of the potential of over 40%, compared to less than 10% in non-mining districts.

Most of the other variables which show significant correlations with the installed capacity of wind energy, at the same time correlate with the presence of coal mining and coal power plants. Overall, this means that the coal energy industry is linked to air pollution, structural depression, higher unemployment, and worse health indicators (lower life expectancy, higher infant mortality). A higher proportion of uneducated people and ethnic minorities in districts affected by coal industries suggest that coal energy is environmentally unjust (cf. Frantál and Nováková, 2014).

To determine the relative strength of the effects of individual variables on installed wind energy capacity, we carried out multiple regression analyses. Since there are strong bi-variate correlations between the presence of coal mining and coal power plants in the district and the structural depression, socio-economic and health indicators, which result in multi-collinearity of the independent variables in the analysis, the final model included only four independent continuous variables that do not significantly correlate with each other (see Tab. 5). This can be regarded as a first level attempt to control for interaction effects. Regarding relative influence, the strongest predictor is the realisable potential (standardised Beta coefficient = 0.41), followed by the votes for the Green Party in regional elections, the installed capacity of coal-fired power plants, and the rate of urbanisation. These four independent variables explained 46% of the variance of the installed wind capacity, indicating that there are other significant variables that have not been included in our analysis. We assume that political-institutional factors at the regional level (e.g. attitudes of regional authorities) will be particularly important, as confirmed by previous studies (Frantál and Kunc, 2010).

The confirmed relationship between the presence of coal energy industries and installed wind energy capacity may indicate several things. First, we could assume that in environmentally deprived areas, wind energy is being adopted more positively as an alternative source to fossil fuels. This is in line with the findings of Balta-Ozkan et al. (2016), who found that smaller households in highly polluted areas in the UK are early adopters of PV installations. Van der Horst (2007) mentions other case studies showing that the existence of heavy industry and large stacks in the area appears to make residents more likely to support wind farms as an improvement of the image of the area. Another reason can be that people living in coal mining landscapes are aware that the lifestyles we lead have attendant costs and that electricity does not come 'out of the switch' but from the earth, it has to be produced somewhere, transported, stored, etc. (cf. Pasqualetti, 2000; van der Horst, 2007).

Indicators	District category[1]		Statistics	
	Non-mining	Mining	F test	Eta[2]
Total realisable potential of wind energy [MW]	2,285	249	–	–
Average realisable potential of wind energy [MW]	32.7	41.5	0.298	0.063
Total installed capacity [MW]	208	103	–	–
Average installed capacity [MW]	2.9	17.2	12.576	0.391*
Utilisation of the realisable potential [%]	9	41	–	–

*Tab. 4: Differences in the utilisation of wind energy potential in coal mining and non-mining districts (Notes: 1) The mining district category includes six districts where coal mining is still active; the non-mining category includes all other districts of the Czech Republic; 2) Measures of association (Eta) are significant at *p < 0.001) Sources of data: Hanslian et al. (2008); Czech Wind Energy Association (2018); authors' calculations*

Predictors	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	S.E.	Beta		
(Constant)	– 12.985	3.248		– 3.997	0.000
Realisable wind potential (MW)	0.109	0.025	0.408	4.383	0.000
Capacity of coal power plants (MW)	0.007	0.003	0.233	2.344	0.022
Share of urban population (%)	1.610	0.765	0.214	2.106	0.039
Green party votes (%)	2.586	0.911	0.272	2.837	0.006

R^2 = 0.46; Sig. = 0.001

Dependent variable: Installed capacity of wind energy (MW)

Tab. 5: Regression model for installed wind energy capacity Source: authors' calculations

Van der Horst (2007, p. 2709), however, also points out that the lack of organised opposition to wind farms does not directly mean that people are actually in favour of them. The (passive) acceptance can be just an indicator of low political efficacy (due to lower education and lack of social capital) and resignation, which is often a characteristic phenomenon in environmentally deprived areas (Frantál, 2016). On the contrary, lower environmental and health deprivation may be correlated with higher political involvement and higher local opposition to new energy projects (van der Horst and Toke, 2010).

On the other hand, we found a positive correlation between installed wind capacity and votes in regional elections for the Green Party, which is the only political party in the Czech Republic which supports the development of renewable energy resources in the long term. The same relationship was confirmed by data from Germany (Goetzke and Rave, 2016). As in Germany, there are, however, regional differences in the effect of this variable in the Czech Republic. The correlation between wind energy and Green Party votes is quite strong and significant ($r = 0.674$, $p < 0.05$) in coal mining districts, but it is not significant in districts without coal mining. The high support for the 'Greens' may therefore be linked primarily to their opposition to possible change to the territorial ecological limits of coal mining in the North Bohemian coal basin (see, for example, Frantál, 2016) and not directly to their support for renewable energy.

The higher adoption of wind energy in regions with coal-fired power plants is to a certain extent in contrast to the lower acceptance of wind energy in Czech regions where nuclear power plants are located (see Frantál and Malý, 2017). Perhaps, a general familiarisation with the risks related to nuclear power, together with significant economic impacts of nuclear power plants in hosting regions (providing jobs, property tax revenues, investments in local infrastructure, etc.), could make municipalities no longer motivated to support other (wind) energy projects in their backyards (ibid.). This is actually in line with the situation in Austria, Germany or China, where people are willing to pay for and support wind energy to prevent a nuclear power plant from being constructed in their regions (Frantál and Kučera, 2008, Sun et al., 2016, Yamane et al., 2011). Another example of the negative correlation between developments of different energy sources was provided by Xia and Song (2018) from China, where an increase in the installed capacity of hydropower plants in an area led to a decrease of installed wind power capacity. The higher adoption of wind energy in coal mining regions is probably affected also by the fact that Czech coal power plants do not provide (in comparison with nuclear power plants and wind farms) local communities with direct financial benefits and investments.

The significant correlation between the installed capacity of wind energy and the rate of urbanisation in Czech districts supports the hypothesis that wind farms are more likely to be implemented in areas with a lower concentration of second home or holiday home owners escaping from a city for unspoiled landscapes and the 'rural idyll' (Cowell et al., 2011; Janhunen et al., 2014; van der Horst and Toke, 2010). An interesting finding from our analysis is the small but significant correlation between the higher installed capacity of wind energy and the location of a district in borderland areas. While these districts do not significantly differ in average wind potential (which is 31 MW in inner districts and 37 MW in borderland districts), they do significantly differ in the average installed capacity (1.8 MW in inner districts and 6.8 MW in borderland districts: $F = 4.951$, $Eta = 0.25$, $p < 0.05$). There may be different reasons for this pattern. Since all coal mining districts are in the borderland areas, the factor of environmental deprivation is likely to intervene here. It is also visible from the map (Figure 1) that larger wind farms are mainly in areas where large wind farms are also located on the other side of the border, i.e. in Saxony (Germany), Lower and Upper Silesia (Poland) and Lower Austria (Austria). Czech people living in these border regions were more likely to see and experience wind turbines personally, so that they could be more familiar with them. Another possible factor is that municipalities on the borders generally have fewer neighbouring municipalities (within a country) that may be in opposition to projects and may intervene in decision-making processes. These hypotheses, however, deserve further verification through research at the local level and with respect to the emerging field of borderlands research.

6. Conclusions

The aim of this exploratory study was to provide new empirical evidence to respond to the research question: To what extent are regional differences in wind energy development related to specific geographical, environmental and socio-economic factors. The analysis of statistical data for districts revealed that the existing spatial differences in the deployment of wind energy in the Czech Republic cannot be explained by the differences in territory area, population density or the intensity of land use and protection (measured as the share of nature and landscape protected areas, forests and agricultural land). This is in contradiction to previous studies from the USA, Germany and Sweden (Staid and Guikema, 2013; Goetzke and Rave, 2016; Ek et al., 2013).

The statistically higher installed capacity of wind energy in the Czech Republic is found in more urbanised areas, in those areas with active coal mining and with a high concentration of coal-fired power plants, which are also characterised by higher emissions and the lower status of the health of the local population, as well as by structural economic depression with high rates of long-term unemployment, and higher concentrations of people with basic or no formal education and ethnic minorities. The coal-mining districts have levels of more than a four times higher rate of utilisation of their realisable wind energy potential than other districts (40% vs. 9%), even though they do not significantly differ in the average realisable wind potential, which is related to land area and population density.

The results suggest that in coal-mining and environmentally deprived areas, renewable energy is more positively perceived and adopted as an alternative source of energy to 'dirty' coal. Higher levels of acceptance may be due to the fact that in environmentally deprived areas economic motivations (e.g. financial compensation for local communities) can have greater effects on local acceptance, while public opposition is less efficient due to lower efficacy and involvement in political matters (cf. van der Horst, 2007; Frantál, 2016).

Nevertheless, the modest coefficient of multiple determination ($R2 = 46\%$) for our final multiple regression model (with independent variables: wind energy potential of a district; urbanisation rate; installed capacity of coal-fired-power plants; and Green Party votes) calls for further

research that will take into account other variables and focus on more spatial levels (i.e. the level of both the municipalities and regions). As Goetzke and Rave (2016) emphasised, it also seems important for future research to distinguish between different types of wind energy projects, mainly in terms of ownership and citizen participation but also spatial scale (size).

With regard to policy and practice, the results of our study suggest that the spatial targetting of new energy projects (not only wind farms but also other energy facilities) towards environmentally and economically depressed regions will be an easier way for planners and developers to reduce the risk of vocal local public opposition. The concentration of power plants and other polluting and risky facilities (such as refineries, incinerator plants or nuclear waste disposal sites) to the landscapes "sacrificed for the state's energy security", raises questions of environmental and/or energy injustice, and the uneven spatial and social distribution of benefits and costs of energy production (see for example: Sovacool and Dworkin, 2015; Sovacool et al., 2017). It has been suggested that renewable energy (with community-based distributed generation) offers unique opportunities for addressing energy justice issues, such as access and energy security, with less environmental impact (Outka, 2012). It does seem, however, that new energy systems (which should replace fossil resources) as they are currently being designed share some characteristics with their predecessors (such as spatial concentration, procedural injustice and lack of trust) – and may reproduce old patterns of environmental injustice (Ottinger, 2013).

Small-scale deployments constitute an easier way to reduce both landscape impacts and spatial concentration, being more acceptable for both residents and tourists (e.g. Frantál and Kunc, 2011). The re-territorialisation process ('one village - one wind turbine,') taking place in Belgium and some other countries is a striking example of the so-called smart practice for siting renewable energy projects (see Frantál et al., 2018). Small-scale projects, however, have limited and often insufficient outputs to achieve longer-term national targets for emission reduction. Therefore, the process of de-concentration or re-territorialisation of energy production requires the involvement of all to share the spatial cost of energy. For the time being, however, this is opposed by many politicians and ordinary people (and not only in the Czech Republic) who strictly claim "no wind turbines in our region!".

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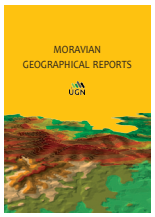

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How distance influences dislike: Responses to proposed fracking in Fermanagh, Northern Ireland

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Abstract

Despite extensive social science research into public perceptions and social responses to fracking, scholars have only begun to examine the relationship between distance to development and support or opposition for it. Importantly, the emerging studies are exclusively from the United States, and focus on communities and regions in which fracking already exists – in contrast to areas where it is proposed and still going through planning approvals. This paper reports public responses to proposed fracking in County Fermanagh, Northern Ireland, United Kingdom. A total of 120 people participated in an in-person survey with a qualitative follow-up in four locations: the village right next to the development site, two other villages just inside and just outside the wider fracking concession area, and in the capital city of Belfast, 150 km away. A clear spatial pattern of opinion was found, from almost universal opposition to fracking next to the site, to an even three-way split between proponents, opponents and 'neutrals' to fracking in general, in Belfast. Results show that some risks are perceived to be more local than others, whilst perceived (economic) benefits are recognised mainly at the national level. Content analysis of local and national newspapers revealed a very clear and similar pattern. Connections to Fermanagh, through visits or long-term residence, were also clear predictors of opposition to fracking. The spatial pattern of support for fracking in Northern Ireland differs substantially from each of the contrasting patterns observed in the United States. We discuss likely reasons for this and implications for both research and policy.

Keywords: *hydraulic fracturing; public acceptance; construal level; psychological distance*

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1. Introduction

Hydraulic fracturing ('Fracking') is an established method of fossil fuel extraction in the US (Jacquet et al., 2018, Haggerty et al., 2018, Theodori, 2018), Australia (Luke et al., 2018a), Canada (Lachapelle et al., 2018), and China (Tan et al., 2019), with many other countries hoping for this technology to reverse their dependence on imported fossil fuels and provide welcome extra cash for the state coffers. Nevertheless, fracking is also characterised by a polarisation of views and there is substantial concern and debate surrounding the possible impacts of fracking within the government, media and public sphere (Smith and Ferguson, 2013; Ritchie et al., 2014). Although studies of the relationship between fracking location and public opinion have emerged in the last few years (Alcorn et al., 2017; Boudet et al., 2016; 2018; Clarke et al., 2016, Davis and Fisk, 2014, Evensen and Stedman, 2016; Howell et al., 2017; Junod and Jacquet, 2019; Junod et al., 2018; Mayer, 2016; Zanocco et al., 2019), these all focus on areas in the United States and compare proximity to current shale gas or oil development with areas more distant from development. Construal level theory, a key psychological explanation for the role of distance in shaping perceptions, contends that people only concretely experience things that are psychologically close to them – spatially (geographically), temporally, socially, and hypothetically (real, not abstract) (Trope and Liberman, 2010). No fracking (yet) exists in the entire country of Northern Ireland – indeed, none existed in the wider United Kingdom during our data collection. Therefore, the psychological processes informing

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construal level (i.e. the abstract or concrete level at which perceptions of fracking are formed) could be quite different in Northern Ireland from that revealed in aforementioned United States research. Furthermore, Alcorn et al. (2017) point to the need for research on the relationship between proximity and attitudes towards fracking to examine different stages of development, and Zanocco et al. (2019) explicitly recommend such research attending to proposed development.

In line with other siting-controversies (Owens, 2004), there are arguments that benefits from fracking seem to be nationwide, yet local communities bear the negative externalities. Research has shown that key environmental risks and health risks associated with fracking tend to be tightly spatially concentrated around drilling sites (Meng, 2015; Meng and Ashby, 2014). Nevertheless, Mayer (2016) demonstrates that perceived proximity to oil/gas development has far greater correlation with risk and benefit perceptions than actual proximity, and Alcorn et al. (2017) reveal support for a moratorium on fracking is much more dependent on perceived proximity than actual distance to the nearest well. Perceived proximity is, therefore, important, but the direction of its influence is less clear; Alcorn et al. (2017) show divergent effects in different US states (increased proximity associating with increased support for a moratorium in Pennsylvania and the opposite in Ohio). Within and across communities and regions, the debate surrounding the distribution of risk and benefits is highly contentious and local opposition is becoming more prevalent, headed by opposition groups and "Fractivists" (Jones et al., 2013; Henderson and Duggan-Haas, 2014; Taylor, 2014).

In the UK and other EU countries, where fracking has been discussed, planned and sometimes tested but commercial production has not (yet) started, public perception research has largely been limited to general surveys. O'Hara et al. (2012; 2014) carried out 10 cross-sectional surveys examining public attitudes towards shale gas extraction from March 2012 to September 2014. The results indicated attitudes towards fracking fluctuated across the random samples over time, with the authors implying that well documented protests against fracking in Balcombe, Sussex, played a vital role in influencing people's perceptions towards fracking (O'Hara et al., 2014). The results from these surveys show higher levels of support for fracking (53.6% in 2012; 51% in 2014) than those found by the Department of Energy and Climate Change in 2014 (24%) and the European Commission in 2013 (32.5% in a survey across Poland, France, Romania, Spain and Germany). These last two surveys found only a small percentage difference in levels of support and opposition, which highlights that the public have undecided views concerning shale gas extraction (see also Whitmarsh et al., 2015).

Understanding public perceptions, especially those in nearby communities who may be most directly affected by fracking, will be important to help policy makers and energy companies effectively engage with communities (Clarke et al., 2012). In an effort to shed light on which factors most influence views on proposed fracking in County Fermanagh – the only location to have been seriously considered for fracking in Northern Ireland (first in 2014 and now again today [June 2019]) – we examine the role of socio-demographics, psychological characteristics (including perceived distance), and local and national mass media coverage.

2. Theoretical background

2.1 Place, proximity, and perceptions

Local opposition to fracking is one of the most significant obstacles to the expansion of shale gas industry in Europe (Cotton, 2013; Luke et al., 2018b; van de Graaf et al., 2018), however comparatively little research has examined how some factors – particularly actual and perceived proximity to development – condition such opposition, which is what this study attempts to address.

Social psychological literature has revealed that the socially-constructed concepts of place identity (Proshansky, 1978; Korpela, 1989) and place attachment (Devine-Wright, 2009; Altman and Low, 1992) can be key determinants of people's perceptions of new developments. Personal experience with an area, either by living there for a long period or visiting the area recreationally, can affect levels of place attachment (Brown and Perkins, 1992; Kyle et al., 2004; Devine-Wright, 2009). Place identity theory explains how people interact and identify themselves with the environment (Wester-Herber, 2004). A new facility can threaten and intrude on people's perception of place, and their own personal identity (van der Horst and Vermeylen, 2012). Place identity, therefore, is important for authorities and locals to discuss in regards to proposed facilities in their area (Woods, 2003).

Henderson and Duggan-Haas (2014) argue that opposition to fracking can be explained as an attempt to ameliorate threats to self-integrity. Similarly, Stedman (2002) notes that people are willing to fight for places that are central to their identity; therefore, high levels of opposition are likely if people identify themselves with a certain place and feel attached to it. This has been observed in numerous studies in relation to fracking, predominantly from the United States, but with some research in Australia (Evensen and Stedman, 2018; Huth et al., 2018; Jacquet, 2014; Jacquet and Stedman, 2014; Lai et al., 2017; Luke et al., 2018b; Perry, 2012; Sangaramoorthy, et al., 2016; Schafft and Biddle, 2015; Willow, 2014; Willow et al., 2014).

Place attachment is the process of attaching oneself to a particular place either due to an emotional bond with the location or the length of dwelling there, and can be at the individual or collective community level (Manzo and Perkins, 2006; Devine-Wright, 2009). The longer someone has lived in an area the more likely they will be attached to a place, and research by Raymond et al. (2010) found significant correlations between place identity and length of residence. Cotton (2013) discusses the shock that individuals experience when shale gas developments are announced which can disrupt an individual's sense of place attachment. Lewicka (2011) suggests collective communal place attachment can help empower communities to oppose change. Junod et al. (2018) link place disruption to proximity to fracking in their research describing a 'Goldilocks Zone' phenomenon – a non-linear relationship between support for fracking and proximity to development – as distance from fracking increases, support first increases and then decreases. The area where fracking is perceived as 'just right' (as in the Goldilocks fairy-tale) is not too close but not too far away from development.

Although the link between place disruption and proximity to development is intuitive, the Goldilocks Zone is not empirically robust; Junod and Jacquet (2019) show that the original findings from the Bakken Shale in the US – an area of extremely remote and socially homogenous

populations – do not systematically replicate in Ohio. Furthermore, Zanocco et al. (2019) find no evidence for a (US) national-level Goldilocks Zone surrounding well sites. Junod and Jacquet (2019) point to differences that likely affect the relationship between proximity to development and support for development, with the following making the Goldilocks Zone less likely: less private mineral rights ownership, greater mix of viable industries locally, higher population density, and increased cultural heterogeneity in communities. Based on these factors, we would expect Northern Ireland not to experience the Goldilocks Zone, and to reveal a more direct relationship between proximity to development and support for fracking.

In the United States, research has shown a direct, positive relationship between proximity to development and support (i.e. closer to development = more support) (Boudet et al., 2018; Gravelle and Lachapelle, 2015; Howell et al., 2017; Junod and Jacquet, 2019; Zanocco et al., 2019). Nevertheless, other research reveals no direct independent effect from geospatial proximity on support for fracking (Alcorn et al., 2017; Boudet et al., 2016; Davis and Fisk, 2014; Mayer, 2016), and Clarke et al. (2016) even provide evidence of a weak but significant inverse relationship (i.e. decreased proximity to development = increase support). Adding further nuance to the relationship in the United States, Evensen and Stedman (2016) note that risks and benefits are more strongly associated with support for fracking in areas closer to well sites than in areas more distant. Similarly, Clarke et al. (2016) reveal a stronger connection between political views and support for fracking in areas farther away from well sites, and Boudet et al. (2018) connect increased geospatial proximity to well sites to greater familiarity with fracking. These last three studies' findings are consistent with construal level theory, mentioned earlier, which predicts that increased distance from something makes ideas of that thing more abstract, and therefore more likely to be associated with general worldviews as opposed to specific concrete beliefs about the thing itself.

A problem with applying construal level theory to Clarke et al.'s (2016), Evensen and Stedman's (2016), and Boudet et al.'s (2018) data is that those data include measures of geospatial proximity, whereas construal level theory speaks to psychological proximity. The two studies that use psychological proximity to predict support for fracking both show psychological proximity as a far stronger determinant of support/opposition than geospatial proximity, but, again, the findings are not consistent with respect to the direction of the effect (Alcorn et al., 2017; Mayer, 2016). In this research, increased psychological proximity associates with support in Ohio, opposition in Colorado and Pennsylvania, and there is no discernible effect in Texas.

In summary, the relationship between proximity (both geospatial and psychological) to fracking and support for fracking is decidedly unclear in the United States. We observe the full range of relationships – direct, inverse, and none. The data suggests that local residents are more aware of fracking and its impacts locally, including risks and benefits, but the valence of those impacts is conditioned by the range of aforementioned factors identified by the scholars working in this area. In our research described below, we examine geospatial and psychological proximity to proposed fracking via the length of time local residents have spent living in County Fermanagh where the Northern Ireland fracking has been proposed (ordinal variable), as well as whether people living outside of Fermanagh have visited the County (dichotomous variable). These are imperfect measures of psychological proximity with room for improvement, but we think they better capture the aforementioned theoretically and empirically manifest connections between place disruption and psychological proximity than the binary measures that were used in the two extant studies on psychological proximity to fracking (i.e., whether people think they live close to fracking or not).

The motivations for public support or opposition are complex, dependent on a person's physical and psychological connection to place, but also contingent on perceptions of fairness and trust (Devine-Wright and Howes, 2010, Cotton 2013).

2.2 Trust

Trust is a social construct derived from relationships between various actors and the individual that plays a vital role in influencing perceptions and understanding of new technologies (Mumford and Gray, 2010). Putman (1993, p. 171) states, "trust lubricates cooperation and cooperation builds trust"; therefore, for developers and policy makers to gain trust they must listen to the concerns of local communities and the wider public. Having trust in developers and those in positions of power is important when introducing new technologies as it is trust within the local community that enables shared cognition (Mumford and Gray, 2010).

Flynn and Bellaby (2007) argue that opposition to new technologies is dependent on trust, and levels of trust can moderate the relationship between place attachment and attitudes towards a project (Devine-Wright and Howes, 2010). Gross (2007) found strong correlations between the strength of trust between the community and developers with the degree of acceptance towards the proposed project. This was also found by Upreti and van der Horst (2004), who established that public perceptions of fairness played a crucial role in the development and siting of new energy facilities, and public acceptance or rejection of developments was mainly based on trust.

