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New Urban Diversity at and after the Economic Downturn: Recent Trajectories of Ethnic Segregation in Central European Cities

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Immigration is one of the most contentious fields of contemporary European urban policy. While the development of urban segregation is well documented in traditional immigration countries with population register data, there is a lack of detailed research on population dynamics in many countries and cities across Europe. This article examines ethnic residential segregation in Czechia in the period after the economic crisis of 2008. Special attention is paid to the trajectories of individual cities and their position in the urban hierarchy. Longitudinal population register data are used and segregation indicators of unevenness and exposure are computed for the largest cities using a detailed spatial grid. The results show a broad picture of decreasing segregation despite the continuously growing number of immigrants in the country. While the economic crisis temporarily halted immigration, the spatial patterns of immigrant dissimilarity did not change and more-established immigration gateway cities experienced an increase in spatial isolation. In the conclusion, the article calls for further discussion on ethnic residential segregation in post-socialist cities.

Keywords: residential segregation, immigration, post-socialist cities, spatial grid, Czechia

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Introduction

Residential segregation by race, ethnicity, class or social group as a potential source of conflict and disadvantage in a society has been among the main interests of urban researchers and policy-makers. As with urban research at large (Robinson 2006), understanding the segregation patterns of ethnic minorities or immigrants has originated in studies of paradigmatic cities located in established destination countries of international migration (see, e.g., Panori, Psycharis and Ballas 2018). According to Nijman (2000: 135), the paradigmatic city is defined as a city that displays more clearly than others the fundamental features and trends of the wider urban system. By contrast, relatively little is known about the nature of ethnic segregation, either across city sizes or in new immigrant destinations, which both often provide new settings in which segregation matters. Smaller cities and new immigrant destinations represent a context for segregation research which is equally as relevant as traditional immigrant destinations. Given the largely labour migration character of many migrant populations, it is relevant here to also discuss the links between economic development and changes in ethnic residential segregation. Labour-intensive manufacturing regions and those struggling with economic restructuring are believed to have higher levels of segregation (Musterd 2005).

Exploring the trends in ethnic residential segregation development across individual cities allows an assessment of the general level and dominant patterns of segregation development. This is a basic yet fundamental task in a new immigration context, where most immigrants are first-generation migrants. The ethnic spatial distribution thus reflects, to some extent, their initial residential choice – as residential mobility in Czechia is generally low and housing opportunities for new migrants are both restricted and spatially limited. More advanced research, focused for example on the role of changing housing needs with respect to the shifting age structure of minority populations, is yet to be developed.

This article explores the trajectories of ethnic segregation in Czech cities in the years following the 2008 economic crisis. This undertaking allows us to inform the segregation literature with findings from a previously unscrutinised context – that of a post-socialist country that has recently become an immigrant destination (King and Okólski 2019) and where the number of foreigners doubled between 2001 and 2011. Specifically, we focus on the following research questions:

- What is the extent of ethnic residential segregation across the differently sized Czech cities?
- How has ethnic residential segregation evolved in the post-crisis period 2008–2011–2015?

These questions are answered using newly available geocoded anonymised data on foreign citizens residing in selected large Czech cities in 2008, 2011 and 2015, extracted from the official country register. To protect their confidentiality, the data were aggregated to a rectangular grid (square size of 250m) covering the territory of the cities. The use of population grid data allows us to directly compare ethnic residential segregation across major Czech cities for the first time. As segregation is a multidimensional phenomenon, we focus here on just two of its dimensions (Reardon and O'Sullivan 2004): evenness – measured by the dissimilarity index – and exposure, measured by the isolation index.

The first part of this article introduces the research into socio-economic and ethnic residential segregation in the Central and Eastern European post-socialist region. The second section contextualises the study on Czechia. The third section presents data sources and the methodology used for our study. The fourth section examines the level of immigrant dissimilarity and isolation in the selected large Czech cities. The fifth part of the article provides a comparison of ethnic residential segregation in Czechia as a post-socialist country and in some more-established immigration countries elsewhere in Europe before, finally, key findings stemming from new immigration into the region are summarised.

Ethnic residential segregation in the Western and post-socialist contexts

Theories of segregation

Residential segregation is a complex, multidimensional phenomenon (Massey and Denton 1988), indicating the preferred or imposed separation of individuals in space and time. In general, it can be understood as the difference in the spatial distribution of the different population groups within a given territory, distinguishing the groups by race, ethnicity, religion, language, wealth, social class or other attributes. The reasoning behind residential segregation measurement is based on an expectation that living in a particular place matters, therefore group differences in places of residence are important mechanisms generating and sustaining inequality (Dorling 2014; Sharkey and Faber 2014). For the purpose of measuring segregation, it can be operationalised along several axes. The recent literature focuses predominantly on the aspects of evenness and of exposure, proposed as key segregation axes by Reardon and O'Sullivan (2004).¹ Evenness is conceptualised as a differential distribution of the subject population, indicating an unequal access to localised resources and infrastructures. Exposure is defined as the composition of people's local environments, measuring the possibility of interaction between groups. The remaining three dimensions of residential segregation focus on concentration, centralisation and clustering.

Ethnic residential segregation is a complex phenomenon, which is illustrated by the number of frameworks explaining the reasons for ethnic segregation to occur and change over time (Krysan and Crowder 2017; Musterd 2020). In general, four main explanations can be identified. First, segregation is thought to be a spatial expression of socio-economic and cultural differences between the minority and the majority population, differences which are expected to decrease over time, as proposed by spatial assimilation theory (Massey 1985). Both the upward socio-economic mobility of a minority and their acculturation through the adoption of the language and customs of the majority population lead to a residential change, where migrants leave their initial poor and migrant-dense neighbourhoods and move to wealthier ones. The assumption of the straight-line assimilation theory was later revised (Portes and Zhou 1993) to include broader and more nuanced insights into various life domains (Waters, Tran, Kasinitz and Mollenkopf 2010; Zhou 1997).

Second, the stratification framework views segregation as the result of housing discrimination, stereotypes and prejudice based on race or ethnicity which, together, create segmented housing markets and neighbourhood strata within urban areas (Chung and Brown 2007). The European segregation literature also stresses the role of public policy and the welfare state in shaping segregation (Arbaci 2007; Asselin, Dureau, Fonseca, Giroud, Hamadi, Kohlbacher, Lindo, Malheiros, Marcadet and Reeger 2006). The eligibility of population groups for housing and social assistance has the potential to prevent the emergence of stratified neighbourhoods. In a similar vein, cross-national research shows that 'grand ideas' (e.g. the models of immigrant integration, the nature of a country's political economy or the tradition of immigration as a constituent part of the nation or not) impact on immigrant integration (Alba and Foner 2014). Since residential segregation represents the spatial aspect of immigrant integration, these factors are equally relevant for ethnic residential segregation (Koopmans 2010).

Third, the approach of resurgent ethnicity (also termed the ethnic community model) explains segregation as originating in individuals' preferences to maintain ethnic community by residing in ethnically homogeneous areas (Alba, Logan, Lutz and Stults 2002; Brown and Chung 2006). This notion challenges perceptions of ethnic neighbourhoods or immigrant enclaves as places of poverty. Instead,

a socially and economically successful ethnic community might provide positive externalities for its residents, such as reported health (Walton 2012).

Finally, a fourth factor – which has seldom been systematically evaluated (some exceptions are Maloutas and Fujita 2012; Skifter Andersen 2019) – is the local context. The term encompasses a number of determinants ranging from local socio-spatial inequalities and history of immigration to urban governance (Skifter Andersen 2019; Hasman and Křížková 2021). One methodologically important factor of the local context for ethnic segregation is the varying population sizes across cities. Smaller population groups naturally have a greater likelihood of being segregated as they can reside in only a few places (Manley, Jones and Johnston 2019).