O'Brien and Hope (2010) and Pijawka and Mushkatel (1991) suggest that high levels of public opposition to new energy developments occur due to the lack of trust created as a result of a top-down approach to policy implementation, and a lack of confidence in local authorities and developers (Rabe and Borick, 2011). A community approach to implementing new technologies will generate greater understanding, support and therefore more trust by the public for the whole process (Aitken, 2010; Walker et al., 2010; Warren and McFadyen, 2010).

2.3 Role of the Media

The possibility of shale gas development in the UK has attracted a lot of media attention, and by selecting and presenting certain snippets of information the media can increase public awareness and shape public perceptions of fracking (Ashmoore et al., 2016; Nerb et al., 2001; Davis and Fisk, 2014; Evensen et al., 2014; Hedding, 2017; Jaspal et al., 2014a; Jaspal and Nerlich, 2014; Olive, 2016). Perceptions of fracking are mediated by many sources and a substantial amount of public knowledge about new technologies comes through various forms of media exposure (Nerb et al., 2001; Cox, 2013). Nevertheless, as Boudet et al. (2014) point out, knowledge gained from media coverage of fracking does depend on the characteristics of those engaging with the information.

Different forms of media coverage can affect the public acceptance of fracking (Boudet et al., 2014). O'Hara et al. (2014) found that in the UK the majority of the public gain their information about fracking from television news. Driediger (2007) claims that television coverage provides more of an emotional setting, rather than informative, in comparison to more analytical newspaper coverage. Ritchie et al. (2014) allege, in the case of fracking, that the media use campaign groups to promote the issue in the public eye and to draw attention to the perceived weaknesses in the policy arrangements, which plays a big part in shaping public perceptions. This is a persistent problem given the increasingly fractured media environment that plays to people's predispositions and vested interests (Henderson and Duggan-Haas, 2014).

There are suggestions that with increasing accessibility to the internet as a source of information on fracking it has a lot of potential for advocacy (Krimsky, 2007) and as it is such a large source of information that provenance and accuracy is often lost, which can shape people's perceptions. Due to various forms of the media influencing people's perceptions of fracking in different ways, it has been recommended that future research should conduct exploratory textual analysis of various media to complement discursive research into psychological factors associated with place and proximity (Dixon and Durrheim, 2000).

In summary, our paper seeks to make the following contributions. Although research has examined the role of geospatial and psychological proximity to fracking, trust, and media use and coverage on support for fracking, no study has yet analysed these key factors in combination. Furthermore, research on these determinants of support for fracking is particularly underdeveloped in Europe where there are various areas (including several in the UK) where fracking has been proposed but where (despite the occasional test drill) commercial drilling is yet to emerge.

3. Methods

3.1 Geographical context: A proposed fracking site in Fermanagh, Northern Ireland

In 2011, the Department for Enterprise Trade and Investment (Northern Ireland) granted a petroleum licence to Tamboran Resources PTY Ltd. covering an area of 750 km^2 in the west of County Fermanagh to explore the viability of fracking (Fig. 1). Tamboran estimated there is potential for up to 2.2 trillion cubic feet of shale gas within the area covered by the licence (Tamboran, 2012). Delivering 50 years of energy security for the whole of Ireland, the company claimed that their Ł6 billion investment would create 600 full-time jobs and up to 24,000 indirect jobs, producing up to Ł6.9 billion of tax revenues to Northern Ireland and setting up a community investment fund in Fermanagh of up to Ł2 million a year (Tamboran, 2012). The granting of the licence in 2011 stimulated debate in the media and government and was met with considerable opposition in the Fermanagh area (Hewitt, 2012). Our fieldwork was carried out in 2014 while the development application was being assessed; therefore, the final outcome was not known to interviewees and questionnaire respondents. Since this initial prospect for development, and subsequent lack of exploration due to public opposition, Tamboran has changed ownership and, just in May 2019, put out a new licence application for public consultation (BBC, 2019).

The economy of Fermanagh consists mainly of agriculture and tourism, and is renowned for its scenic beauty. The licence covers an area which is the only cross-border Global Geopark in the world, attracting up to 55,000 visitors per annum, with tourism in Fermanagh contributing Ł86 million to the economy in 2013 (Northern Ireland Statistics and Research Agency, 2014). Sixty-five percent of Fermanagh consists of farmland, and in Northern Ireland the total income from farming isŁ298 million, with

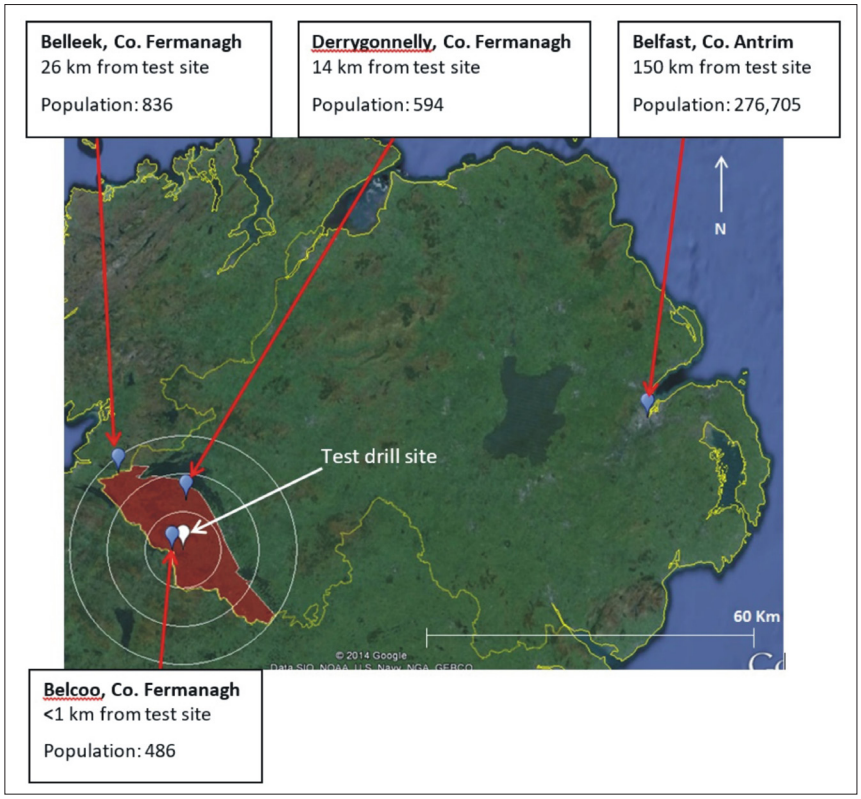

Fig. 1: Map of Northern Ireland with the fracking license area (in red) and the four research sites

Fermanagh's agricultural sector extensively contributing to the local economy (Department for Agriculture and Rural Development, 2013).

To investigate the relationship between proximity to proposed development and support/opposition, the method described by Warren et al. (2005) was used; sampling the largest centre of population at increasing distances from the site (see Fig. 1). The three sample villages within the licensed area were Belcoo (by test site), Derrygonnelly (14 km from the test site), and Belleek (26 km from the test site). A forth sample, representing more remote, national-level perceptions was collected in in Belfast, the largest city of Northern Ireland, some 150 km away.

3.2 Questionnaire survey design

The survey questionnaire was developed using various sources, in particular literature on the possible disadvantages and benefits that fracking can have on the environment, economy, and communities (Stevens, 2010; Smith, 2012; White et al., 2015). The questionnaire began with an introductory section explaining the purpose of the research followed by five sections to understand what people's perceptions of fracking were (in general, and specifically in Fermanagh) and what may govern their perceptions (see Tab. 1). The questionnaire contained a mixture of open-ended, Likert scales, and fixed responses, allowing for a range of answers, and an additional comments section to highlight any important reasons people may have for support or opposition (McLafferty, 2003). The mixture of question types also permitted the quantitative research to be blended with the depth and insights of qualitative inquiry (Kitchin and Tate, 2000).

In the period 15–23 August 2014, the first author conducted thirty questionnaires in each location. Respondents were recruited during the day, in public spaces in the three villages and in Belfast city centre. The questionnaires were conducted on the spot, with either the interviewer asking the questions and filling in the form, or with interviewees reading the questions and filling in the form by themselves if they preferred that.

3.3 Textual Analysis

Despite being unable to interview Tamboran, van der Horst and Vermeylen (2012) suggest that the preferences expressed by organisations can be analysed from their communications in the form of press releases, websites, and reports. These forms of communication were analysed along with publications by the Northern Ireland Assembly and the local protest group, FFAN, to understand the policies in place in regards to fracking and the reasons why some groups oppose them.

The media plays a key part in the production of perceptions; therefore; to understand what may influence people's perceptions of fracking, textual analysis was carried out on two local (Fermanagh Herald and The Impartial Recorder) and national newspapers (Belfast Telegraph and Belfast Newsletter). Using the academic database LexisNexis, the term 'fracking' was searched for in the newspapers from 1st April 2011, when the license was first granted, until 1st December 2014, when the judicial review was confirmed. The content of the article was analysed, for example, whether it supported or opposed fracking and the reasons behind these views, to see if there were any differences in the coverage of the conflict. The analysis provided an insight into variations in the representations of fracking in the newspapers and how public perceptions may in turn be shaped by these representations (Evensen et al., 2014; Jaspal and Nerlich, 2014).

4. Results

Of the 120 respondents 47% were male and 53% female. Respondents ranged in age from 18–75+ years, with the largest proportion in the 35–44 years category (29%, Median = 37 years). Fifty-one percent of respondents were in full-time employment with Education (20%), Tourism (17%), and Health Services (13%) being the three largest employment categories.

4.1 Perceptions of fracking in each location

Overall, there were high levels of knowledge about fracking; only one respondent had never heard of it and 83% of all respondents had at least a general knowledge of fracking.

As Figure 2 shows, the highest levels of opposition were found closest to the drilling test site; 97% of respondents were strongly opposed in Belcoo, 67% in Derrygonnelly and 43% in Belleek with only 6% in Belfast. Levels of support did increase with distance from the proposed test site, however, these supporters remained very low in number with only 13% of respondents in Belleek supporting fracking in Fermanagh and 27% strongly supportive in Belfast. This spatial pattern was also seen in regards to fracking in general, as shown in Figure 3. The overall trend

Section	Information Obtained
Introduction	Detailed the purpose of the research, instructions of how to complete the questionnaire and my contact details.
Socio-demographic	Age, gender, qualifications, occupation and employment sector.
Psychological (Personal Experience)	Psychological proximity (measured as length of dwelling at a location [for local communities], or whether visited it before [for comparison group]). Evidence of any NIMBY responses to fracking – attitudes to fracking in general and attitudes to fracking in Fermanagh.
Knowledge and information	Extent of people's knowledge of fracking and from what sources they obtained this information.
Perceived Impacts	The perceived advantages and disadvantages that fracking may bring to the environment, economy and community.
Psychological (Trust)	Trust in Tamboran and N.I. Assembly to be transparent, fair and act with due diligence.
Additional Comments	If people wished to explain any of their answers or thoughts further.

Tab. 1: Concepts explored in each section of the questionnaire (Note: The selection of questions was informed by Kyle et al. [2004], Barr [2007], Devine-Wright [2009], Jacquet [2012], and Boudet et al. [2014])

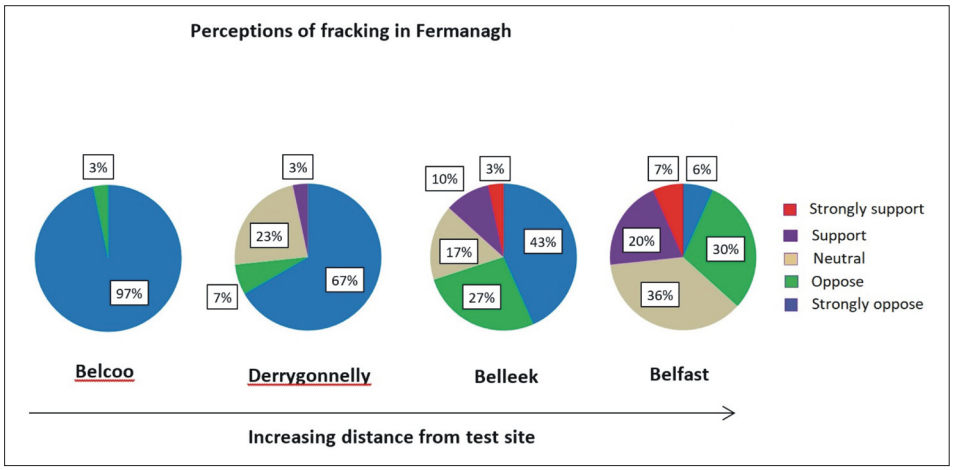

Fig. 2: Perceptions of fracking in the four research sites

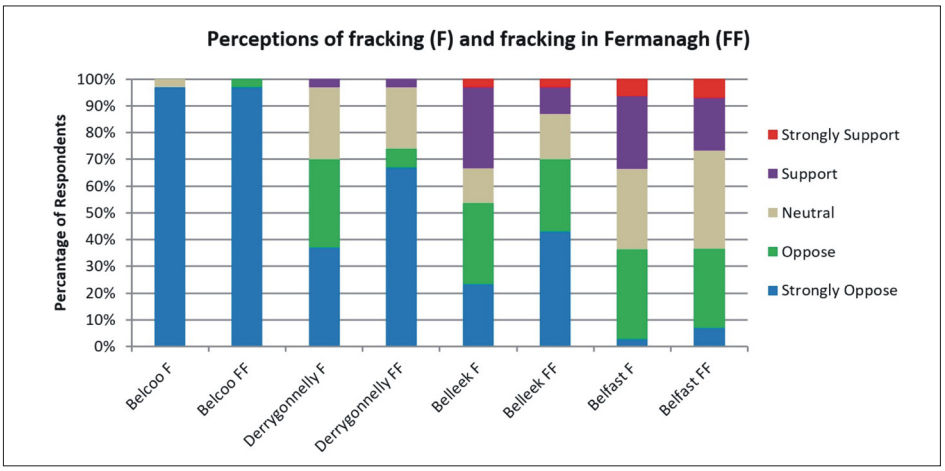

Fig. 3: Perceptions of fracking in general (F) and fracking in Fermanagh (FF) in the four research sites

shows that in all locations respondents were more opposed towards fracking in Fermanagh (FF) than to fracking in general (F) but the distinction diminishes with an increase of distance from the site.

The majority of respondents were opposed fracking, no matter where it was proposed. In Belcoo and Derrygonnelly there was little difference in attitudes towards fracking in general and fracking in Fermanagh. Respondents were more supportive of fracking in general in Belleek, with 33% either supportive or strongly supportive, however, this reduced to 13% supportive of fracking in Fermanagh. Belfast had the highest levels of support with 37% of respondents in favour of fracking in general, however this decreased to 27% in favour of fracking in Fermanagh, again reflecting that the majority in all locations were less favourable towards the development of fracking in Fermanagh than if it was proposed elsewhere. Both of the above figures demonstrate that opposition to fracking in Fermanagh is highest in the target (local) areas, nevertheless, 37% of respondents in Belfast were also opposed to fracking in Fermanagh.

4.2 Perceptions of risks and benefits

A wide range of risks associated with fracking were identified by respondents, as shown in Figure 4. Risks were identified 759 times across the 120 questionnaires, with respondents in Belcoo identifying the most risks (265 risks identified), and followed by Derrygonnelly (221), Belleek (169) and Belfast (104). A change in the landscape and negative impacts on ecosystems were the most important concerns identified in all four areas, followed by water contamination and hazardous waste materials.

As revealed in Figure 5, in all locations there were considerably fewer benefits identified in comparison to the perceived risks. Benefits were identified 350 times, the most in Belfast (117), which then declined to just 13 identified in Belcoo. Economic benefits were regarded as the most important positive impacts, as well as a potential source of employment, and this was recognised in all locations. Respondents in Belcoo barely associated fracking with having any benefits, compared to those in Belfast; this further exemplifies that distance from the proposed test site had an impact on the formation of perceptions of proposed fracking, although in the opposite direction to the most commonly observed relationship in the United States.

4.3 Personal experience with Fermanagh: Psychological proximity

Figure 6 demonstrates that in the three target sites, temporal proximity to Fermanagh (as measured by length of time living there) is related to the level of opposition to proposed fracking. Respondents who lived in Fermanagh for a longer period of time were more likely to oppose proposed fracking than respondents who lived in Fermanagh for fewer years.

Of the respondents who had lived in Fermanagh for over 31 years (n = 38), 97% were opposed or strongly opposed to fracking. This strong opposition was also seen

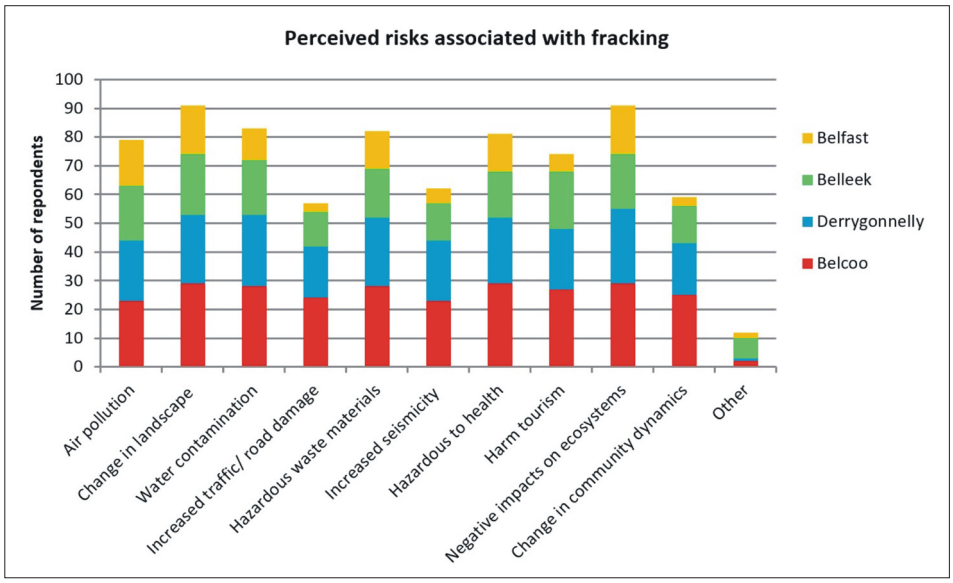

Fig. 4: The main risks respondents associated with fracking

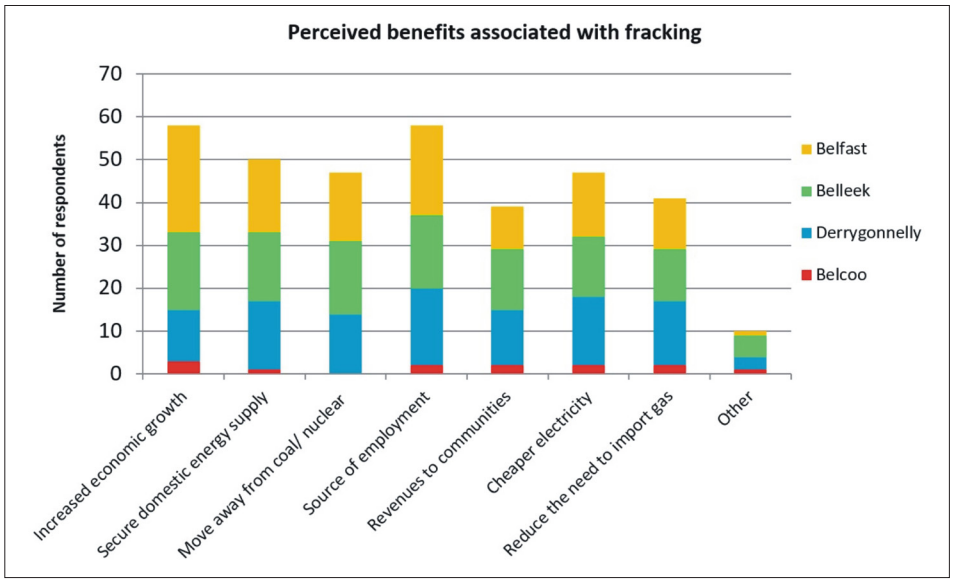

Fig. 5: The main benefits respondents associated with fracking

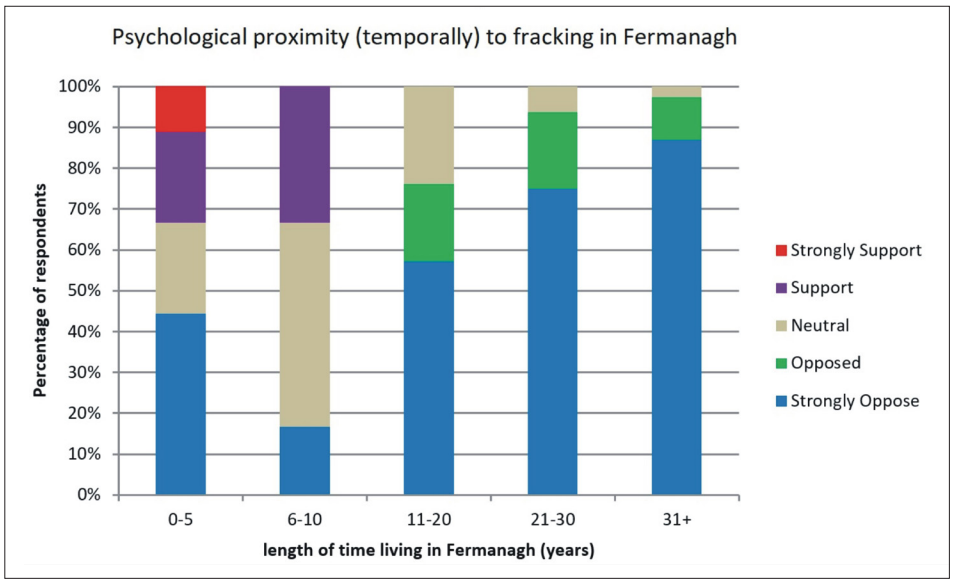

Fig. 6: the relationship between residence time (psychological proximity) and perception of fracking in Fermanah (for respondents from the three local communities, i.e. N = 90)

in responses by residents who had lived in Fermanagh for 11–20 and 21–30 years (n = 37). As the length of time living in Fermanagh decreased there were increasing levels of support for fracking in Fermanagh, with 33% of respondents who lived in Fermanagh for less than 10 years (n = 15) holding more supportive views of proposed fracking. In Belfast, respondents who had visited Fermanagh before (n = 21) and therefore had personal experience with the area (Kyle et al., 2004; Devine-Wright, 2009), were more opposed to fracking than those who had never visited Fermanagh before (n = 9); see Figure 7. People who had not visited Fermanagh held more supportive views of proposed fracking in Fermanagh, 44% were in favour compared to 19% in favour who had personal experience with the area.

4.4 Trust

Figure 8 reveals that there were high levels of distrust in the developer, Tamboran, particularly in Belcoo where 100% of respondents, distrusted or completely distrusted the company. Again, a spatial pattern is seen with levels of trust increasing with distance from the test site, with the highest levels of trust found in Belfast (30% of respondents). Nevertheless, overall levels of trust remain very low with no respondents completely trusting Tamboran, and only 12% of all respondents having some trust in them.

Trust in the Northern Ireland Assembly was also found to be very low, with 65% of all respondents distrusting or completely distrusting the Northern Ireland Assembly to be decisive and engage with all parties involved in the planning process. No relationship was found between distance from the site and levels of trust in the Northern Ireland Assembly.

4.5 Sources of Information

There were a wide variety of sources respondents used to obtain information about fracking. The three most used sources in each location are presented in Table 2; individual research on the Internet was a popular source of information in all locations. In Belcoo and Derrygonnelly

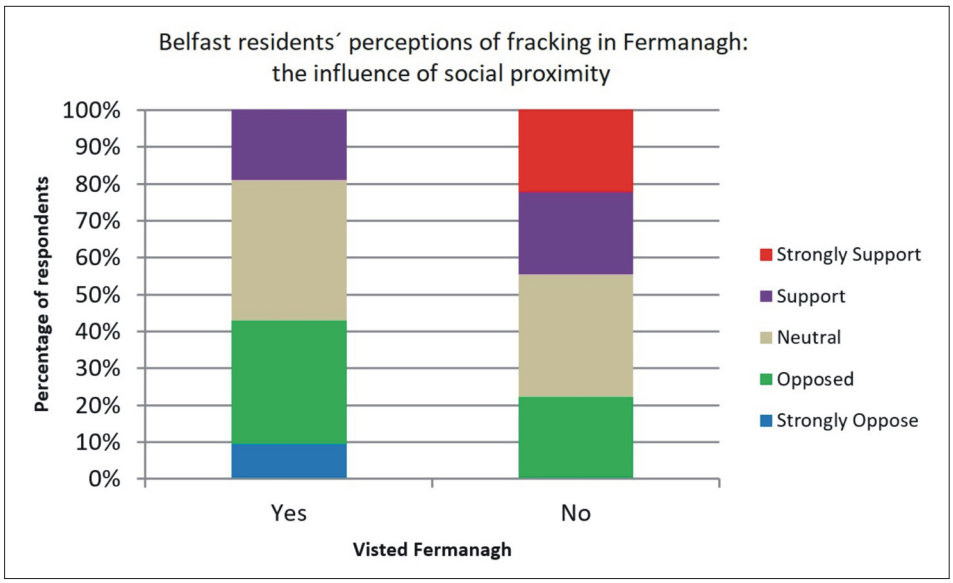

Fig. 7: The relationship between familiarity with Fermanagh through visits (psychological proximity) and perception of fracking in Fermanach (for Belfast respondents, i.e. N = 30)

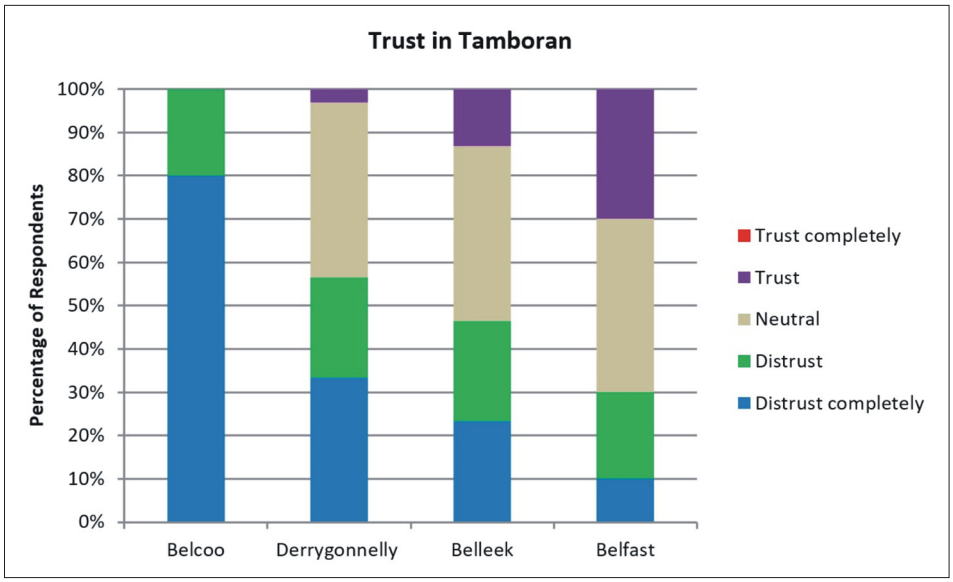

Fig. 8: Trust in the fracking company Tamboran in each of the four research sites

(the two areas closest to the proposed test site), many respondents obtained information about fracking from local protest groups. This evidence confirms that local protest groups are often trusted and can have a strong impact on local public opinion.

The relationship between obtaining information local protest groups and fracking perceptions can also be seen in Figure 9, with 93% of respondents who obtained information from them (n = 46) opposed or strongly opposed to fracking in Fermanagh. Those who attended community meetings (n = 34) were also strongly opposed to fracking in Fermanagh. Respondents who were more supportive of fracking gained knowledge from the Internet (own research and social media), the news on television, national newspapers, and a small minority from the local authorities.

Of those respondents who read national newspapers (n = 17), 18% strongly supported fracking, however 44% were strongly opposed. Readers of the local newspapers (n = 52) were much more likely to hold opposing views with 94% of respondents who read the local newspaper either opposed or strongly opposed to fracking in Fermanagh.

To see how the content of newspaper articles may have influenced reader's perceptions, textual analysis was conducted on newspaper articles in local and national newspapers that reported about fracking from 1st April 2011 – 1st December 2014. In total, the Belfast Telegraph had 121 articles, Belfast Newsletter 31, Impartial Reporter 79 and Fermanagh Herald 56. The majority of articles in all the newspapers were opposed to fracking, particularly in the local newspapers, where 94% and 88% of articles were opposed to fracking in the Impartial Reporter and the Fermanagh Herald respectively (Fig. 10). Local newspapers held much more opposing views compared to national newspapers, where articles were more mixed in opinion, with 44% and 41% of articles supportive of fracking in the Belfast Telegraph and the Belfast Newsletter. The main reasons cited for support of fracking included economic prosperity and energy security in both national and local newspapers, compared to the difference in the reasons for opposition between the national and local newspapers. National newspapers argued that the negative effect on the environment from pollution and water contamination was a reason to oppose fracking, compared to the local papers that focused on the physical change that could occur to the Fermanagh landscape.

Location	Sources of Information	Share of respondents (%)
Belcoo	Internet (own research)	63
	Local Protest Group	60
	Community Meetings	57
Derrygonnelly	Local Newspaper	60
	Local Protest Group	53
	Internet (own research)	47
Belleek	Local Newspaper	53
	Internet (own research)	53
	Internet (social media)	50
Belfast	News on Television	53
	National Newspaper	50
	Internet (own research)	30

Tab. 2: Summary of the top three sources of information used by people in the four research locations to obtain information about fracking

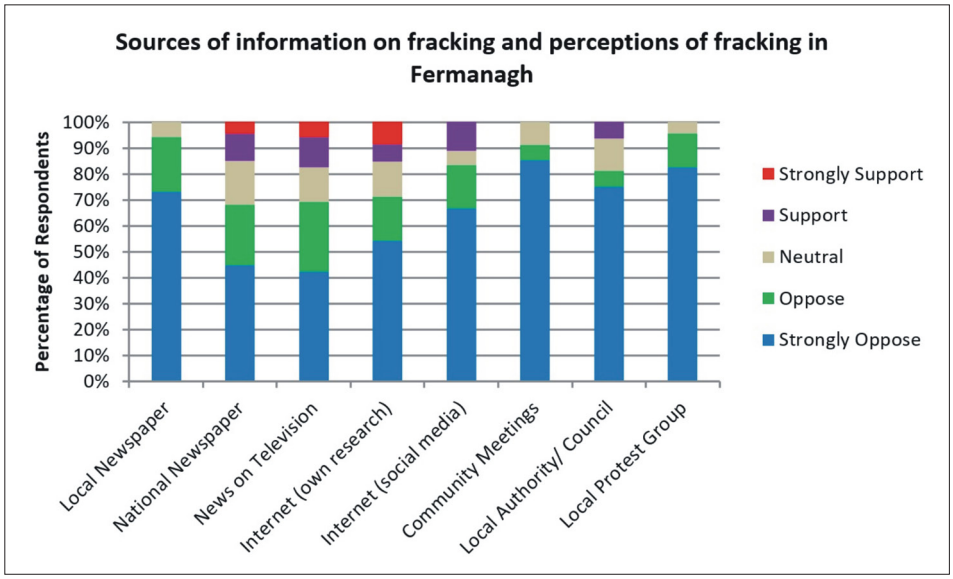

Fig. 9: Respondents' main source of information on fracking, and their own perception of fracking

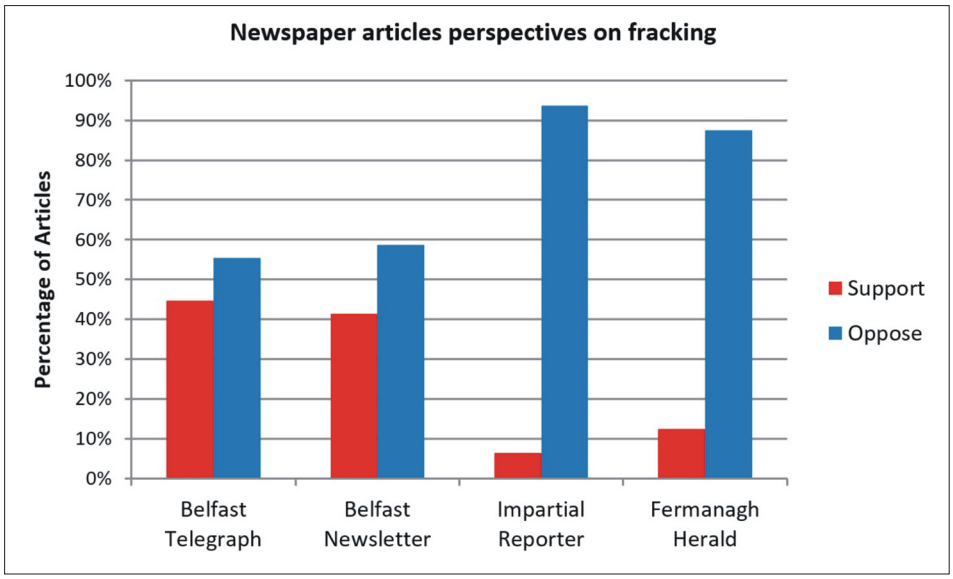

Fig. 10: Number of supportive and critical articles on fracking, reporting in the two national papers (Belfast Telegraph and Belfast Newsletter) and the two local papers in Fermanagh (Impartial Reporter and Fermanagh Herald)

5. Discussion

5.1 Localised opposition

The results indicate that opposition to fracking in Fermanagh is high, with 70% of all respondents opposed, much higher levels of opposition than observed in research conducted at a similar time in the UK generally (O'Hara et al., 2012; 2014; Department of Energy and Climate Change, 2014). The results also show clear evidence of a distance decay effect with regards to the strength of the opposition (nearer is stronger).This is consistent with findings from various studies beyond the fracking perceptions literature that residents closer to proposed developments are more likely to be opposed than those who live further away (van der Horst, 2007; van der Horst and Toke, 2010; Schaffer-Boudet, 2011; van der Horst and Vermeylen, 2012). Geographic and psychological proximity are predictors of opposition to fracking in Fermanagh; those in locations closest to proposed development were most likely to identify (multiple) potential risks (Fig. 4).

The small difference in opinions of fracking in general and fracking in Fermanagh, along with the high levels of opposition in all locations (including Belfast) indicates opposition is not just localised; most people who opposed fracking in Fermanagh, opposed fracking in general.

5.2 Psychological proximity

Observations from this study support the contentions from construal level theory that temporal, social, and/or spatial proximity to fracking (via connection with the place in which fracking is proposed to occur) will make fracking more concrete and less abstract. Respondents who lived in Fermanagh for over ten years were more opposed to proposed fracking than those who lived in Fermanagh for less than 10 years. Additionally, respondents from Belfast who had visited Fermanagh were more likely to oppose proposed fracking than those who had never been there before (Fig. 7). Whilst the connection between psychological proximity and support/opposition has been unclear in the United States, it is intuitive that greater proximity (including proximity in time and space) would equate to increased opposition in Northern Ireland, and likely the UK more widely. Whilst local benefits actually exist in some US communities near development, there are no benefits yet in the UK because development does not actually exist currently. Furthermore, even if development were to occur in the UK, the much smaller scale on which development would occur, compared to the US, the lack of privately-owned mineral rights, the higher population densities in the UK, and the different mix of local industries, including tourism, would seem to point in favour of local opposition (Boudet et al., 2016; Junod and Jacquet, 2019).

High levels of efficacy (self-efficacy and collective efficacy) were evident throughout the local communities, with organised protests and community meetings. Many people felt that the conflict actually brought the community together rather than forcing them apart, thereby empowering communities to oppose change (Lewicka, 2011). Given Northern Ireland's sectarian history, this coming together is even more notable. In the open-ended comment portion of our research, some participants reflected:

> "Aye it sure has brought the community together with a common goal. We had a cross-community service outside the gates [of the test site] to show Stormont[1] it is not a sectarian protest. We had Methodists, Catholics, Protestants, Quakers, Baptists, Men, Women, Grandads, Grandsons, you name it, all there to prove that no one wants fracking." (FFAN member, Belcoo)

> "I used to just smile and say hello to my neighbour but I went to a meeting about fracking and saw my neighbour there. Since then we've been in lots of contact even making a sign for in front of our houses." (Aoife, Belcoo)

This indicates that communities can be shaped by opposition to proposed facilities, contributing to the reproduction of local identities and collective place attachment (Dalby and Mackenzie, 1997; Manzo and Devine-Wright, 2014).

[1] Stormont is the name of the area in Belfast where the Northern Ireland Assembly is based

5.3 Sources of information

Respondents in this study were well-informed about fracking and the associated impacts, which contradicts findings from earlier studies (Boudet et al., 2014; DECC, 2014). Respondents used many sources to obtain information about fracking (see Tab. 2), in particular from protest groups who were very active in local areas, which may help explain why there was such high opposition within these localities. Fermanagh Fracking Awareness Network organised meetings, circulated flyers[2] with information about fracking and its impacts, whilst also encouraging individuals to do their own research. However, the information they provided cannot be considered 'objective', but rather as produced in line with their strong opposing views (MacDonald, 2001).

In line with findings by Jones et al. (2013), opposition groups used communication technologies and social media to good effect, which could explain the high levels of opposition by respondents who used social media to learn about fracking (over 80% who used social media were opposed to fracking in Fermanagh). Using the Internet has a much higher potential for advocacy, as was recognised by a respondent;

> "Fracking has got a bad name due to scare mongering and press interest stirred up by the 'like' culture of Facebook rather than being scientifically based" (Comment on questionnaire in Belfast)

Public awareness has been fuelled by increasing media attention, and this study found that newspapers, both local and national, were highly used sources of information by all respondents (Tab. 2). The majority of articles in both local and national newspapers drew attention to the negative aspects of fracking, in particular environmental aspects with headlines in the Impartial Reporter calling fracking the "geological equivalent of an endoscopy". This negative journalistic style is often summed up as "bad news is good news; good news is no news" for media outlets seeking to share engaging stories (Cohn, 1989, p. 5), which may explain why most newspapers focused on the negative impacts of fracking.

The textual analysis was exploratory, used to illustrate some of the differences between the newspapers (Dixon and Durrheim, 2000), finding that local newspapers (Impartial Reporter and Fermanagh Herald) went beyond the binary divide of economic benefits versus environmental costs that were usually a major point of discussion in the national papers (Belfast Telegraph and Belfast Newsletter). The local newspapers discussed local, social, and personal costs of fracking and its implications for ways of life with headlines such as "Community are Guinea Pigs" (Fermanagh Herald), which could provide an explanation for the high levels of opposition in the local areas where local newspapers were widely used as sources of information about fracking.

National newspapers were more supportive of fracking, and those who were more supportive of fracking were also readers of national newspapers. Articles supportive of fracking cited economic reasons, the Belfast Newsletter referred to shale gas as "Gold beneath our feet", and economic benefits were also the main advantages identified by respondents in this study (Fig. 5). Supporters of fracking in Fermanagh also watched the news on television, which mirrors findings by Boudet et al. (2014) and O'Hara et al. (2014).

6. Conclusions

This study has supported the importance of several key factors previously identified as influencing perceptions of fracking. It did so in the novel context of Northern Ireland, in a place where fracking has been proposed, but has not yet occurred. It is to the best of our knowledge the first study to draw together geospatial and psychological proximity, trust, and media use. Our findings show that:

1. Psychological proximity measured through the proxy of geospatial distance has clear influence on perceptions of fracking in Fermanagh; the level of support grows with the increase in spatial distance to the proposed fracking site.
2. Non-spatial aspects of psychological proximity – via longer temporal connection to Fermanagh, or having visited Fermanagh from Belfast, is also influential in the formation of perceptions towards proposed fracking.
3. Perceptions of trust in Tamboran reflect attitudes towards fracking in Fermanagh, with high levels of distrust correlating with high levels of opposition. Trust in the Northern Ireland Assembly was also low but displayed no spatial gradient and did not appear to be linked to perceptions of fracking in Fermanagh.
4. The key source of information reportedly used by the research participants to understand fracking seems to shape (or at least to represent or confirm) perceptions of fracking in Fermanagh. Those who read local newspapers, were in contact with the local protest group, and attended community meetings were very likely to oppose proposed fracking. Meanwhile those who said they obtained their information from reading national newspapers and watching the news on television were more likely to be supportive of fracking in Fermanagh.

Results showed that respondents were relatively well-informed about fracking, with opposition based strongly upon the psychological proximity to the local place; therefore, this research supports the growing body of literature which suggests that NIMBY theory should be re-conceived, and localised opposition is likely founded upon processes of place attachment and place identity. Due to the strong relationship found between perceptions of fracking in general and fracking in Fermanagh, and from interview data, we would be inclined to agree with calls to use "not-in-anyone's-backyard" as an explanation for most (but not all) of the public opposition to fracking (Schaffer-Boudet, 2011), as the majority of respondents were calling for a blanket rejection of fracking, not just opposing fracking in Fermanagh.

Results from this study demonstrate that to manage effectively siting processes in specific areas, it is critical to understand what influences public support and opposition. Responding carefully to widespread negative public perceptions about fracking will be essential if shale gas is to be commercially exploited in the future (as seems to be Tamboran's renewed focus [BBC, 2019]). It is evident that public attitudes have played a critical role in shaping the degree to which shale gas may, or may not, be developed in Northern Ireland. This research has shown that the public have spoken and "Fermanagh is not for shale". However studies in relation to wind energy have shown how perceptions change over time as development progresses (Devine-Wright, 2005; 2009); therefore, further research

[2] Flyers available at: http://www.frackaware.com/wordpress/?page_id=941 Accessed: 20 June 2019

could investigate whether opposition would increase or decrease if fracking had received the green light and commercial drilling had commenced.

The very clear patterns identified in this study despite the relatively humble size of the sample, and the contrasting findings with (and amongst) studies from the United States, show that there are still new insights to be gained from further research into the perceptions of locally new and controversial activities like fracking. That doesn't mean we should necessarily have 'more of the same' research in different locations. It could be argued that the likelihood of uncovering generalizable findings like the (construal level theory) confirmation of a distance decay effect in the support/opposition to fracking, depends on an individually tailored research design that reflects the particular lie of the land, e.g. the histories and characteristics of local communities, the presence of particular media outlets and the nature of the economic and political landscape.

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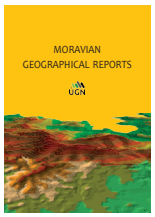

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The countryside in the city? Rural-urban dynamics in allotment gardens in Brno, Czech Republic

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Abstract

The position of urban allotments in the rural-urban spectrum is evaluated in this paper, which contributes to literatures on urban gardening, as well as contemporary rural-urban dynamics. Historically, European allotments can be seen as a product of urbanisation. At the same time, they embody a number of "non-urban" characteristics that create the impression of "the countryside in the city". This research project investigates how the urban and the rural are materialised, represented and practised in five allotment sites in Brno, Czech Republic. We follow three main lines of enquiry where the urban and the rural seem to meet: the physical environment of the allotments; the social life of these spaces; and food production as one of their core functions. Critical reflection of the rural-urban perspective advances our understanding of urban gardens, while, at the same time, allotments offer an example of hybrid spaces, which, in turn, contribute to discussions on current cities and countrysides. Overcoming the urban-rural dichotomy could facilitate the inclusion of urban gardening in contemporary cities.

Keywords: *urban gardening; allotment; rural-urban dynamics; counterurbanisation; food self-provisioning; new sociations; Brno; Czech Republic*

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1. Introduction

In recent decades, the world has become increasingly urban-centred, and the countryside has acquired new features and meanings. For the first time in human history, the majority of the world's population now lives in urban areas (UNPF, 2007). In some regions, the global economy has decreased the importance of the countryside as a place of production (Horlings and Marsden, 2014). The loss of fertile soil, agricultural land and the 'natural' landscape has created a hybrid peri-urban interface (Allen, 2003).

Scholars have been following rural-urban dynamics, and developing new concepts for hybrid forms of rural-urban blends. The changing role of the countryside has been addressed by rural sociologists (as summarised by Granberg, 2016), and "the consequences of a sprawling urbanism have emerged as theoretical objects in urban planning, critical human geography and anthropology" (Vasantkumar, 2017, p. 368). Rather less attention has been paid, however, to alternate trajectories in which the rural "spills out" into the city (ibid.).

Urban agriculture could be seen as an example of such dynamics, as it places food production in urban locations and in close connection to urban economic and ecological systems (Mougeout, 2000; van Veenhuizen, 2006). In the last two decades, diverse ways of producing food in cities have attracted growing attention from both scholars and practitioners. This paper uses insights from urban agriculture scholarship to add a new perspective to the ongoing discussion about the changing nature of cities and countryside, and the different ways of conceptualising these dynamics. We investigate the rural-urban intersections implied by the term urban agriculture, using the example of allotment gardens[1] in Brno, Czech Republic. As we will elaborate, this form of urban gardening has a long tradition

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[1] We understand the term allotment gardens to mean parcels of land divided into smaller plots that are used by individuals. Thus, allotments differ from community gardens in which a group of people cultivates a shared piece of land together. Some authors, however, conflate these terms, including allotments under the heading of community gardens (e.g. Veen, 2015; Okvat and Zautra, 2011). Both allotment gardens and community gardens can be categorised as types of urban gardening, together with home gardens in the city, guerrilla gardening and other forms of non-professional food growing in urban settlements. Urban agriculture is a broader term that covers both private and commercial food production practised in cities.

in Europe (Tóth et al., 2018). At the same time, researching allotments is relevant from the perspective of urban planning and policy because they are often located on public land.

In this paper, we present urban allotments as spaces that are physically located in cities but which feature several rather "non-urban" characteristics. Researchers of Czech urban allotments have already pointed out that these urban gardens do not in fact seem urban at all. Klvač and Ulčák note that urban allotments are in a way more "rural" than the countryside itself, where vegetable beds are gradually being replaced by swimming pools, lawns and other features associated with urban lifestyle (Klvač and Ulčák, 2008; Klvač, 2013). Following upon these observations, we investigate how the rural and the urban manifest and interact in urban allotments. Specifically, we explore three main areas where the urban and the rural seem to meet: the physical environment of allotments; the social life of these spaces; and food production as one of their core functions. The rural-urban lens offers a novel perspective that advances our understanding of urban gardens.

The paper is structured as follows. Section 2 briefly outlines some of the perspectives on the rural and the urban as analytical categories used in this paper. In section 3, we refer to existing literature on urban gardens as green environments (3.1), places of social interaction (3.2) and food production sites (3.3). We use a chronological perspective, discussing the relation of gardens to the city since their (European) origins at the end of the nineteenth century to the present, and the evolution of their three afore-mentioned functions during this time. After presenting our research methods in section 4, we follow up on the environmental (5.1), social (5.2) and productive (5.3) dimensions of urban allotments, by introducing and discussing the results of our study. Our conclusions are summarised in section 6.

2. Changing meanings of the rural and the urban

The city and the countryside have undergone significant changes, and scholarly understandings of the rural and the urban have become increasingly complex and contested. This section aims to briefly introduce some of the main developments in the ways of being of, and discourses about, the city and the countryside, which inform our approach in this paper.

Vasantkumar (2017) summarises some of the operational definitions of the rural and the urban, which include demographic and economic variables. In terms of population density and distribution, the countryside can be defined as spaces with relatively lower concentration of a human presence, whereas urban settlements are characterised by higher densities of inhabitants. In terms of modes of production, the countryside has been associated with agriculture and other activities in which humans engage directly with the natural environment (e.g. natural resource extraction, and more recently also tourism). Cities, on the other hand, have been understood as places where the countryside's products are processed, and where industry, services and knowledge-based sectors predominate (Cloke, 2006; Andersson et al., 2016, chap. 1). While such spatial and functional descriptors are still used, they have become less reliable with the spatial hybridisation of the urban and the rural observed from the twentieth century to the present.

According to Gandy (2010), the early modernist city was easily distinguished from the countryside because both were defined as their own political and economic entities. During the twentieth century, the industrial city expanded into the countryside, "corrod[ing] and dissolv[ing] it" (Lefebvre, 1996, p. 119), by weakening its specific peasant features and producing a new type of "rurban" space (ibid, p. 120). The boundaries between the city and the countryside have been blurred by suburbanisation and urban sprawl, the scope of which varies from region to region (see e.g. Sýkora, 2014; Oueslati et al., 2015). While urbanisation remains the most prevalent trend globally, some regions – including the Czech Republic – are also witnessing the inverse processes of urban shrinkage (Haase, 2008; Rumpel and Slach, 2012), and migration to the countryside, termed counterurbanisation (Andersson et al., 2016, chap. 1; Berry, 1976; Šimon and Bernard, 2016). This migration pattern is mostly assumed to be driven by lifestyle choices, although economic necessity can play a role as well (Mitchell, 2004).

Rural and urban societies and lifestyles have evolved in parallel to changes in the physical environment and the economy. Modernist social theorists saw rural societies as conservative and dependent on traditional knowledge and strong social bonds. Cities, on the other hand, embodied progressive worldviews, expert knowledge and the concentration of political power (Granberg, 2016; Vasantkumar, 2007). Urban lifestyles granted more anonymity and individual freedom, which relates to the process of individualisation (Novák, 2013, p. 16)[2]. Changes in rural and urban forms and the mingling of urban and rural populations challenge the commonplace characteristics of urban and rural societies, particularly as urban lifestyles have gradually penetrated the countryside.

Some authors therefore understand urbanisation not only as the physical expansion of cities, but also as the adoption of stereotypically urban lifestyles regardless of where people live (Champion, 2001, p. 144). In a similar vein, Andersson et al. (2016) also link counterurbanisation to an increased interest in nature and the countryside among urban populations. This interest is interpreted as a reaction to individualisation, human-nature alienation and the late-modern search for spiritual and bodily fulfilment (ibid., p. 3). Apart from actual changes in residence, this tendency can manifest itself in rural tourism, an appreciation of local, ecological and healthy food, or the preference of hand- and home-made goods over industrial products (ibid.).

These more nuanced understandings are part of a move beyond modernist social theory, in that some scholars have begun to acknowledge that the seemingly inherent and essential characteristics of the urban and the rural are in fact a product of political-economic power dynamics and the social construction of meaning. In some disciplines, such as geography and critical anthropology, the very notions of the rural and the urban have become contested (Cloke, 2006).

On the other hand, modernist categories of the city and the countryside remain strongly entrenched in

[2] Individualisation is conceptualised as one of the main social changes accompanying industrialisation and urbanisation. It entails loosening social roles and cultural norms linked to class, gender, religion and place (Novák, 2013; Librová, 2010). These can be seen as positive developments in terms of personal freedom, but also more critically as the atomisation of society and the loss of support provided by traditional social bonds.

both popular and academic discourses as "apparently commonsensical" (Vasantkumar, 2017) understandings of the rural and the urban. As some authors argue, this is partly due to the fact that the opposition of rural and urban mirrors other sociological dichotomies: the modern and the traditional (Granberg, 2016), culture and nature, the human and the non-human, and the globalised and the localised (Vasantkumar, 2017). These intertwined dichotomies tend to reinforce each other, leading to oversimplification, stereotyping and methodological confusion. What is more, this construction of meaning seems to favour the urban, whereas the rural must settle for a negative definition of "whatever is leftover [sic] after the urban has been identified" (Vasantkumar, 2017, p. 370), or, as Plüschke-Altof (2016) puts it, the rural is conceptualised as periphery.

Rather than maintaining such simplifying dichotomies, we should acknowledge that – as a result of the above-mentioned changes – the city and the countryside create hybrid forms in which both "urbanisation of the rural" and "ruralisation of the urban" occur (Cloke, 2006). A key challenge for scholars is how to conceptualise these hybrid forms in a way that reflects both spatial and social changes.

3. Allotment gardens as products of (counter) urbanisation

Allotment gardens have played a specific part in the development of rural-urban relations, and examining their history in Europe is revealing in this sense. The first urban allotments were established at the end of the nineteenth century with the aim of providing factory workers, who had migrated from the countryside, with the opportunity to improve their livelihoods through food self-provisioning. Furthermore, garden plots were to compensate for poor housing conditions and the generally insalubrious living environment typical of the rapidly-expanding and industrialising cities of the era (Keshavarz and Bell, 2016). These gardens also served as a place for workers to spend their free time and carry out activities that were close to their rural identity, and therefore brought a sense of familiarity and belonging (Nilsen and Barnes, 2014). In this section, we discuss how these three functions[3] of urban allotments have evolved into their present forms.

3.1 Urban gardens as green environments

As indicated above, the first European allotments were established in part as a reaction to the poor hygienic conditions in newly-built workers' neighbourhoods. The German branch of the gardening movement (Schrebergarten), in particular, emphasised the health benefits of fresh air and a green environment (Keshavarz and Bell, 2016; Nilsen and Barnes, 2014). Later, urban gardens were embraced by modernist urban planners who experimented with urban greenery – the most pronounced example is Ebenzer Howard's concept of the garden city (Kershavarz and Bell, 2016).

In the twentieth century these ideas resonated with planners throughout the entire continent, not only in Western Europe but also in Central and Eastern Europe. For instance, in the 1970s planning visions for Belgrade, Yugoslavia, public greenery met place-making: "Each household should be granted contact with soil and its creative cultivation. This estrangement from land, grass, flowers, trees, from that to which a concrete man has a personal obligation and responsibility, is one of the important problems both of the concrete-paved center [sic] and the open block of no man's land, grass, and greenery" (Ferenček, 1977, quoted in Djokić et al., 2017, p. 4).

With a more nuanced understanding of environmental issues, discussions about the environmental dimension of urban gardens have expanded. From an ecological perspective, urban gardens constitute a part of urban green infrastructure and a way of ensuring ecosystem services for urban environments (Tóth and Timpe, 2017). As green spaces, gardens reduce the urban heat island effect, capture rainwater and therefore serve as a climate adaptation measure (van Veenhuizen, 2006). They function as local biodiversity hotspots, providing refuge for animals, including pollinating insects. Plants and trees contribute to carbon sequestration, composting alleviates urban waste systems and helps close nutrient cycles[4]. Environmental benefits are also linked to localised food production (Vávra et al., 2018), although some growing methods might be problematic from an environmental perspective, and there is an ongoing discussion about the use of industrial pesticides and fertilisers and gardeners' environmental consciousness (see Sovová, 2015).

Another body of literature describes the health benefits of spending time in green surroundings. The negative impacts of human alienation from nature have been documented in psychology and educational sciences (McClintock, 2010). Okvat and Zautra (2011) list the psychological benefits of urban gardening in both cognitive and affective realms. Prescribing gardening as a remedy to the soul-destroying inner city echoes the narratives of Schrebergarten.

Moreover, urban gardens have been praised as spaces of environmental education. Breuste and Artmann (2014) explain that gardeners often use their plots to observe animals and learn about nature. Some authors even suggest that gardening can foster environmental consciousness. According to Bhatti and Church (2001), for instance, everyday encounters with nature facilitated by a garden can make abstract environmental issues more accessible. In this way, gardens have the potential to contribute to environmental awareness and more sustainable lifestyles (Okvat and Zautra, 2011), although this potential should be assessed critically.

3.2 Urban gardens as new sociations

The earliest allotments in Europe were in part founded to occupy factory workers' free time. This was a strategic move on the part of the political and economic authorities: the logic

[3] The focus of the first European allotments varied slightly in different countries. For instance, the German allotment movement emphasised healthy environment and outdoor activities (see section 3.1), whereas the French gardening movement stemmed from solidarity with the poor and focused more on food provisioning (Gibas et al., 2013, p. 31).

[4] These benefits of green spaces are not unique to cities, but they are often discussed specifically in relation to urban environmental issues. This confirms the persistent association of nature with the countryside. The word "greenery" would rarely be used in a rural context; "rural nature" sounds redundant, for nature is presumably linked to the rural. At the same time, terms such as "urban nature" or "urban wilderness" also carry an inherent tension, suggesting that "nature" and "wilderness" are not typical urban attributes (see also Vasantkumar, 2017).

was that content workers who spent time at their allotments would be less likely to engage in politically radical activities (Nilsen and Barnes, 2014; Novák, 2013). Contemporary urban gardens do not follow this trend; in fact, they are often places that question the status quo (McClintock, 2010; Tornaghi, 2016). At the same time, the social features of urban gardens are still considered important. Urban gardens are praised as places of community empowerment (Okvat and Zautra, 2011), social cohesion (Veen, 2015), and inclusion and integration (Koopmans et al., 2017). They foster urban dwellers' senses of belonging (Djokić et al., 2017), home (Bhatti and Church, 2001) and place-making (Koopmans et al., 2017).

As Novák (2013) argues, urban gardens can function as "new sociations", that is, as less institutionalised forms of social arrangements (Macnaghten and Urry, 1998, p. 27). Unlike traditional communities, sociations are joined voluntarily and can be left freely. People join them because of the emotional satisfaction resulting from shared goals and social experiences (ibid.). They can bring a new solidarity based on cooperation and sharing. They provide, in sum, a remedy for urban individualisation and alienation. According to Novák, such tendencies are definitely identifiable in the community gardens that have appeared in the United States and Great Britain since the 1970s, which have been established "not only for the purpose of collective cultivation of vegetables but also identity cultivation, community revitalisation and civility" (Novák, 2013, p. 21). Some authors (e.g. Schmelzkopf, 2002) even frame urban gardens as political spaces where urbanites enact their right to the city and civic engagement.

Historically, Czech allotment gardens have developed along a different path. In socialist Czechoslovakia, urban gardening was supported by the state: gardening associations were allocated state-owned land unfit for professional agriculture, and gardeners supplied their surplus produce to regular food chains (Tóth et al., 2018). Despite being controlled by the authorities, allotments were mostly internally apolitical. In fact, being one of the few non-politicised spaces, gardens served as places of "internal exile" for many (Duffková, 2002). Novák argues that allotments still enabled gardeners to develop their identities and social relationships, and they thus played the role of new sociations (2013, p. 21).

3.3 Food production in the city: tradition and alternative

In the modernist rural-urban distinction, food production was unequivocally placed in the countryside, whereas cities were places of trade and consumption (Koopmans et al., 2017). During the last two decades, however, a growing body of literature on urban agriculture has shown that cities can and should include food provisioning in their agendas. As mentioned, land-use changes and economic diversification together with the depopulation of the countryside and changing rural lifestyles, have challenged the traditional equation of the rural landscape with food production (Duží et al., 2017; Granberg, 2016). At the same time, urbanisation poses numerous logistical issues: although cities are the sites of most of the political and economic power, their basic metabolism is fundamentally dependent upon external supply (Simms, 2008).

These issues were already reflected in the development of allotments at the beginning of the twentieth century, as summarised by Bellows: "Urbanisation required massive adjustments in land and labour. The technicalities of feeding the relocated rural population were largely left to the uprooted peasants. (...) Policy effectively transplanted a 'country' livelihood into the physical design and social expectations of emerging urban areas" (2004, p. 248). Since then, urban gardens have supplied food in times of crisis throughout the world: in the USA and Great Britain during World War II in the form of the 'victory gardens', in Cuba after the decline of food and fuel imports caused by the collapse of the Soviet Union (Simms, 2008), in slum areas in cities of the global South via aid programmes (Voleníková, 2014), and in Southern European cities affected by the 2008 economic crisis (Delgado, 2017).

Furthermore, growing food in cities brings other benefits beyond food security. Urban gardens are linked to the broader search for more environmentally sustainable and socially just ways of producing, distributing and consuming food, known as alternative food networks (AFNs; Renting et al., 2003). AFNs have evolved in reaction to problems inherent in the conventional food system, which is based on industrial agriculture and long supply chains. These initiatives try to offer a more transparent food system, in which the origin and qualities of food are known to consumers. AFNs strive to bring producers and consumers closer not only geographically (i.e. localised food production) but also socially: consumers should be able to know the farmer who produced their food and vice versa, and relations between producers and consumers should be based on trust and solidarity. Thus, AFNs aim to create opportunities for rural development while at the same time addressing the urban dwellers' alienation from food production (ibid.).

We can therefore view AFNs as an incarnation of the 'counterurbanisation ethos': once urban consumers lost trust in standardised industrial products, they began to search out more wholesome food-production alternatives in agriculture's traditional place – the countryside. Indeed, as Andersson et al. (2016, p. 3) note, increased interest in food is one of the manifestations of the urban desire to reconnect with the countryside, as well as one of the vehicles to achieve this reconnection.

As more critical scholars warn, however, interest in transparent, short food-supply chains is at the risk of being reduced to a fetish for distinctiveness (see e.g. Overton and Murray, 2016). The desire of conscientious urban consumers for "food with a story" is driven by nostalgic ideas of the countryside as pure, healthy and home-like. But the same disconnect between the rural and the urban that propels these wishes, also makes it easy for corporations to satiate them by marketing – featuring romanticised images of a countryside that no longer exists, if it ever has.

Urban gardens have the potential to overcome this risk by removing the gap between producers and consumers, and by offering consumers the most direct contact with their food as possible. According to McClintock (2010), urban agriculture facilitates hands-on experience with human dependence on the biophysical environment, and reconnects urban dwellers not only with food, but also with manual labour. Studies from the Czech Republic and other countries confirm that this experiential aspect of urban gardening, which distinguishes it from other AFNs, is appreciated by gardeners. People grow fruits and vegetables because they like to have healthy, fresh food of known origin. A crucial condition, nonetheless, is that urban gardeners enjoy the activity of gardening (Jehlička et al., 2012; Sovová, 2015; Veen, 2015). Compared to people involved in other AFNs, urban gardeners interact with food and agriculture in a way that is more embodied (Pottinger, 2017), routinised (Veen, 2015) and unreflected

(Sovová, 2015). At the same time, as recent research from the Czech Republic has demonstrated, gardens can contribute significantly to a households' food supply (Sovová, 2015; Vávra et al., 2018).

Despite its promising potential, however, food production seems to be the most disputed feature of the allotments. As Tornaghi (2016, p. 4) remarks, planning policies might accommodate urban gardens under the headings of leisure and community spaces, but their productive function is not easily accepted. The Czech experience confirms this observation: the ecological benefits of allotments as urban green spaces are generally acknowledged, as are their social and recreational functions. The potential of allotments for non-commercial food production, however, is largely omitted, even by their supporters (Sovová, 2015). We thus encounter a paradox: on one hand, urban dwellers are interested in food alternatives, but on the other hand, food production seems to be dismissed (by authorities) as unworthy of urban space.

4. Research questions and methods

This study focuses on the interplay between the rural and the urban as observed in urban allotments. Our principal question is: what manifestations of the rural and the urban (or their hybridisation) can be observed in urban allotments? Thus, we use the rural-urban lens to advance our understanding of urban allotments and, at the same time, to explore what these specific places can add to the broader discussion on rural-urban dynamics.

We investigated three specific aspects of urban allotments: (1) the physical environment of allotments; (2) the social relations in and around allotments; and (3) food production as a distinctive activity practised in allotments. These three topics[5] guided our data collection and provided a structure for our analysis. In studying these three topical areas, we observed the manifestations of the urban and the rural in terms of: (1) materiality; (2) imaginary or meaning; and (3) practice (Cloke, 2006). With this operational design for the study, we approach the categories of urban and rural in a social-constructivist way, seeing them simultaneously as localities, images and ways of life (Halfacree, 2007).

4.1 Research sample

We conducted qualitative research in five localities spread around the city of Brno[6] (see Fig. 1). Our choice of sites was aimed at capturing the diversity of allotments in Brno in terms of size, distance from the city centre, surroundings,

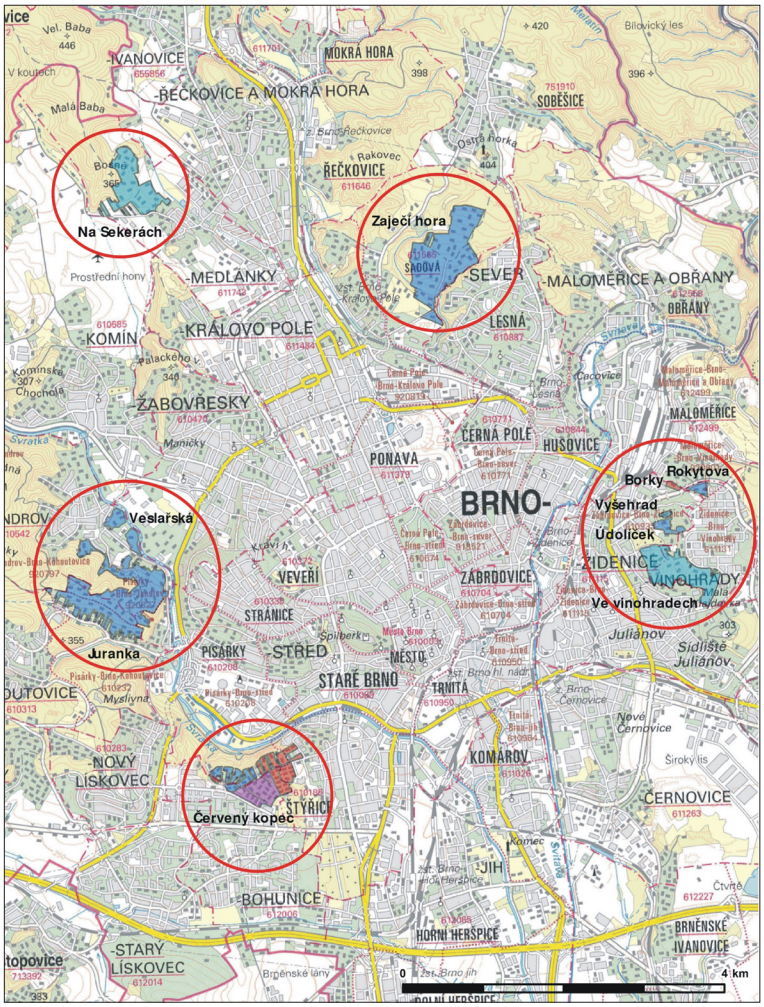

Fig. 1: Location of the research sites within the city of Brno
Source: Dostalík et al. (2017)

[5] The choice of these three aspects was based on the core functions of urban gardens, as described in Section 3, as well as our own research interests.

[6] The second largest city in the Czech Republic, with approximately 400,000 inhabitants.

forms of ownership and administrative arrangements. Short descriptions of the research sites can be found in the Appendix 1.

The communication partners for interviews were recruited using a combination of methods. Our entry into the field was facilitated by 'gatekeepers', typically allotment representatives who introduced us to the gardening community and recommended suitable participants. We also used snowball sampling in which communication partners recommended other potential respondents. At later stages in our research, we used purposive sampling. Communication partners were chosen based on selected criteria in order to gain a more accurate picture of the diversity of allotment users and their practices[7]. Our final sample was thus composed of people of different ages, genders, marital statuses and incomes, who used their gardens in different ways and had varying statuses as members, or non-members of the Czech Union of Allotment and Leisure Gardeners[8] – including four allotment officials. Although the sample is not representative of the entire gardening community in Brno, we believe that it fairly reflects the diversity of gardeners in the selected allotments.

4.2 Data collection

Research was conducted in two waves. The first round of data collection took place from May to October 2016, and it included 17 semi-structured interviews[9]. We used an interview guide with 25 questions covering our three topics of interest. To study the physical environment of the allotments, we asked about the characteristics of the plots, ways of using the gardens and motivations for joining the allotment. In the section dedicated to social relations in and around the allotments, we discussed ownership, relations with neighbours, organised events and relations with the public and the authorities. To understand issues related to food production, we posed questions related to growing methods, variety and volume of crops and the importance of the gardens as a food source. We also discussed gifting and sharing networks, bringing together the topics of food production and social relations[10]. Interviews were complemented by participant and non-participant observation, which helped us to get acquainted with the field and to characterise the research sites.

The second round of data collection took place from March to November 2017 with the aim of refining, adding and validating data. It consisted mainly of participant and non-participant observations (about 12 field trips in total)[11] and semi-structured interviews with nine communication partners. In this phase of the research, we concentrated more specifically on the social relations in the allotment gardens and their linkages to the materiality of the site. Our observations therefore focused on shared facilities within the allotments (rest-rooms, tools, notice boards) and places that might facilitate social interactions (common fireplaces, playgrounds, etc.) or hinder them (fences, inconvenient paths, etc.). In the realm of practices, we gathered information about social events in the allotments, relations with outsiders and the movement of people within the allotments. One of the authors participated in an event related to the turning-on of the water taps in the spring[12], which allowed some insight into the social relations in the allotment and allowed for informal encounters and conversations with its members.

The interviews in the second round of data collection were also semi-structured but the interview guide was only used loosely as a checklist and we encouraged the communication partners to share their own narratives. Questions focused on gardeners' routines, relations with neighbours and social control, and the use of space. Some of the communication partners also provided us with a tour of the allotment or marked places of importance on a map.

5. Results and discussion

In this section we summarise the manifestations of the rural and the urban and their hybridisation in the areas of physical environment, social relations and food production that we identified in our data[13]. We contextualise our findings using relevant perspectives from the literature.

5.1 Allotment gardens as non-urban environment

The appearance of allotments is specific. All of our research sites allowed for small houses or garden sheds on the plots, but there were no norms regarding their appearance (other than a size limit). This resulted in a diverse mosaic of houses: from pre-fabricated to self-made, from sophisticated to frugal. The informality, do-it-yourself (DIY) and widespread use of all kinds of recycled materials (see Figs. 2 and 3) for garden sheds and other furnishings, creates a pastiche that reflects great care and creativity, and which confirms the role of the gardens for home- and place-making (Bhatti and Church, 2001), but which is not necessarily aesthetically pleasant.

[7] Our sample included 18 women and 12 men (including 6 couples that used the same plot and were interviewed together). Among the communication partners were 11 retired, 10 middle-aged and 9 younger gardeners. Four gardeners were rather production-oriented, and three used their gardens mostly for recreational purposes. Most of the participants used their plots for both food production and recreation. In nine cases, gardens played a more significant role in participants' lifestyles – garden houses were adapted for overnight stays and the communication partners spent a large part of their time there. One of the communication partners also used his plot for organising educational events.

[8] An association that administers most Czech allotments.

[9] Interviews from both rounds of data collection were recorded. We used the recordings and partial transcriptions during the analysis.

[10] We did not inquire directly (i.e. to participants) about the perception and construction of the allotments as urban or rural. This lens was only applied during the analysis.

[11] The observations followed an open set of indicators, and they were complemented by taking photographs and recording GPS coordinates.

[12] Some of the allotments only had tap water from spring to autumn. Turning on the water thus marks the start of the gardening season, and most of the allotment members are present at this event.

[13] First, we analysed interviews and observation notes inductively, based on recurring topics. These were partly guided by the three areas we consider specific to urban allotments, but new topics also emerged. Second, we looked at the data through the lens of the rural, the urban and their hybridisation, searching for their manifestation in materiality, imaginary or meaning, and practice.

Fig. 2: Old bathtubs used for rainwater harvesting – similar DIY improvements can be both practical and picturesque, but they do not fit the image of neatly-maintained urban gardens (Photo: J. Dostalík)

Fig. 3: Peculiar garden decorations are typical of the eclectic aesthetics of the allotments. (Photo: R. Krylová)

Appearance was a major point of criticism in some recent discussions about the future of Czech allotments. As documented by Kožešník (2018) and Gibas (2011), respectively, allotments were said to "resemble slums" or to be "ulcers on the face of the city". An official report on allotments commissioned by the municipality of Brno refers to compost heaps, a common part of the gardens, as "controversial (…) little waste dumps" (Ageris, 2006). These criticisms reveal a perception of the allotments as aesthetically inappropriate for the city, in other words, non-urban. Such argumentation is neither new, nor specific to the Czech Republic: for example, Borčić et al. (2015, p. 53) explain that during state socialism, Zagreb's illegal urban gardens were in stark contrast with its newly-constructed buildings, and thus, they also constituted a discursive opposite to the ideas of (socialist) modernity. Similarly, Djokić et al. (2017) state that although modernist planning visions for Belgrade emphasised contact with nature as a part of the modernisation process, urban gardens were often marginalised due to their association with rural areas[14].

The opposition to the city is also marked by how gardeners use and perceive the allotments – both in relation to the physical environment and the lifestyle they entail. For example, one of our communication partners described her feelings after a longer stay in her garden as follows: "When I go to the theatre, I feel like a bushman; those nice clothes, you don't have to deal with them here [in the allotment]. You have the feeling that you go out to the big city when you leave this place."

One of the most common characteristics attributed to spending time in gardens was rest. Some communication partners connected it to the absence of noise, sometimes specifically to the absence of the sound of machines, radios

[14] Note the difference with socialist Czechoslovakia, where allotments were supported and integrated in urban planning (see Section 3.2).

or cars: "If you want to build, you will be hammering, chopping wood, it will always make some minor noise, but it's about tolerance. But there are ten thousand cars in the city, and you cannot do anything about it." Others associated rest with solitude and privacy: "There is divine peace. If there was a path [through the allotment], that wouldn't be the case." Sometimes rest was perceived in opposition to modern technology and in connection to nature: "There is no electricity, but it does not matter to us. We're glad to hear birds in the summer; it's such peace." Gardens were thus seen as opposed to the modern city and rather close to nature, as we will elaborate later.

Communication partners also framed going out to the garden as an opposition to staying in their apartment (many of our communication partners live in high-rise apartment buildings). This was sometimes linked to former lifestyles: "We moved from a small town; in the city we would go crazy in the concrete, so we bought a garden", or similarly: "I come from the country, we had fields. We wanted to be outside, we wanted to have our good vegetables and fruits. And for the children, to get some fresh air." Some gardeners associated "going out" with health and exercise: "Without realising it, I'm doing it for health. The winter has always destroyed me, I ended up badly last year [...] It's really about getting the old guy out"[15].

Another characteristic our communication partners associated with allotments was connection to nature. Gardeners spoke of reconnecting with nature and the land through plant cultivation. Some enjoyed feeding birds, which made them visit their garden at least twice a week even in winter. Whereas communication partners appreciated "nature", represented for instance by small animals (frogs, hedgehogs), wilder or bigger species that entered the gardens from the nearby forest were portrayed as a threat: "It was worse with the wild boar. If I had a gun, I would shoot it right away. It will do a lot of damage. That there's a hare, all right, you have to give that kind of tax to nature."

Other communication partners contrasted the gardens as cultivated places with the "wild" in terms of both nature and humans: "What's under the road towards the gardens, that's a jungle. It is a place of junkies, seedling scrub; if one does not eliminate it in the garden, nature takes over the garden in two years with everything; in four years the garden is lost, and there is a jungle. We have been reclaiming the garden out of this state for four years." With that, our sample reveals the ambiguity of experiencing nature, while at the same time appreciating a cultivated, safe leisure environment (Bhatti and Church, 2001).

To summarise, allotments are seen as non-urban spaces for different reasons, by the gardeners as well as outsiders. Whereas critics deem the appearance of allotments as inappropriate for the urban environment, gardeners appreciate the allotments' contrast with the concrete, rush and noise of the city. The non-urban character of the allotments was further related to what we could term the simplicity or informality of the allotment lifestyle – the absence of modern technologies, the irrelevance of dress codes, and so forth. This appreciation of a "simple life" echoes the narratives of voluntary simplicity, which can also be linked to migration to the countryside (Kala et al., 2016).

At the same time, allotments cannot be easily conceptualised as natural spaces. Gardeners might praise "being in nature" in their gardens but only as long as "nature" is cultivated and controlled. Allotments offer a mix of features: DIY sheds and vacant lots, overgrown with vegetation on the one hand, and sophisticated recreational features (i.e. swimming pools) and neatly-maintained flower beds on the other. In their materiality, perception and use these spaces are urban-rural or rather culture-nature hybrids.

5.2 Allotments as new sociations?

As indicated earlier, communication partners use their gardens for individual recreation, valuing the peaceful atmosphere and quiet surroundings. Despite this appreciation of rest and privacy, some gardeners also welcome the social life of allotments.

They expressed that when being "out" at the garden, they meet others more easily than in their homes in the city: "When we make coffee, we talk to our neighbours. It's kind of a social event, we say hello, we exchange a few words. In that [apartment] building, people are closing everybody behind their doors." This confirms the relevance of urban gardens for the development of social relations, which is documented in the literature (see section 3.2).

Communication partners reflected that the use of gardens is slowly changing. As we confirmed through our observations, gardens now provide recreation beyond cultivating plants: "Every fourth [garden] is only greenery, flowers, barbecues, just elders grow funny things, it [food growing] declines." Despite the slightly critical tone of this comment, other forms of recreation were highly valued among gardeners. 'Friends passing by', 'children playing', or 'neighbours having coffee together', were seen as integral parts of gardening.

When exploring the nature of social encounters in the allotments, we noticed that most were rather "private" – gardeners would invite their family or friends to their plot, or they would meet in small groups with their garden neighbours. There often seemed to be strong relationships between neighbours, who help each other out, share surplus produce and seedlings, and so forth. These expressions of solidarity and conviviality, however, seemed to be mostly spontaneous: "Here the visits are not announced; they just sometimes come for tea. We don't meet regularly, but we see each other outside all the time, around work."

Similarly, mutual help and sharing appeared to be widespread, but situational and informal: "When I mow the grass, I usually mow a little bit to the left and a little bit to the right." The motivation behind these acts of kindness is related to a sense of togetherness based on a shared interest in gardening: "We had a lot of apricots, and I felt sorry to waste them, so I would offer them to people. At first people thought I would want something for it. So later they came by and brought me something else, to keep appearances. Or, when I had too many tomato seedlings. People were surprised that I gave them away for free. But well, I'm not gonna give them to people who come here to cultivate the garden for money. That's against my beliefs."

Contact between neighbours is facilitated by the physical layout of the allotments – many (although not all) of our research sites did not have fences separating individual plots, which can be interpreted as a sign of trust among members of the gardening community. In a few cases, communication partners commented upon the intense

[15] See also Wang and MacMillan (2013) who elaborate on the health benefits of gardening, particularly for the elderly.

contact between neighbours with a more critical tone: they viewed it as a source of social control that leads to a loss of privacy. Even communication partners who viewed their neighbours as slightly intrusive, however, mentioned some benefits of neighbourly relations, such as a feeling of safety or knowledge exchange.

Whereas allotments have a vibrant social life in terms of informal encounters and relations, official social events attended by all allotment members are rare. Some communication partners expressed slight nostalgia for the past, when these types of communal events were organised more often: "There used to be trips, there used to be a rose exhibition, but everybody is old now and no one wants to do it. Three or four times a year, [we do] communal work, but not these events. The [allotment] representatives are getting older and the young ones are not interested in socialising"; or "I think the times have changed, people do not socialise this way, they socialise with their family, they prefer their family and friends."

Nonetheless, the communal character of gardens was indicated by the number of places for formal and informal information exchange in the allotments, such as bulletin boards next to entrances (see Fig. 4) and information boards on fences and gates. These boards demonstrate that even in localities with weak official organisational structures there is the will or need to communicate and exchange information among community members. In that sense, the allotments in our study could be categorised as interest-based (rather than place-based) communities (Veen, 2015). While people appreciated the social life in the allotments, their main motivation to join was the activity of gardening itself, rather than establishing new social relations. As a result, the allotments facilitated social encounters, but these relationships typically did not extend beyond the space of the allotments.

We conclude this section by mentioning the linkages of the allotments to their surroundings. Through observation, we obtained data regarding the permeability of each site. All of the localities are used for walks and are interwoven with a number of paths used primarily by those who know the localities well. At the same time, allotments also feature relatively large enclosed enclaves, separated from public paths by locked passages that prevent public use (see Fig. 5). Thus, the allotments are attractive areas for public recreation, and the proximity of forests, local hiking trails and natural sites near some of the researched sites (which add to their non-urban character) make them even more appealing. The gardeners do wish to keep a certain level of privacy and security, however, which can be interpreted as a sign of the privatisation of these spaces (for a more nuanced discussion of a similar situation, see Koopmans et al., 2017).

Fig. 4: Notice boards still play an important role in internal communications in allotment gardens (Photo: R. Krylová)

Fig. 5: The areas around allotments are used for walks, but the gardens themselves are closed to the public (Photo: J. Dostalík)

At the same time, DIY repairs and beautification, which typically contribute to the appearance of allotments (see above), sometimes spread over garden fences and into surrounding areas. These activities can be interpreted as an expression of the gardeners' interest in their surroundings – beyond their private spaces. The material character of the study sites thus reveals the hybrid character of allotment gardens, which are at the same time public, private and community spaces. Some communication partners were aware of the advantages brought by their voluntary efforts, which benefitted not only their families or the community but also the public: "Families with children or the elderly, while using their free time, are doing something and keeping the garden, so it's still better than if the city had to make a park, cover it with grass and then maintain it for a lot of money." In this way, the materiality of the gardens can be seen as enhancing the liveability of the neighbourhood also for residents who are not involved in the allotments, as suggested by Veen (2015).

In summary, although our communication partners perceived their gardens as more suitable for socialising than elsewhere in their urban environment, we see the influence of individualisation in the allotments in weakening social ties and a preference for privacy. At the same time, the weakening of formal ties and the strengthening of informal ones suggest that the social groups we studied have some features of new sociations, in which solidarity and conviviality arise based on shared goals but in which relationships are not necessarily binding (Macnaghten and Urry, 1998, p. 27). Our findings thus align with Novák's picture of some allotment gardens as places which can cultivate not only vegetables, but also identity, community and civility (Novák, 2013, p. 21).

5.3 Food production as an integral part of life

A recent nationally representative survey on food self-provisioning in the Czech Republic (Vávra et al., 2018) showed that food production remains an integral part of people's use of land. Of the 818 respondents who reported to have access to a garden, an orchard or a similar type of agricultural land (40% of the survey participants), 775 used the land to produce some food (38% of the survey participants (Vávra et al., 2018). Our case study confirms these findings on the micro-level, while also supporting the observations of Gibas et al. (2013) from Prague allotments, where plots are used for both cultivation and other forms of recreation.

The gardens of all our communication partners include vegetable beds and/or fruit trees and bushes, but most of them also feature signs of other recreational uses, such as swimming pools, grills, outdoor seating, and playgrounds for children (see Fig. 6). Gardeners did not see the recreational and productive functions of allotments as contradictory but as interconnected and in fact inseparable. All communication partners perceived gardening and food production as a hobby, something they "enjoyed" but "did not do for living". This finding is consistent with the observations of Jehlička et al. (2012), who noted that the most important motivation for food self-provisioning is pursuing a hobby, followed by acquiring healthy and fresh food.

In our sample, home-grown food was valued for its qualities, which were commonly juxtaposed with conventional produce (referred to as "what you can buy in the shop"). The latter is described as "chemical" and "tasteless", whereas gardeners' own produce "is not sprayed" and "you know what you put in it". In the eyes of our communication partners, the transparent origin of home-grown food is linked to its freshness, healthiness and better taste, which "cannot compare" to that of fruits and vegetables from other sources. The appreciation of home-grown food is consistent with existing literature from the Czech Republic (Jehlička et al., 2012) and elsewhere (Kortright and Wakefield, 2011; Veen, 2015).

The construction of the value of home-grown food, however, seems to go beyond its sensory qualities and into more embodied and affective realms (McClintock, 2010; Pottinger, 2017). The fact that gardeners interact with produce by investing their time, skill sets and physical work in it is – at least for some of our communication partners – not only a guarantee of the transparent origin of their food, but a value in itself. As one of the gardeners put it: "it makes one feel better, to have one's own." Similarly, our informants' criticism of conventional produce was not only concerned with the use of pesticides and fertilisers, but it also reflected a sense of alienation from more traditional ways of food production and a criticism of 'over-technologisation': "If you look at the mass-production sites… What you buy in the

Fig. 6: Most plots in the studied areas combined productive, ornamental and recreational elements (Photo: L. Kala)

shops today has not even seen a field; it grows in a fiberglass cube with a drip of water and a chemical compound of fertilisers. And you can recognise that on the tomato."

When deciding on which crops to grow, gardeners tend to be pragmatic, considering the returns on their work and the quality of produce they could harvest compared to the quality of fruits and vegetables they could obtain from other sources. For instance, gardeners are less likely to grow crops that are available in the market for a low price – especially if such crops are (perceived as) difficult to grow and the (perceived) difference in quality is low. Contrarily, when the quality of home-grown and store-bought produce differs significantly, economic considerations are left aside: "Root crops I buy. It doesn't pay off [to grow them], price-wise. Peas you can also buy, but they are always better home-grown. With tomatoes, the difference is remarkable. I don't buy a tomato in winter. My tomatoes might be there only three months a year, but I try to make preserves for the winter, so I have them all year and I don't have to buy them in a shop." This quote shows that gardens are perceived as a suitable source of some crops but the practice of growing your own is not overly romanticised.

Despite their strong opinions about conventional food production, most of our communication partners cannot be categorised as conscious consumers. For instance, the term organic was often used half-jokingly to describe home-grown produce, whereas certified organic goods were seen as overpriced or even fraudulent: "I don't buy organic food because there is no such thing as organic food. I come from a village; I know how it goes. My parents used to grow vegetables a lot, so I'm aware that if you don't spray it, it simply won't grow. The organics, that is only a matter of fashion."

Self-provisioning was not motivated by the desire to obtain food in a sustainable way, confirming previous observations about Czech gardeners (Jehlička et al., 2012; Sovová, 2015) and contributing to ongoing discussions about gardening as an environmentally conscious practice (e.g. Tornaghi, 2011; Veen, 2015). Gardeners' critical attitudes towards conventional "chemical" produce might lead to the assumption that their gardening methods are strictly organic. Although most gardeners in our sample had negative attitudes towards agrochemicals, some felt that their use was necessary because pests spread easily within the allotments from one plot to another. Whereas some gardeners are open to inspiration from alternative growing methods, such as permaculture or organic agriculture, others perceive them as suspicious novelties.

This brings us to an important point in our case: our informants' gardening skills and their attitudes towards gardening. Our communication partners were mostly experienced gardeners with broad knowledge about and skills in food growing, as well as other practices related to the produce, such as cooking, storing and preserving, and other gardening-related activities, such as small repairs and DIY. Many of our communication partners mentioned being involved in gardening since childhood, whether in urban allotments or in former home gardens, which in some cases were located in the countryside. Consequently, they perceived food growing as an integral part of their lives. Garden visits were well integrated in their daily routines, and therefore garden produce was easily incorporated into their food provisioning and meal planning (see also Veen, 2015).

Some gardeners liked to educate themselves (e.g. by following television shows and magazines about gardening) and experiment. Innovations spread easily through informal knowledge sharing. Especially for older allotment members, though, the core of their skills seemed deeply ingrained and routinized and largely taken for granted: knowing how to grow food was a matter of common sense. This is in stark contrast with the recent concern about deskilling in matters of food, which some communication partners also expressed. Statements such as: "The kids nowadays don't even know how carrots are grown" were not uncommon, and some gardeners used their plots to educate their children and grandchildren about gardening[16].

The hybridisation of food-growing practices can be seen on several levels. Our communication partners engaged in food production as a natural and routinized part of their lives, guided by a down-to-earth logic, rather than as a result of conscious deliberation or an activist agenda typically linked to alternative food networks. But at the same time, they did not produce food for their livelihoods; without exception they referred to gardening as their hobby, albeit one with a strong influence on their lifestyle and identity. Furthermore, we have shown that the narrative of home-grown food as being better than conventional produce is not free of internal contradictions.

6. Conclusions

Urban gardens have always been at the intersection of the rural and the urban. Established to facilitate the transition of rural workers to the industrial city, these spaces have become a reminder of the incompleteness of the urbanisation process. Borčić et al. (2015, p. 53) use the term heterotopia to describe urban gardens as places that differ from the dominant (urban) environment and which are marginalised for their association with the countryside (see section 5.1).

Similar perspectives, which implicitly refer to modernist categories of the urban and rural, resonate throughout contemporary discussions about the future of allotments in the Czech Republic and elsewhere in the world. With advancing urbanisation, allotments have faced increasing pressure as they are often located on lucrative land suitable for development (for a description of the situation in the Czech Republic and Slovakia, see Tóth et al., 2018). In an example described by Gibas (2011), the claim that urban allotments "do not belong in the modern city" was used as an argument to abolish allotment gardens in Prague and to replace them with a public park – a form of greenery deemed more appropriate for the urban context. Not only are urban gardens viewed as "rural", but – as we mentioned in the theoretical section of this paper – the rural is implicitly seen as inferior (Plüschke-Altof, 2016). On that account, urban gardens are still commonly pushed to "the cracks of the system", as Tornaghi (2016) pointed out.

Our research confirms that allotments are indeed perceived as being distinctive from the city and are used accordingly. Notably, the features of allotments that are 'commonsensically' viewed as non-urban were also the most appreciated by our communication partners. The allotments were described as peaceful and quiet in contrast to the hectic city. Furthermore, they facilitated social interactions unlike the anonymous urban environment, and provided an opportunity to reconnect with one's food production, in

[16] See Hake (2017) for an overview of the use of gardens for intergenerational learning

contrast to the alienation of the conventional food system. This discursive but also physical and lived construction of the allotments forms a parallel to counterurbanisation as criticism of the urban and renewed interest in the rural. Broadening the use of the term, we therefore suggest that the increasing interest in urban gardening could be conceptualised as "intraurban counterurbanisation", that is, an "escape from the city" within its own boundaries.

Borčić et al. (2016, p. 55) describe the gardeners of socialist-era Zagreb as a "hybridised class of 'urban bodies with rural souls' whose socio-economic identity is urban, but whose socio-cultural identity is still deeply rural". Our findings defy such an elegant image: the materialities, narratives and practices we encountered in Brno allotments exhibited some characteristics that would commonsensically be associated with rural (or at least non-urban) settings. They were, nonetheless, inseparably intertwined with other influences that are stereotypically urban (or at least non-rural). Indeed, as Andersson et al. (2016, chap. 1) note, counterurbanisation cannot be understood as a simple return to the rural, but rather as a case of urban-rural hybridisation, an eclectic mix of features associated with both cities and the countryside.

To summarise, we have drawn two conclusions from our research. First, our study of urban allotments adds to the body of literature documenting the dynamic changes of the urban and the rural. Within this field, scholars have mostly studied changes in the countryside resulting from migration to and from rural areas, the dissemination of urban lifestyles and cultures, and related socioeconomic developments. Our contribution focuses instead on the rural-urban dynamics within the city. Our constructivist approach allows us to trace these dynamics not necessarily in terms of major demographic trends or physical changes, but rather in terms of perceptions, practices and micro-level adjustments. It also allows us to challenge the rural-urban dichotomy, which our data demonstrate to be an oversimplification.

The rural-urban perspective adds a new angle to some of the discussions about urban gardens: it deepens our understanding of why urban gardens are attractive for urban dwellers, and at the same time, why it can be challenging to accommodate gardening in urban planning schemes. The case of allotments adds yet another crack to the modernist rural-urban dichotomy. In our second conclusion, we therefore add our voices to authors who call for a break of these categories, which no longer serve to accurately describe the realities we inhabit. We believe that overcoming the outdated constructs of the city and the countryside and acknowledging urban gardens as a specific type of space, could help legitimise allotments in the eyes of planners and policymakers, and hence open new possibilities for making our towns and cities more liveable.

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Appendix 1: Descriptions of the research sites

Zaječí hora is located on the city's outskirts, but is easily accessible by public transport. The allotment is surrounded by a forest, which provides a pleasant and calm environment, but also presents a threat in the form of wild animals. Although most plots are privately owned, the entire allotment is part of the Czech Union of Allotment and Leisure Gardeners. The gardens are diverse, including extensive orchards as well as intensive vegetable production; some gardeners even raise animals.

The Na Sekerách allotment lies on the city's outskirts, in the vicinity of an airport. Most of the plots are privately owned, and there is a gardeners' association independent of the Czech Union of Allotment and Leisure Gardeners. Most gardens are managed rather extensively, and there is a community of people interested in permaculture and natural gardening methods. Part of the allotment does not have access to water other than collected rainwater, which influences crop composition.

Červený kopec is located on a hill in the city centre on the site of a former brick factory. Remnants of bricks and other building materials are present in the soil, lowering its quality. More than half of the area is rented via the local branch of the Czech Union of Allotment and Leisure Gardeners, which has the land in short-term lease from the city. This situation creates insecurity about future access to land. The plots are rather homogeneous in terms of size and appearance.

The Jundrov allotment is situated outside the city centre between a river and a row of houses and is thus inaccessible to outsiders. The area is difficult to access via public transport. Land ownership is mixed; plots belong to individual gardeners, other actors, and the city. The allotment is part of the Czech Union of Allotment and Leisure Gardeners. The gardens are mostly managed in an intensive way.

Židenice is an allotment consisting of five different sections located in the same neighbourhood that differ somewhat in their characteristics. One of the sections consists of large, privately owned and extensively managed plots. Two other sections we included in our sample fall under the Czech Union of Allotment and Leisure Gardeners. Plots here are privately owned (by gardeners and other actors who rent the plots); they are smaller and managed more intensively than gardens in the first section. The small amount of plots within these allotments contributes to closer communities.

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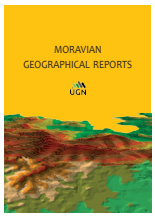

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Capturing cross-border continuity: The case of the Czech-Polish borderland

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Abstract

The differences in welfare amongst European countries are especially evident in border regions, and this affects cross-border cooperation and relationships. Due to the historical development of Central and Eastern European countries over the last century, the affected countries are unique "laboratories" for geographical research. This study assesses disparities in socio-economic indicators representing socio-economic phenomena in the Czech-Polish border region, through the analysis of cross-border (spatial) continuity, using quantitative methods (multivariate statistics and socio-economic profiling), GIS analysis and cartographic visualisation. It is demonstrated how such a combination of methods is useful for the comparison and evaluation of the complex socio-economic situations in neighbouring countries. This research project identifies the most suitable common indicators for a proper evaluation of cross-border (spatial) continuity, and it reveals the spatial patterns as reflected by a cluster analysis. The greatest cross-border (spatial) continuity is apparent in the easternmost part of the borderlands, while significant differences on both sides of the border are evident in the very central part of the areas under study. The paper also describes methodological aspects of the research in order to provide a quantitative approach to borderland studies.

Keywords: *GIScience, socio-economic data, profiling, clustering, border regions, Poland, Czech Republic*

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1. Introduction

According to Bell (2014), the word continuous means 'unbroken' or 'uninterrupted', thus a continuous entity has no 'gaps.' In geography, it is expected that natural phenomena are continuous (in space and time). From the GIScience perspective, Goodchild (1992) claims that "what distinguishes spatial data is the fact that the spatial key is based on two continuous dimensions", meaning that there are no gaps in the Earth's surface (DiBiase, 2014).

Nevertheless, socio-economic phenomena are mainly the product of human activities (Haining, 1993), which are not always continuous in space and time. In GIScience, this kind of phenomena is commonly represented in a non-continuous form, i.e. by using administrative or census units. These discrete objects represent the geographical world as a set of objects with well-defined boundaries in an otherwise "empty space" (Longley et al., 2011). Haining (2003) gives the example of political units (areas) conceptualised as objects – in contrast to, for example, air temperatures, which are conceptualised as fields. In the case of the field representation of geographical phenomena, geo-statistical methods (e.g. kriging) and interpolation methods (e.g. inverse distance weighting – IDW) are ordinarily used to analyse spatial continuity.

Although administrative units seamlessly cover a geographical region, the aggregated socio-economic data within the units may change abruptly from one part to another. Thus, it is not appropriate to apply geo-statistical or interpolation methods to such data to evaluate (spatial) continuity. Haining (2003), however, describes how the values missing from data relating to an area can be obtained using interpolation methods which are more commonly used for naturally continuous data (field representations). The continuity of socio-economic data expressed by administrative or census units (areas) can be evaluated more simply. It is possible to assess (spatial) continuity via a visual analysis of choropleth maps depicting socio-economic data, typically at the interval or ratio level (Haining, 2003;

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Robinson et al., 1995; Slocum et al., 2009). To smoothen sharp interval boundaries of attribute data, fuzzy sets and logic can be used, prior to choropleth map-making (Pászto et al., 2015; Woodcock and Gopal, 2000), to evaluate spatial continuity more intuitively. Another way to evaluate the spatial continuity of socio-economic data is to identify units with similar properties through the use of, for example, geographical typology and regionalisation. Moreover, from a quantitative point of view, it is desirable to perform a multivariate statistics and cluster analysis to reveal any common properties of data, especially when using a large number of attributes (e.g. Kaufman and Rousseeuw, 2009; Marek et al., 2015). Clearly, it is important to first establish the purpose or objective of the research, and then to find an appropriate method. Therefore, in the next section there is a brief explanation of the authors' understanding of the continuity of socio-economic data (indicators) as it relates to determining which methods to use.

In the context of cross-border cooperation, it is expected that sub-regions on both sides of a border will share common characteristics and needs. Perkmann (2003) defines (European) cross-border cooperation as a (more or less) institutionalised collaboration between contiguous sub-national authorities across national borders, which should generate a cross-border region. In one of his previous works (Perkmann, 2002), this author mentions that for Western European countries cross-border cooperation has been strongly institutionalised and attributed to long-lasting activities. The cross-border region is characterised by homogeneous features and functional interdependencies, because otherwise there is no need for cross-border co-operation (CoE, 1979). Moreover, Jaschitz (2013) emphasises that for cross-border areas there is a need for cross-border cooperation among local actors, especially while the border plays the role of a contact zone.

Many contributions dealing with cross-border cooperation have been presented worldwide. Some have concentrated on the role of the borders themselves (e.g. Anderson and Wever, 2003; Diener and Hagen, 2012; Guichonnet and Raffestin, 1974; Martinez, 1994; Minghi, 1963; Prescott, 1965; Van Houtum, 1998), classifying them according to a specific function (conceptual, thematic, process-based), origin (natural or artificial), frontier-type (political, cultural, mental), or as cross-border flows. A very large number of papers, reports and studies about borderland regions, cross-border cooperation, cross-border interactions and related topics are available from various institutions (e.g. Association of Borderland Studies, Association of European Border Regions, Centre for Borders Research at Durham University, Centre for Cross Border Studies), transnational program documents (e.g. European Commission, Central European Free Trade Agreement, North American Free Trade Agreement, Mercosur), and scientific journals (especially the Journal of Borderland Studies, and other geographical and policy-oriented journals).

Nevertheless, in the case of Central and Eastern European countries (including the Czech Republic and Poland), the European Commission (AEBR and the European Commission, 2000) states that approaches to cross-border cooperation started to emerge after 1989 with the opening of the borders. In this region it has been necessary to cooperate "in order to offset the geographical disadvantages of border areas and the huge disparities in incomes and infrastructure… amongst these countries themselves" (AEBR and the European Commission, 2000, p. 7). Within this context, the permeability of the borders creates great potential for further local or regional socio-economic development. On the other hand, there is an emerging demand for the protection of external borders (a border as a barrier or filter zone), especially regarding the recent immigration crisis in Europe (e.g. Carrera et al., 2015; Havlíček, Jeřábek and Dokoupil, 2018).

In the case of the Czech and Polish cross-border cooperation, these efforts were accelerated by EU programs (e.g. Phare and INTERREG), but disparities are still present. Studies on Czech-Polish cross-border cooperation were mainly conducted by Czech and Polish researchers, usually with a focus on one specific geographical theme (Heffner, 1998; Szczyrba, 2005), sub-region (Mintálová and Ptáček, 2012; Runge, 2003), and/or higher level administrative units (ČSÚ, 2005; Dołzbłasz, 2013; Kladivo et al., 2012). Such studies also demonstrated limited use of GIScience methods.

In this paper, the authors deal with socio-economic indicators (using the local administrative units, level 2 – LAU2) which reflect the social, demographic and economic situation in the Czech-Polish border regions. The overall objective of the paper is to capture cross-border continuity (or discontinuity) of socio-economic phenomena (represented by respective indicators) in the Czech-Polish border regions using a combination of methods. This objective is partitioned into a leading research question is: Is the cross-border continuity of socio-economic phenomena even visible in the available data? Which (non-)spatial tools would be best utilised to reveal a (spatial) pattern of the cross-border continuity? How can the resulting analysis from these tools be interpreted, and what are the most (dis) continuous borderlands?

2. Cross-border continuity of socio-economic indicators – a concept

The following concept of cross-border (spatial) continuity of socio-economic indicators is based on a typology of borderland regions and models of borderland interactions. Generally, borderlands are areas on the fringe of a national territory (Tykkyläinen, 2009). As such, these rather peripheral regions exhibit diverse functions according to the specific inter-relations with their cross-border neighbours. Strassoldo-Graffenberg (1974) defined borderland regions in relation to their permeability into four types: closed borderland regions; one-way opened borderland regions; partially opened borderland regions (bridge system); and fully opened borderland regions (system of contact territories). These different types of borderlands imply different border effects. Considering the border effect, Martinez (1994) proposed four models of borderland interaction: alienated borderlands; co-existing borderlands; interdependent borderlands; and integrated borderlands. Various aspects of types of border regions with detailed literature reviews were discussed in Dokoupil and Havlíček (2002), and they suggested that continuous border relations are only present where there are open borders. In the context of types and models of the borderlands mentioned above, the continuity of human and economic activities requires a system of contact territories and interdependent or even integrated borderlands. It is not a trivial task, however, to evaluate the integration of borderlands, and this can involve combinations of qualitative and quantitative methods. With respect to the historical background and

current situation of the study area in this paper, i.e. the Czech-Polish borderland, a concept of cross-border (spatial) continuity of socio-economic indicators is introduced. In this concept, the authors use rigorous quantitative approaches, supplemented with visual analytics and expert knowledge (for more details, see Section 3.4 below).

From our perspective, cross-border (spatial) continuity can be described as: the smoothness and/or trend in which the change in the indicators' values occurs in the direction from the inner part of country: from country A through its borderlands, across the border and to the inner part of country B. The authors characterise the most common types of cross-border (spatial) continuity based on trend curves, as follows:

- constant – this is the ideal type of continuity (Fig. 1a);
- progressive and regressive – the values gradually increase from country A to country B, and vice versa, i.e. the values gradually decrease from country A to country B (Fig. 1b);
- ridge – high values around a border with a gradual decrease towards the inner parts of both borderland regions (Fig. 1c);
- valley – opposite to the ridge type, i.e. low values around a border can be identified, with the increasing trend towards the inner parts of both borderland regions (Fig. 1d);
- oscillating – the phenomena do not show any significant trend; neither continuity nor discontinuity can be identified (Fig. 1e) and
- abrupt – this type is characteristic of distinct (spatial) discontinuity (Fig. 1f).

From a geospatial perspective, this concept could be used for line transitions (in the case of LAU2 units, these are individual municipalities along the studied axis/direction), or areal transitions (the whole borderland region is evaluated). The concept is most suitable for the interpretation of socio-economic profiling analyses. It could however also be easily applied to the results from cartographic visualisation (choropleth maps) and cluster analysis. In combination with the methods used in this paper (Section 3.4), it helps to assess the overall picture of the cross-border (spatial) continuity of socio-economic indicators.

3. Material and methods

3.1 Historical background

The Czechoslovakian borders newly established after World War I did not correspond to the ethnic composition of the population (see Fig. 2). Except for its eastern part, the Czech borderland is often called Sudetenland. This area is characterised by various historical developments that have played a significant role in shaping it into its current form. Sudetenland resulted from the Munich Agreement in 1938, and its status as a German Third Reich land continued until the end of World War II. In the dramatic post-war period, that part of the population with German nationality was forced to leave the region. The displaced German population was quickly replaced with new settlers and a new industrialised area with a high migration rate was created. On the other hand, Poland claimed the Teschen region (the north-east of Czechoslovakia), and in August 1945, nearly 700,000 new Polish settlers were transferred to the region. At the same time, the Czechoslovaks were told that if they did not take Polish nationality, they would be expelled from the area. This led to the expulsion of 21,000 Czechs from the Polish part of the border region. Through this act, Poland annexed original territories from Czechoslovakia. The disputes did not cease however until 1947, when a Treaty of Friendship and Mutual Assistance was concluded between Czechoslovakia and Poland. In the 1950s, the Treaty between Czechoslovakia and the People's Republic of Poland on the definitive demarcation of state borders was signed, and this resulted in minor border adjustments in the form of Czechoslovak territorial gains. The present form of the state border was defined by the Treaty between the Czech Republic and the Republic of Poland on Common State Boundaries from 1996. Historical events influenced the border region, particularly the geo-demographic and socio-economic situation, which makes the region particularly interesting from a research perspective.

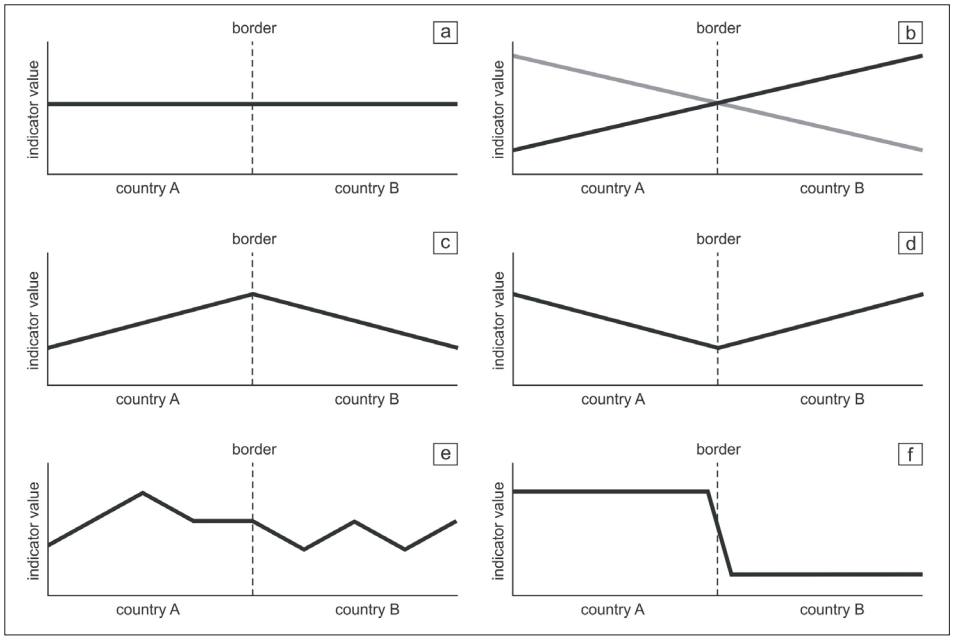

Fig. 1: Main types of cross-border (spatial) continuity of socio-economic indicators
Source: authors' visualisation

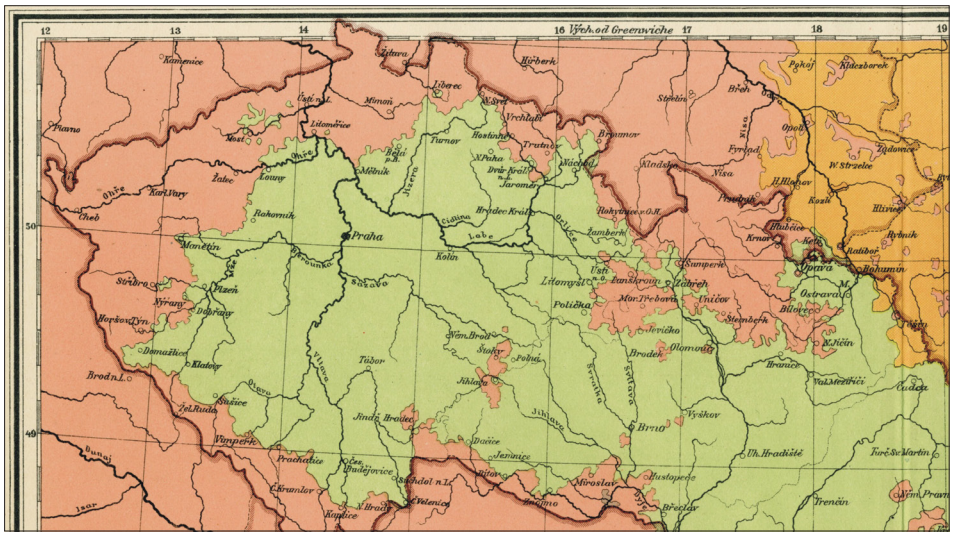

Fig. 2: Map segment of ethnicities in Czechoslovakia and neighbouring countries in 1930 (Colours: red represents Germans; green, Czechoslovaks; and orange, Poles. German ethnicity in the Czech territory closely corresponds with the Sudetenland borders established in 1938). Source: Brunclík and Machát (1930)

For more information, a comprehensive overview of the German influence on Poland and the Czech Republic is given in an historical context by Cordell and Wolff (2005). For instance, these authors mention that German ethnicity plays a minor role in the Czech Republic in comparison with Poland, where the ethnic has been reconstituted as a conscious entity. Further in-depth research about the former Sudetenland and the impact and consequences of World War II on the Czechoslovak borderlands is provided by Glassheim (2016), who touches on topics such as expelling German ethnic persons and resettlement programs, as well as environmental and health issues in the borderlands.

3.2 Study area

The region in this study is depicted in Figure 3 and was selected as in Kladivo et al. (2012). The delimitation of the study area follows administrative divisions on both sides of the border (in general, these administrative units are in size between LAU1 and LAU2). These medium-detailed administrative units have relatively similar size in terms of population, which is very important regarding socio-economic analyses. Subsequently, these units have been replaced by the most detailed level (municipalities, i.e. LAU2 units) to obtain the highest spatial resolution.

The overall area of the region is approximately 20,000 square kilometres (roughly the same size as Slovenia) and it is divided by the border into Czech and Polish parts (with approximately the same size). Both regions are composed of the smallest local administrative units (i.e. LAU2) as defined by Eurostat (2015) for statistical purposes. It is worth noting that the unequal average size of individual territorial units on the Polish and Czech side causes different spatial fragmentation. It is apparent at first glance from the number of municipalities in both states – in Poland,

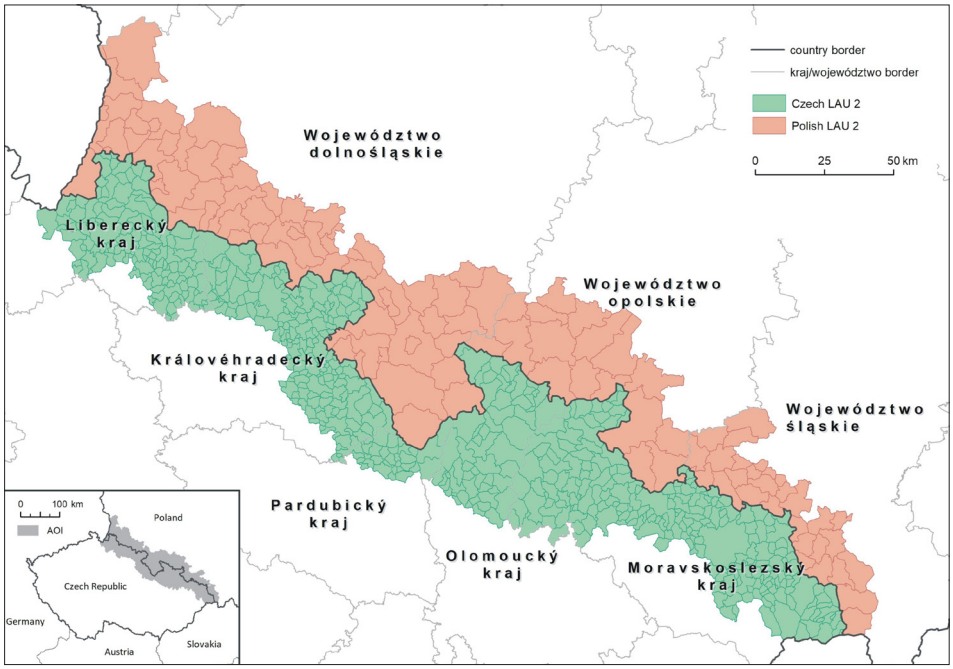

Fig. 3 Study area of the Czech-Polish borderlands
Source: authors' elaboration

109 municipalities (gminy) were selected and in the Czech Republic, 604 municipalities (obce). This problem is present, however, when comparing most European countries, and other administrative divisions at this or a finer level are simply not available.

3.3 Data

Attribute data were acquired for the LAU2 units from national statistical offices: the Czech Statistical Office and the Central Statistical Office of Poland, with the reference date 2014. Although both statistical offices have a large amount of socio-economic indicators available to download, not all are available at the level of LAU2 for both countries. Therefore, only the relevant indicators available for both countries for LAU2 were included in this study in order to evaluate their continuity (Tab. 1). Geographically, there are 109 LAU2 on the Polish side and 604 units on the Czech side. For every unit, 43 indicators were obtained but not all were used in further analyses (see below for more details, Section 3.4.3). Geographical data were obtained from the Polish Office of geodesy and cartography (CODGiK) database, and from the ArcCR® 500 database provided by the Czech company ARCDATA PRAHA and the State Administration of Land Surveying and Cadastre (ČÚZK).

3.4 Evaluation of cross-border continuity

In order to evaluate the continuity of selected socio-economic indicators, three methods were used:

1. cartographic visualisation as a proxy for visual analytics was used – in total, 26 choropleth maps were made to depict the (dis)continuity of each individual indicator;
2. the socio-economic profiles of socio-economic indicator values in LAU2 following cross-border development axes were calculated – this approach is inspired by topographic profiling, usually used in physical geography. Socio-economic profiling is based on the theoretical concepts introduced in Section 2, above;
3. statistical analyses were carried out in order to: (a) reduce the dimensions of attribute data with the use of Pearson's correlation; (b) find groups of similar LAU2 areas (according to socio-economic indicators) by hierarchical clustering using Ward's method.

For the statistical analyses, IBM SPSS Statistics and RStudio software were used. Further analyses were carried out in Esri ArcMap from the ArcGIS Desktop family. Additionally, a special toolbox in Esri ArcMap was prepared by the authors for more comprehensible visualisation and analysis of clustering results. Key features of the toolbox are: (a) user- defined threshold for LAU2 area size; (b) user-defined LAU2 distance from the borderline; and (c) automatic calculation of basic statistics of socio-economic indicators in particular LAU2 areas.

3.4.1 Cartographic visualisation

The choropleth method is one of the most commonly used cartographic tools for displaying the intensity of phenomena in a monitored area. The intensity is graphically expressed by colour or raster (pattern filling). The choropleth map represents relative values in order to compare the various spatial units. An important issue is the creation of the interval scale, which also influences the correct interpretation of a map's content. Usually, it is recommended to use 4–10 intervals,

Abbreviation	Indicator	Abbreviation	Indicator
P	Population, total	AI	Ageing index
P14	Population ages 0-14	JS	Job seekers
P64	Population ages 15-64	ANFC	Absolute number of completed flats
P+	Population ages 65+	AAGR	Area of agricultural land
AA	Average age	ABUA	Built-up area
M	Population, male	**PD**	**Population density**
W	Population, female	**MI**	**Masculinity index**
FI	Femininity index	**CBR**	**Crude birth rate**
B	Births	**CMR**	**Crude mortality rate**
D	Deaths	**RNI**	**Rate of natural increase**
NI	Natural population increase	**NMR**	**Net migration rate**
I	Immigrants	**RTG**	**Rate of total population growth**
E	Emigrants	**CMR**	**Crude marriage rate**
MB	Migration balance	**IMR**	**Infant mortality rate**
TG	Total growth	**DR**	**Dependency ratio**
MA	Marriages	**EAI**	**Economic activity index**
D	Divorces	**UR**	**Unemployment rate**
CDR	Crude divorce rate	**NFC**	**Number of completed flats (per 1,000 inhabit.)**
A	Abortions	**AGR**	**Proportion of agricultural land**
CAR	Crude abortion rate	**BUA**	**Built-up area ratio**
DI	Dependency ratio I	**CES**	**Coefficient of ecological stability**
DII	Dependency ratio II		

Tab. 1: Complete list of socio-economic indicators obtained for the study (Note: Attributes in bold were selected for final analysis)

but it is important to note that a small, as well as a large, number of intervals, degrade the map. In the case of a large number, the map is mostly not easily interpreted, and, in the opposite case, it erases the differences between the individual units. In this research project, four and five intervals using Jenks' 'natural breaks' method have been chosen to minimise variability within intervals (by minimising average deviation from the interval mean) and to maximise its diversity among them (by maximising each interval deviation from the means of the other intervals) (Jenks, 1967). This approach reflects natural groupings inherent in the geographical data and is one of the most commonly used in the geosciences (Dvorský et al., 2013). The study area (area of interest: AOI) was evaluated through visual analysis and it was possible to create the first statements about the behaviour of the observed phenomena in the Czech-Polish borderlands (see Fig. 4).

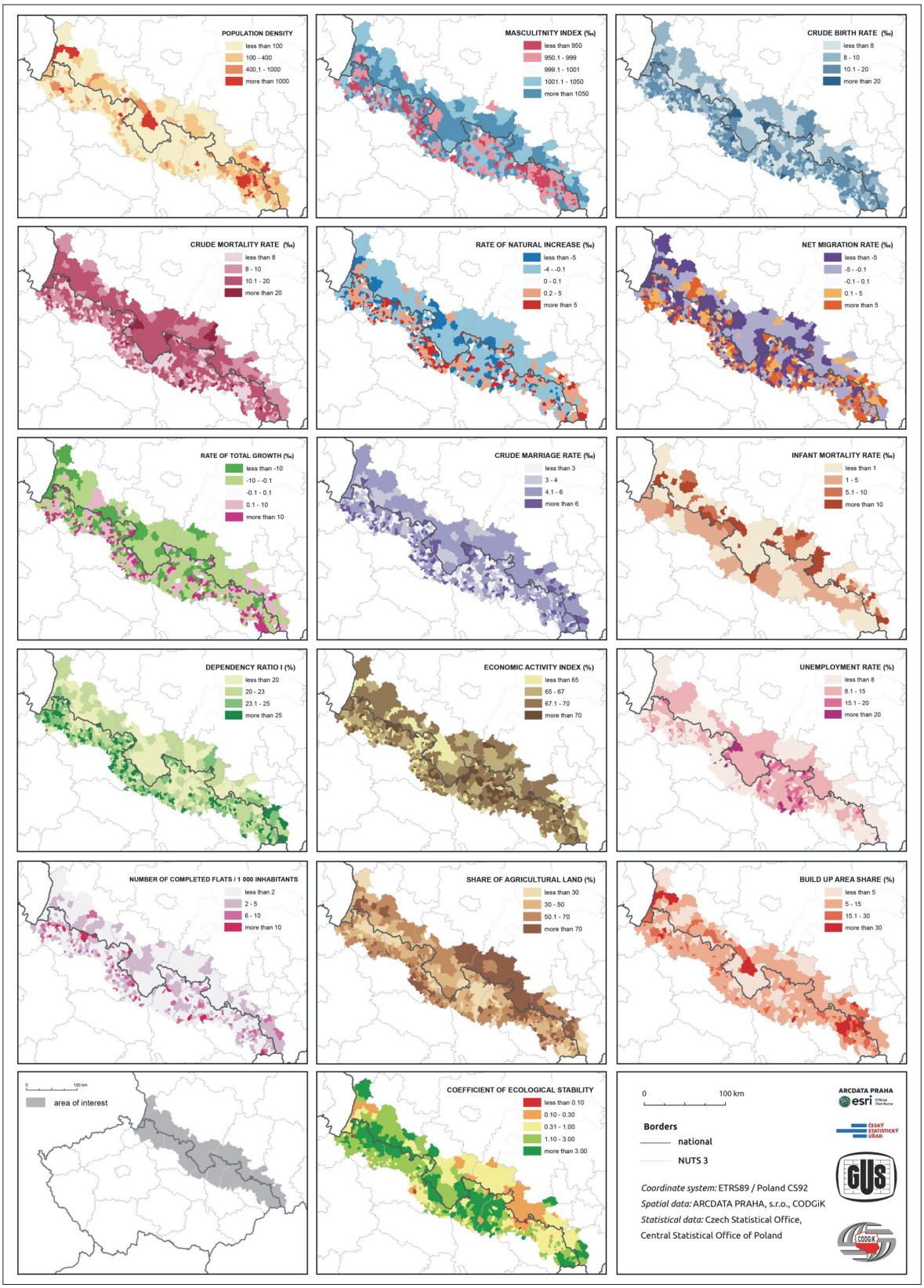

Fig. 4: Selected indicators visualised on choropleth maps. Source: authors' calculations and visualisation

Using choropleth maps with indicators classified into four or five classes, it is possible to acquire general knowledge about cross-border (dis)continuity patterns. Visually, the greatest spatial continuity appears to occur in the case of population density. Since most of the borderlands in both countries could be treated as peripheral regions, and due to the mountainous character of the landscape along the border, there is evident cross-border continuity, mainly of low values. There is a clear exception in the most eastern part of the studied area, which is situated in lowlands and is historically a centre of heavy industry connected with mining. Therefore, a considerable number of towns and cities is located in this area, which has a direct influence on the indicator of population density. Another example of cross-border spatial continuity is the indicator of unemployment rate. Higher values of the index in the central part of the study area are affected by the mountainous terrain, and the consequent low economic performance due to industry not being subsidised by post-socialist governments. A relatively high degree of spatial continuity can also be seen in the economic activity index.

A good example of cross-border spatial discontinuity (obviously with several local exceptions) is manifested by the masculinity index, the rate of total population growth, the dependency ratio and the rate of natural increase. Given the female prevalence in the population on the Czech side, according to the masculinity index, the crude birth rate is also higher, which results in a certain level of discontinuity. A combination of local cross-border spatial continuity and discontinuity can be found in the share of agricultural land and the coefficient of ecological stability. It is logical and evident that these two indicators are complementary in almost all the study area. Again, looking at the central part, cross-border spatial discontinuity is clear with a relatively high proportion of agricultural area on the Polish side, and a low proportion on the Czech side. The rest of the study area is more cross-border spatially continuous, as regards this indicator. Analogically, the coefficient of ecological stability is the reverse of the proportion of agricultural area.

The remaining indicators evince cross-border spatial (dis) continuity locally and should be interpreted with this fact in mind. In general, it is important to take the local context into consideration when interpreting all the maps, but the spatial pattern of the indicators mentioned above is the most apparent, even on a regional scale. Moreover, it is desirable to generalise the visual analysis by omitting small LAU2 units that disrupt map reading. Due to the local heterogeneity of indicator values, it is impossible to find perfect (dis) continuity, but at the same time it is feasible to uncover homogeneous spatial patterns in cross-border spatial (dis) continuity. The setting of interval ranges also affects the overall visual impression gained from choropleth maps. As mentioned earlier, the authors chose Jenks' methods for data classification into four or five intervals, but interval boundaries were then justified for each choropleth map in order to meet cartographic rules (rounded intervals in this case). Yet, every classification simplifies the information, therefore even slight modifications to interval boundaries may cause significant changes in the final appearance of the map.

3.4.2 Socio-economic profiles

Socio-economic profiling offers a different point of view of the (dis)continuity. It is possible to evaluate an increase (or a decrease) in the continuity of socio-economic indicators in one direction across the border. This method is inspired by the elevation (longitudinal) profile method, but here it shows the values of the studied phenomena instead of the altitude between points A and B. In this project, socio-economic profiles were constructed in directions that follow development axes in the area of interest. Four development axes between the Czech Republic and Poland were drawn based on the Czech and Visegrad groups' strategic documents (ISD et al., 2014; MRD and ISD, 2015). Two additional axes were defined by the authors to cover the remaining parts of the study area.

Axes 1 and 2 form two major European routes from Poland to the Czech Republic. Axis 1 crosses the industrial city of Katowice and continues through Ostrava towards Přerov and Brno. Axis 2 leads from Wrocław to Praha (Prague) via the towns of Trutnov and Hradec Králové. Axis 3 was defined with respect to the important Czech development area around Liberec, heading to Praha (Prague) on the Czech side, and to Legnica in Poland. Axis 4 is a planned development axis and was recently defined in Czech strategic documents.

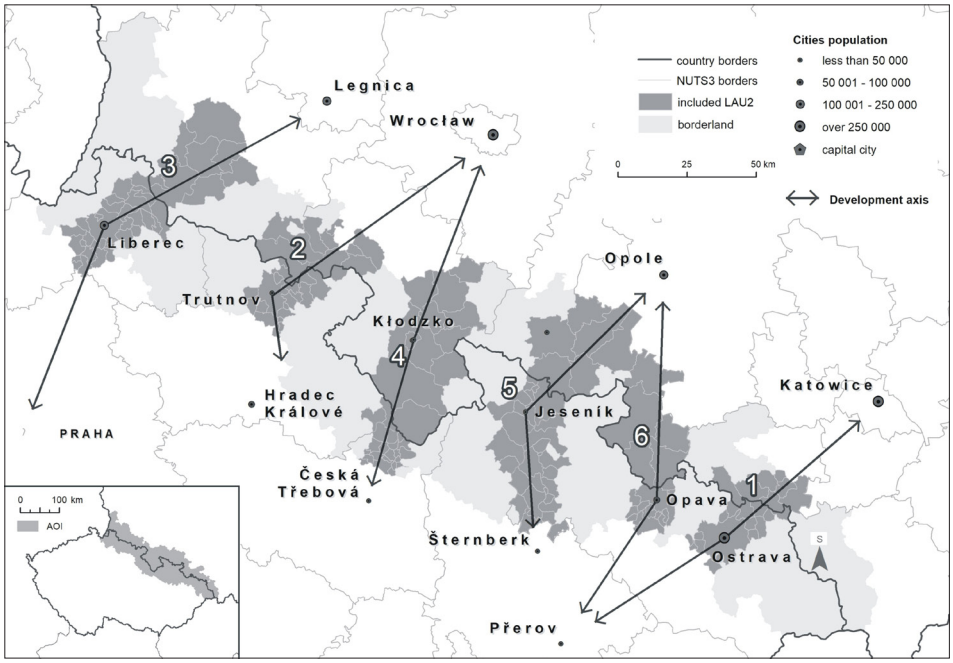

Fig. 5: Development axes in the Czech-Polish borderlands. Source: authors' calculations and visualisation

It leads from Wrocław, via Kłodzko and continues to the Czech town of Česká Třebová. Axes 5 and 6 were created by the authors, who noted the absence of any significant infrastructure links, rail or road. Therefore, they are not strictly development axes but selected "axes of interest". For simplicity, the authors also refer to the latter as development axes. All development axes are depicted in Figure 5.

For each development axis, a selection of sixteen socio-economic indicators was profiled in order to evaluate cross-border (dis)continuity in view of the theoretical concept described in Section 2, above. It is possible to comprehensively interpret individual socio-economic profiles within a development axis from one diagram, or to focus on individual indicators across all development axes (see Table 2). In the first case, a graph matrix with all indicators displayed together was prepared. An example of such a matrix for development axis 3 is shown in Figure 6.

The x axis on the graphs represents all territorial units intersected by development axes and their closest surroundings. This axis is scale-less, so the resulting graph does not display the actual distance between territorial units. Nevertheless, the order of LAU2 is set according to their centroid distance from the border. The value of one of the socio-economic indicators is plotted on the y axis.

In Figure 6, the profiles for development axis 3 are depicted in order to demonstrate the variability in cross-border continuity types as described in the theoretical concept (Fig. 1). As regards development axis 3, the ideal case for cross-border continuity of the socio-economic indicators is manifested by population density, the number of completed flats (at least in proximity to the border), and the proportion of built-up areas (with two peaks on both sides close to the border which are left out of consideration). A slightly progressive (or regressive, depending on the starting point) trend could be identified in the dependency ratio and, to some extent, in the rate of total population growth and the net migration rate. The valley type of cross-border continuity is mainly demonstrated by the proportion of agricultural land indicator in its generalised course without local peaks (although the "valley floor" is not directly on the border), the masculinity index in proximity to the border, and the crude marriage rate (again when considering the generalised course of the profile). There is one ridge type shape to the profile, which is the unemployment rate. Typical examples of the abrupt type is represented by two indicators – crude mortality rate and the coefficient of ecological stability. The remaining profiles could be classified as oscillating types. In the same fashion, all the other development axes with their respective socio-economic profiles can be analysed.

Looking at the individual indicators across all development axes, Table 2 summarises the most prevalent type of profile within a development axis (profiles read from left to right, i.e. from Poland to the Czech Republic). Table 2 could be read by row for an individual indicator across the development axes, or by column, providing a picture of

Indicator	Development axis					
	1	2	3	4	5	6
PD	abrupt*/oscillating	constant***	constant*	constant*	abrupt*/oscillating	abrupt*
MI	regressive	ridge*/regressive	valley*/oscillating	constant**	valley*	valley*/oscillating
CBR	regressive*/ constant	oscillating	progressive*/ oscillating	abrupt*/ progressive	constant**	progressive*/ridge
CMR	progressive**	regressive/ constant	abrupt*/oscillating	abrupt*/oscillating	constant*/ oscillating	constant**
RNI	regressive*	constant*/ progressive	abrupt*/oscillating	progressive	constant**	progressive*/ oscillating
NMR	oscillating	ridge*	abrupt*/ progressive**	abrupt	abrupt*/oscillating	constant**
RTG	oscillating	ridge*	progressive**	abrupt	abrupt*/oscillating	constant**
CMR	regressive	abrupt*/oscillating	valley**	valley*/oscillating	abrupt*/oscillating	constant**
IMR	abrupt*/oscillating	abrupt	oscillating	ridge*/constant	constant***	abrupt***
DR	regressive*/valley	abrupt*/ progressive**	progressive**	progressive	constant*/ oscillating	progressive
EAI	abrupt*/ progressive**	Abrupt*/ oscillating	constant*/ oscillating	progressive*/ oscillating	progressive*/ridge	progressive*/ oscillating
UR	progressive**	valley*/regressive	ridge*/oscillating	abrupt*/regressive	abrupt*/ progressive	constant*
NFC	oscillating	abrupt*/oscillating	constant*	abrupt	oscillating	abrupt**
AGR	abrupt*/oscillating	oscillating	valley	valley	regressive*/valley	constant*/ regressive
BUA	oscillating	constant*/ oscillating	constant*	constant*/valley	ridge**	ridge*
CES	progressive	abrupt*/oscillating	abrupt*	ridge*/constant	constant*/ridge	constant**

*Tab. 2: Types of socio-economic profiles within development axes (Notes: * Applicable only in proximity to the border, ** except the right end of the profile, *** except the left end of the profile)*
Source: authors' calculations and visualisation

Fig. 6: Socio-economic profiles of sixteen selected indicators for development axis 3
Source: authors' calculations and visualisation

each development axis. At first glance the table is rather challenging to read, nevertheless certain patterns can be found. The most continuous indicators appear to be the proportion of built-up areas, the crude mortality rate, the coefficient of ecologic stability and the population density (all classified three times as constant types). In contrast, the greatest discontinuity is shown by the net migration rate, the infant mortality rate (albeit its values are very low in general), the number of completed flats and, paradoxically, the population density. All four indicators fall into the abrupt change type of socio-economic profiles. A comprehensive frequency analysis of all indicators and types derived from Table 2 is depicted in Figure 7.

It is important to note that interpretation using profiling is expert-based and is rather subjective. This requires some degree of generalisation to estimate overall trends in the examined socio-economic indicators. The evaluation of profiles also depends on the scale (range) of the trend analysis – how far from the border in a profile graph is the evaluation applied. It is recommended that the intensity of an indicator's value change in the context of the values ranges is also taken into consideration.

Moreover, all the socio-economic profiling is highly dependent on the sequence order of the selected units, and on the direction/course of an axis to be studied (as mentioned earlier, the authors used centroids of LAU2 units and their distance from the border).

3.4.3 Correlation and Cluster analysis

Before the statistical analysis was performed, it was necessary to prepare an input dataset. First, unnecessary attributes/indicators were removed for the correlation and

	PD	MI	CBR	CMR	RNI	NMR	RTG	CMR	IMR	DR	EAI	UR	NFC	AGR	BUA	CES
constant	3	1	2	3	2	1	1	1	1	1	1	1	1	1	3	3
progressive /regressive	0	2	4	2	4	1	1	1	0	5	4	4	0	2	0	1
ridge	0	1	1	0	0	1	1	0	1	0	1	1	0	0	2	2
valley	0	3	0	0	0	0	0	2	0	1	0	1	0	3	1	0
oscillating	2	2	2	3	2	2	2	3	2	1	4	1	3	2	2	1
abrupt	3	0	1	2	1	3	2	2	3	1	2	2	3	1	0	2

Fig. 7: Frequency analysis of types of socio-economic profiles (development axis 3)
Source: authors' calculations and visualisation

clustering analysis. Second, a recalculation of absolute values into relative values was carried out, such as the number of births and deaths into crude birth and mortality rates.

In the next step, the interdependence of the remaining indicators was examined. The Pearson correlation coefficient was calculated to describe the degree of linear dependence between each pair of indicators (Cohen et al., 2003). If two indicators are highly dependent on each other, they do not add any additional information to the data file, so the presence of both is not necessary. By displaying the correlation matrix, indicators with a strong interrelationship were easily identified. As part of the data preparation phase, three sets of data were prepared using the correlation analysis results to enter the consequent cluster analysis. The first included all the indicators obtained, regardless of the degree of correlation or the logic of their suitability for use (43 indicators). In the second group, indicators with a strong correlation coefficient were excluded and the threshold value of this coefficient was determined as 0.7 (14 indicators remained). The last group was determined expertly – it also contained indicators with a strong correlation coefficient value (the highest correlation between net migration rate and rate of total growth was 0.96). The authors wanted to take expert knowledge into account as well, however, and kept this information because of its significance in the cluster analysis used in this paper (16 indicators, see Fig. 8). All analyses in this paper (cartographic visualisation, socio-economic profiles, and cluster analysis) were performed based on these sixteen expertly selected indicators as the most comprehensive combination of human and computer-based decision making.

In assessing the cross-border continuity statistically, a similarity between LAU2 areas in relation to all monitored attributes was examined using multidimensional data aggregation – cluster analysis. Clustering simplifies the attribute information and allows behaviour to be monitored across borders. For grouping of values based on one variable, several methods have been introduced, e.g. by Cox (1957) and Fisher (1958). Cluster analysis provides the user with empirical and objective methods to perform one of the basic data processing procedures – classification. Militky and Meloun (2011) state that cluster analysis is one of the

	PD	MI	CBR	CMR	RNI	NMR	RTG	CMR	IMR	DR	EAI	UR	NCF	AGR	BUA	CES
PD		-0.13	-0.03	0.00	-0.03	-0.04	-0.05	0.03	0.02	0.09	-0.10	-0.03	0.34	-0.03	0.42	-0.11
MI			0.03	0.00	0.03	0.02	0.02	0.03	0.07	-0.18	0.19	0.11	-0.03	-0.09	-0.09	0.22
CBR				0.28	0.57	-0.04	0.11	0.21	-0.06	0.06	-0.06	0.05	-0.03	0.04	-0.06	-0.01
CMR					-0.63	-0.12	-0.28	0.21	0.01	0.15	-0.15	0.07	-0.04	-0.06	-0.01	0.01
RNI						0.06	0.34	-0.01	-0.06	-0.08	0.08	-0.02	-0.02	0.09	-0.05	-0.02
NMR							0.96	0.16	0.00	-0.12	0.13	0.03	0.01	0.06	0.04	-0.02
RTG								0.15	-0.01	-0.14	0.15	0.02	0.00	0.08	0.02	-0.02
CMR									0.00	-0.14	0.13	-0.05	0.04	0.00	-0.03	0.04
IMR										0.03	-0.03	-0.03	0.07	0.00	-0.01	-0.02
DR											-1.00	0.05	0.09	0.04	0.12	-0.13
EAI												-0.04	-0.10	-0.05	-0.12	0.14
UR													-0.02	-0.03	0.05	0.02
NCF														-0.04	0.41	-0.10
AGR															-0.03	-0.65
BUA																-0.27
CES																

Fig. 8: Correlation coefficients between 16 selected attributes (Notes: Red colours for positive and blue colours for negative correlations; richer colours indicate stronger correlations)
Source: authors' calculations and visualisation

methods involved in investigating the similarities among multidimensional objects (objects with a large number of variables) and classifying their features into clusters.

For cross-border continuity analysis, the authors chose hierarchical clustering due to the unknown target number of clusters to be created (in contrast to the partition methods which require certain user parameters, such as target number of clusters) (Aggrawal and Reddy, 2014). Hierarchical classification creates clusters that are hierarchically organised, i.e. clusters at the higher level always contain clusters from the lower levels. The objects are classified in a "bottom-up" order – the first clusters are created from individual entities, and in the next iterations, based on their similarities, these clusters are aggregated together.

Ward's method was selected for the clustering because it minimises the heterogeneity of clusters by using analysis of variance (Ward, 1963). At each step, a possible pair of objects (clusters) is considered to minimise the sum of the squares of deviation from the mean value within the cluster (Militky and Meloun, 2011). The distance matrix was calculated by the Euclidean metric. The clustering process is graphically represented by a dendrogram, which helps in determining the target/optimal number of clusters (see Fig. 9).

Since the dendrogram for a large number of records (LAU2 units) is rather difficult to interpret, a decision about the optimal number of clusters was made in order to generalise the information from the dendrogram. The optimal number of clusters was based on the silhouette measure (Rousseeuw, 1987) of cohesion and separation, which supports the decision-making process concerning the target number of clusters. The silhouette index statistically evaluates the quality of each cluster, expressed by the silhouette value, ranging from – 1 (poorly clustered observations) to 1 (well-clustered observations). The silhouettes are constructed when compact and clearly separate clusters are desired, and the advantage of this method is that it only depends on the actual partition of the objects (not on the clustering algorithm that was used to obtain it). Consequently, the silhouette index could be used to improve the results of cluster analysis, or to compare the output of different clustering algorithms applied to the same data (Rousseeuw, 1987).

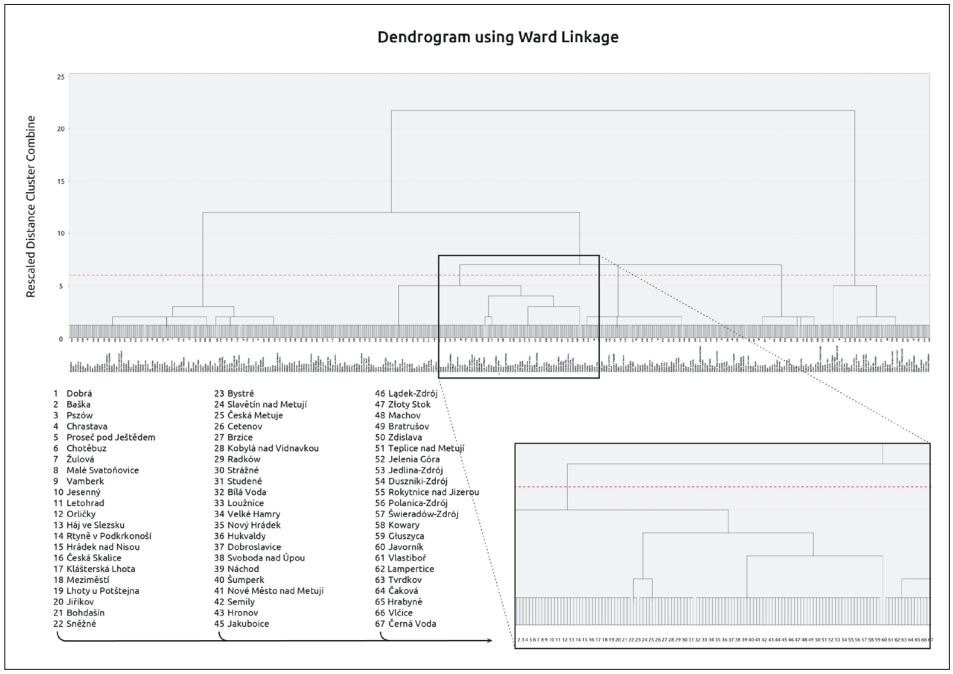

Fig. 9: Dendogram from clustering analysis using Ward's method with example of detailed cluster structure Source: authors' calculations and visualisation

For each set of data (all indicators, non-correlated indicators, and the authors' selections), clustering for 3–10 clusters was tested (more clusters than 10 tend to be difficult to interpret). The results showed that the highest quality of clustering took place on data with 16 indicators, expertly selected, so these were chosen for the visualisation and evaluation of the cross-border continuity. Using the evaluation methods (the silhouette index value is in Fig. 10), the value of 5 was decided upon as the optimal number of clusters. This amount is also readable in the subsequent cartographic visualisation (Fig. 11).

The dendrogram is not intuitively readable, so it is not useful for the evaluation of cross-border spatial continuity and the cluster membership of LAU2 was displayed on the map. Nevertheless, perception difficulties also emerged from direct map visualisation of the clustering results. When every single LAU2 colour was placed according to their cluster

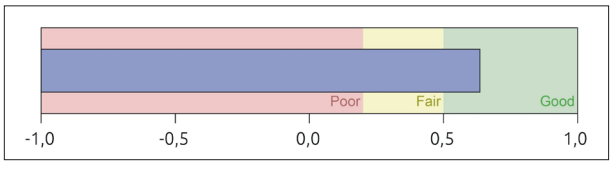

Fig. 10: Evaluation of quality of clustering into five groups using the silhouette measure of cohesion and separation. Source: authors' calculations and visualisation

membership, the resulting map appeared too complex due to the heterogeneity of unit sizes. Thus, individual small LAU2 units disrupted the overall perception of spatial continuity so it did not meet the requirements for its proper evaluation. Therefore, a semi-automated process (toolbox) in the Esri ArcMap Model Builder environment was designed to improve the final visualisation of the clustering analysis.

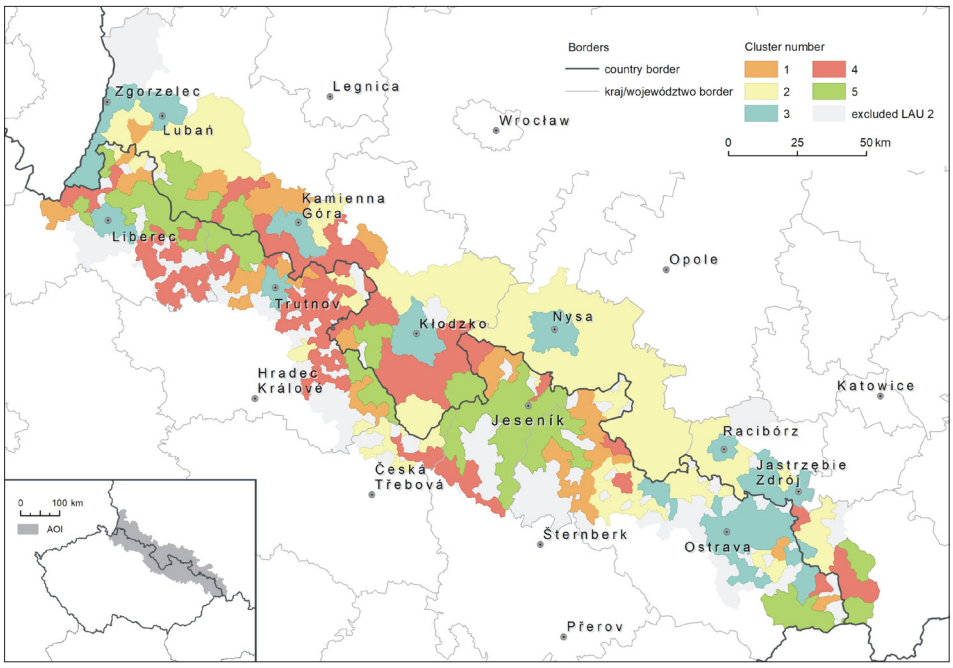

Fig. 11: Resulting clusters using Ward's method after improvement using authors' toolbox
Source: authors' calculations and visualisation

First, the toolbox dissolved administrative boundaries of input data according to cluster membership. Basic statistical information (minimum, maximum and mean) was also added for each indicator entering the cluster analysis. This was in order to keep both the indicators' contribution to further interpretation, and the cluster membership, in the single attribute table. Second, the toolbox selected only LAU2 with a minimal area of 30 square kilometres and which were within six kilometres of the border. These thresholds were set expertly by the authors after a series of tests. Nevertheless, both parameters can be modified in a dialogue box by the user, based on the specifics of a given study area. The final map of LAU2 with cluster membership is shown in Figure 11 and a basic summary of the clustering results is in Table 3.

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From the perspective of the individual indicators, cluster 1 is characterised by the lowest values in population density, number of completed flats and proportion of built-up area in the analysed area. Cluster 2 contains LAU2 units with high values in phenomena that emphasise the importance of agricultural production. From the demographic point of view, there is a population decrease in the area and higher values of the dependency index. In cluster 3, there are significantly high values in population density, ratio of built-up area and number of completed flats. As a result of the suburbanization process, population decline occurs in larger settlements. Cluster 4 is mainly composed of sub-mountainous areas with the prevalence of natural landscapes. It is similar to cluster 1, but with a higher

Cluster	Area (%)	LAU2 count	Characteristics
1	13.9	138	Sub-mountainous, rather smaller units, with significant share of natural sites
2	33.9	224	Agricultural units, mainly on Polish side of border
3	13.5	58	Urban units
4	19.8	201	Hilly, natural landscape prevalence, larger units
5	18.9	92	Highest parts of mountains, conservation areas (protected-by-law parks)

Tab. 3: Summary characteristics of the clustering results
Source: authors' calculations

population density due to the influence of cities within this category. For this reason, there is a larger proportion of built-up area compared to the first cluster. Cluster 5 is characterised by mountains and other natural landscapes and there is little noticeable human interference. It has the lowest proportions of both built-up and agricultural lands in this whole area of interest. Low settlement levels cause it to have the lowest population density in comparison with all other clusters.

The cluster analysis provided comprehensive results which generalised the information from all sixteen indicators into compact outputs – the dendrogram and the final map. Both clustering and visualisations offered an overall picture of cross-border (dis)continuity in socio-economic indicators, and it proved feasible to employ them in combination with individual evaluation using choropleth maps and the profiling method.

4. Results and discussion

Three different methods, their characteristics and the main outputs were described in the sections above, mainly from a methodological perspective but also with a description of the interpretation of individual outputs. In addition to the previous section, a combination of socio-economic profiling and clustering analysis is further presented as a synthetic outcome, encapsulating important findings from individual methods. This section summarises the main geographical results from all three analyses. Euroregions are taken as the main geographical reference units since they cover almost all the study area. Moreover, Euroregions are internationally known, so this should help readers to easily locate the results in a geographical context (instead of referring to municipalities or national sub-regions using local nomenclature and geographic names).

Sixteen selected phenomena represented by socio-economic indicators were visualised via choropleth maps. The cartographic visualisation revealed sub-regions with almost perfect continuity of socio-economic indicators (i.e. values of an indicator are at the same interval). Specifically, the easternmost part of the study area around the city of Ostrava (partly falling into Euroregion Teschinensis and partly into Euroregion Silesia; around development axis 1) is the most typical sub-region with cross-border spatial continuity in most of the indicators (e.g. population density, marriage rate, dependency ratio). This is due to the fact that the sub-region is highly urbanised and shares similar environmental, social and economic conditions. For this part of the borderlands, it is also important to point out the historical background, because this part of the region represents the long-standing Czech-Polish 'touch' region and, unlike other parts of the Czech-Polish borderlands (mainly the western parts), which were mostly part of Sudetenland, it was not inhabited by Germans. On the other hand, an example of a sub-region showing rather more discontinuity of socio-economic indicators (especially in the case of Kłodzko county in the central part of the study area), is part of the Euroregion Glacensis (western-central part of the study area, development axis 4). In comparison with the previously mentioned Euroregions, Glacensis is a mountainous region with well-preserved nature, but with significant societal differences. Cross-border spatial continuity for the remaining parts of the study area is only apparent in the limited number of socio-economic indicators and larger scales (greater detail), so it is better to refer to discontinuity in these cases.

As a result of the socio-economic profiling, line graphs were constructed (an example of development axis 3 was given in Fig. 6). In each of them intensity and trend curve are used to better understand the (dis)continuity of the phenomena in a given transect. An example of the presence of both continuity and discontinuity is development axis 3, almost entirely belonging to Euroregion Neisse-Nisa-Nysa in the western part of the study area. The average values of socio-economic indicators (population density, number of completed flats, and proportion of built-up area) show a constant trend and differ only minimally in their close proximity to the border. On the other hand, in the same region but after "crossing" the border, other indicators do change in their intensity (e.g. crude mortality rate, net migration rate, coefficient of ecological stability). Unlike the choropleth maps, socio-economic profiling did not provide examples of sub-regions that can be clearly classified as continuous or vice versa. Socio-economic profiles (Tab. 2) indicate that development axis 6 (contained by Euroregion Silesia) is the most continuous and this corresponds with the results from the visual analysis of choropleth maps. Greater cross-border continuity, as expressed by several constant trends of socio-economic profiles, is shown by development axis 5 (Euroregion Praded). Yet at the same time almost the same number of abrupt types of profile are detected for this axis, and a considerable number of oscillating types are also present. In contrast, development axis 1 (Euroregion Teschinensis) appears to be very discontinuous which is, paradoxically, in contradiction with observations based on choropleth maps. Significant discontinuity can be found in development axis 2 (partly in Euroregion Glacensis) and this is in accordance with previous findings. The remaining axes cannot be distinguished in this fashion since they are quite diverse in terms of profile type.

Cluster analysis permitted a more comprehensive evaluation of the continuity as it is not intuitive (if possible) to evaluate it by looking at individual indicators separately. This analysis created five groups of LAU2 (excluding those with an area less than 30 square kilometres) according to the values of socio-economic indicators – all combined together. Looking at the detailed cluster composition, it was possible to evaluate the significance of some attributes in cluster formation. Some indicators hardly contributed to the dissimilarity of the clusters (e.g. crude birth rate, crude mortality rate, net migration rate or marriage rate), while others were quite important and influenced the classification (e.g. dependency ratio and proportion of agricultural land). The remaining indicators helped to describe individual clusters. Regarding the cluster types, the most cross-border continuous sub-region is located in the east of the study area (Euroregions Teschinensis and Silesia, around development axis 1) with a prevalence of cluster numbers 2 and 3. Cluster number 3 is mainly composed of urban LAU2, thus the values of the socio-economic indicators are similar. In contrast, cluster number 2 mainly contains agricultural units, but in the case of Euroregion Silesia, the cross-border continuity is evident (with some exceptions). Cross-border continuity can also be seen in the western half of the study area. In the western parts of Euroregion Glacensis (development axis 2), LAU2 are mostly members of cluster number 4, which is typically composed of sub-mountainous LAU2 and the presence of several towns increases the importance of urban-related indicators (e.g. population density, built-up area proportion, number of completed flats). Further west, cluster number 5 is dominant in the Euroregion Neisse-Nisa-Nysa (development axis 3), mainly

enclosing the border. This part is typically composed of mountainous LAU2 representing rural villages with well-preserved natural landscapes.

The most spatially discontinuous borderlands are located entirely in Euroregion Praded (central-eastern part of the study area, development axis 5). There is distinct cross-border discontinuity and the border literally separates the region into Czech and Polish parts, where the former is predominantly mountainous in character and the latter is more or less agricultural (except for the town of Nysa). Of course, physical geography does not necessarily imply the formation of certain socio-economic conditions, but the opposite is true in this case. It is necessary to mention that the road infrastructure is insufficient and in combination with the dispersed settlements, it hinders the socio-economic development of the region. Finally, a mixture of cross-border continuity and discontinuity occurs both in the westernmost and easternmost parts of the study area. Additionally, the eastern part of Euroregion Glacensis (development axis 2) appears to be a compound of continuity and discontinuity.

A fusion of development axes and clustering analysis enabled the analysis of cross-border transition in a wider socio-economic and spatial context, in comparison with non-spatial socio-economic profiling. For this purpose, each development axis was supplemented with pie charts, illustrating the composition of cluster types of member LAU2 units (see Fig. 12). Generally, this combination (development axes with clustering analysis) confirms the results of previous analyses. The most continuous development axes tend to be numbers 1 and 6, and, as already mentioned, these are parts of Euroregions Teschinensis and Silesia. The prevalence of LAU2 from cluster number 3 (urban units) can be seen in the case of development axis 1, whereas development axis 6 mainly contains LAU2 from cluster number 2 (agriculture/rural units). Structural similarity, in the sense of the composition of LAU2 cluster membership, can be found in the case of development axes 3 and 5. Nevertheless, development axis 5 is, according to the socio-economic profiling, halfway between cross-border continuity and discontinuity, and with respect to the cluster analysis it represents a typical example of cross-border spatial discontinuity. On one hand, development axis 3 contains the greatest variety of socio-economic profiles, but on the other hand it belongs to one of the more continuous cross-border sub-regions in the study area, according to the cluster analysis (with a prevalence of cluster number 5 around the border). Cluster type 4 is predominant in the LAU2 composition of development axis 2, therefore it corresponds with previous results quite well. The character of Euroregion Glacensis, which is partly cross-border continuous and partly discontinuous, determined the results for development axis 4. Spatially, cluster types 4 and 2 oscillate as we move further from the border, also causing the axis to be difficult to classify.

To summarize the most important findings from all analytical procedures, the following specific points can be mentioned:

- The greatest cross-border spatial continuity of socio-economic indicators is present in the eastern part of the study area (Euroregions Silesia and Teschinensis, around development axis 1). This is in accordance with Tykkyläinen (2009, p. 349), who stated that "...in more industrialised areas there is usually a certain daily crossing of labour over the border", which is exactly the case in this part of the Czech-Polish borderland. In particular, the Euroregion Teschensis, a former unified region sharing a common history, shows "better conditions for mutual interpersonal and business contact than elsewhere..." (Siwek, 2018, p. 169). Moreover, the communication infrastructure (high-speed roads and railways) is much more developed in this region compared to other parts (Jeřábek, Havlíček and Dokoupil, 2018). Having little or no language barrier (Böhm, 2015) also contributes to outstanding relationships on both sides of the border;
- The most discontinuous cross-border region is in the central-eastern part of the study area (Euroregion Praded), where the border acts as a socio-economic barrier of (spatial) continuity. These findings are in

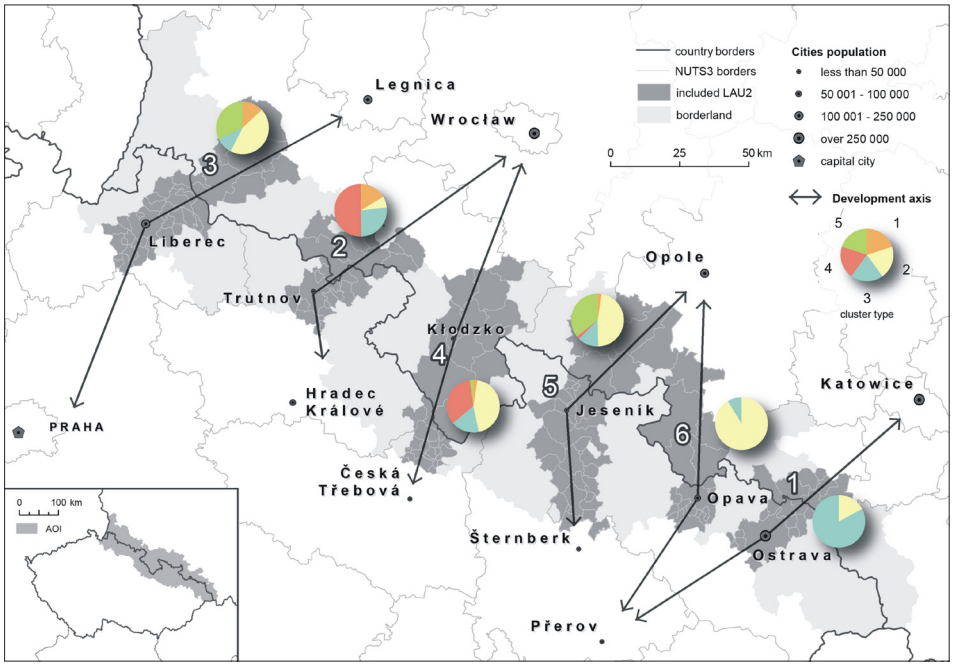

Fig. 12: Proportion of cluster types of LAU2 at the development axes
Source: authors' calculations and visualisation

line with Mintálová and Ptáček (2012), and Kladivo et al. (2012), who also mentioned the structural problems of this region, although it has a high potential for tourism which could even out the differences between the Czech and Polish parts. The non-continuous higher-level road infrastructure also causes discrepancies, especially when considering roads of secondary importance on the Polish side (Jeřábek, Havlíček and Dokoupil, 2018);

- Euroregions Neisse-Nisa-Nysa and Glacensis are examples of mixed cross-border (dis)continuity, depending on the selected indicator, method and distance from the border. As Böhm (2015) states, there is still a significant language barrier in the Euroregion Neisse-Nisa-Nysa and it is a co-operation obstacle, which may contribute to the lack of fully developed cross-border cooperation (albeit this region was amongst the first Euroregions in post-Soviet countries). Thus, these regions are represented by mixed (dis)continuity in socio-economic indicators; and
- Generally, the analyses presented have demonstrated that "... most of the borderlands of the Czech Republic… are considered to have high development potential due to their favourable geographical position combined with low economic performance." (Tykkyläinen, 2009, pp. 350–351), which is still a valid argument today.

From the methodological point of view, the main points to be stressed are:

- Socio-economic profiling provides a detailed view of (dis) continuity based on the values of non-restricted, concrete indicators. A certain level of expert knowledge is needed for interpretation, however, which may imply rather subjective conclusions. Thus, socio-economic profiling should be compared with other (objective) methods;
- Choropleth maps allow one to display smoother transitions of socio-economic indicators across the border, since they use classified scale ranges with broader intervals in contrast to socio-economic profiling;
- Cluster analysis seems to be the most comprehensive method for cross-border spatial continuity detection, as it takes all indicators for all LAU2 into consideration;
- Proximity to the border and the scale of interpretation are crucial for (dis)continuity evaluation. In most cases, some visual/cognitive generalisation is needed; and
- The combination of all outputs and results from the three main analytical steps represents a complex procedure but provides valuable views for the thorough evaluation of cross-border (spatial) continuity using socio-economic indicators.

5. Conclusions

An analysis of cross-border (spatial) continuity of socio-economic indicators was performed in order to determine whether the border sub-regions shared common characteristics expressed by the statistical data. The main aim of cross-border cooperation is to balance the overall quality of life in participating sub-regions. One possible way to evaluate cross-border cooperation is to use "hard" statistical data. The authors of this study used quantitative methods in combination with GIS analysis, cartographic visualisation and socio-economic profiling in order to assess cross-border cooperation. The mutual deployment of these methods appears to be helpful for this purpose and could be applied to any type of borderlands across Europe or even worldwide. Beside the main geographical conclusions, this paper demonstrated a universal procedure of Spatial Data Science, as an umbrella term for quantitative, GIS-based, data-driven and visual analysis.

To summarise the main research objective – whether there is cross-border continuity in socio-economic phenomena (represented by respective indicators) in the Czech-Polish border regions – a thorough analysis and interpretation was performed. According to the results, the answer is both "yes and no", depending on the sub-region, proximity to the border, method used and selected indicator. While mentioning selected indicators, the most important indicator for cross-border continuity evaluation appears to be population density (in all types of presented methods), and this is in line with its wide and general application in geo-demographic studies. To answer other specific research sub-questions, the combination of presented methods adequately captures current state-of-the-art of cross-border continuity, at least from a quantitative point of view. Interpretation itself can be assessed with the notion that the expert is familiar with methods used and is aware of potential limitations of such tools. It is indeed important to invite relevant experts on cross-border topics and also policies that are rather trans-national (or regional in sense of the "shared" borderlands).

In general, the typical areas of cross-border (spatial) continuity, where most of the phenomena are fluently crossing the border, are located in the eastern part of the Czech-Polish borderlands (Euroregions Silesia and Teschinensis, around development axis 1). Geographically next to them, in the central part of the study area, the most discontinuous region is located (Euroregion Praded, development axis 5). Further west, namely Euroregions Glacensis (development axis 4) and Neisse-Nisa-Nysa (development axis 3), their cross-border (spatial) continuity depends on their proximity to the border, method used, and selected indicator analysed individually, and thus they can be treated as mixed types of (spatial) continuity. A future step to understand clearly cross-border continuity can be to realise a qualitative research project in the model areas. Especially at a regional scale, in selected most interesting model areas, further investigation could shed new light on specific cross-border co-operation (as qualitative research could cover all of the borderlands).

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Fig. 7: Wind farm in Nová Ves v horách, district of Most, Czech Republic (Photo: B. Frantál)

*Fig. 8: City of Kladno with wind turbines (Pchery wind farm) and the "national" hill of Ř*íp *in the background (Photo: B. Frantál)*

Illustrations related to the paper by B. Frantál a E. Nováková

Fig. 13: Meadows in the foothills of Králický Sněžník (Photo: K. Macků)

Fig. 14: Sunrise over the Czech-Polish borderland (Photo: K. Macků)

Illustrations related to the paper by V. Pászto et al.