Context of segregation research

Although the explanatory frameworks of segregation listed above originate in established immigration countries and can be challenged in the post-socialist context, we believe that the underlying mechanisms which the theories identified remain relevant. Given the differences between them and newer immigrant destinations, these approaches need to be adapted for use in other contexts. Crucially, established immigration countries belong to the ‘Western’ world, whereas some of the emerging ones are located in the post-socialist region, which laid on different ideological and material foundations for over 40 years (Malý, Dvořák and Šuška 2020; Stanilov 2007). According to Přidalová and Hasman (2018), important differences between established immigration countries and new destinations in the post-socialist region include the different lengths of the countries’ immigration histories, the composition of their immigrants’ origins and the specificity of the post-socialist geographical context in terms of the urban structure, housing markets and social inequality. For instance, only a small minority of immigrants can be considered as ‘visible minorities’ and a large share of immigrants have an economic status similar to that of the majority population (Křížková and Šimon 2021).

Moreover, residential segregation is likely to be related to different determinants in the capital city and in smaller cities. Capital cities typically concentrate more political, economic and cultural power and are more embedded in global networks than other cities (Cardoso and Meijers 2016; Connolly 2008). Given this privileged position, capital cities receive different types of migrants than do second-tier cities. The largest cities function as escalator regions, attracting young professionals at the expense of second-tier cities (Champion, Coombes and Gordon 2014). Previous research suggests that the attractiveness of capital cities to both international and internal migration and their connectedness to global networks result in more pronounced and polarised spatial patterns than can be observed in second-tier cities (Haase, Steinführer, Kabisch, Grossmann and Hall 2011).

Conversely, small cities and towns feature different settings as they probably provide a smaller diversity of housing, schools and labour choices. Smaller urban areas, notably those dominated by a certain economic sector like manufacturing, can be impacted on by economic developments to a different extent than larger cities with more diversified economic bases. This is particularly relevant for Central and Eastern Europe (CEE), where the pre-2008 economic growth and post-2008 decline were more intense in the capital-city regions than in the remaining areas (Capello, Caragliu, Fratesi 2014; Cuadrado-Roura, Martín, Rodríguez-Pose 2016).

Immigrants are often perceived as vulnerable populations because of their generally lower socio-economic status, restricted political rights and limited command of the destination-country language. Due to their less-advantageous position in a society, they are more likely to be impacted on by economic crises.

Andersson and Hedman (2016) show that an economic downturn increases the inequality between advantaged and disadvantaged populations on the labour market. Moreover, their results corroborate Musterd's (2005) claim that manufacturing regions and those struggling with economic restructuring have greater social segregation. Consequently, the segregation of vulnerable populations is expected to be higher during economic downturns and to decrease with an improvement in the state of the economy. Given that a substantial proportion of the foreign population in Czechia consists of labour migrants and that this population was indeed impacted on by the economic crisis set off in 2008, we analyse their residential segregation from a longitudinal perspective. Although there are surprisingly few studies which address the impacts of economic crises on ethnic segregation with which we can compare our results, we intend to highlight this relationship and to open discussion of its causes and consequences.

Segregation research in post-socialist countries

Analyses of residential segregation have focused on the largest, often capital, cities (Bolt, van Kempen and van Ham 2008; Malheiros 2002; Musterd 2005; Tammaru, Marcińczak, van Ham and Musterd 2015), leaving aside the segregation experiences of smaller urban areas. Socio-economic segregation (which may be related to ethnic segregation in some cases) increased across Europe between 2001 and 2011, reaching similar values in CEE and Western European cities in the later years (Marcińczak *et al.* 2015). Although the issue of the largest or capital cities as opposed to smaller cities was not the main focus of most of these studies, differences in ethnic residential segregation stem not only from city size but also from the cities' locations within Europe. In line with the advocates of the 'ordinary cities' approach, we argue that segregation studies need to overcome their focus on a few paradigmatic cities of the West and their neglect of cities elsewhere. Truly comprehensive segregation research, like urban studies at large, needs to be informed by empirical studies of 'ordinary cities' across city sizes and world regions (Arbaci 2019; Robinson 2006).

Research on urban segregation is relatively limited in post-socialist countries thus far, when contrasted with research in Western countries which relies on population register data. There is a big knowledge gap (in ethnic segregation) between countries with available long-term register data or countries where important variables such as income are available and many CEE countries, where these options are not yet or are just recently available. The geo-coded and linked population data enable us to trace how certain population groups ended up living in particular neighbourhoods, providing an insight into processes producing residential segregation. This insight is further advanced by the decomposition and examination of all underlying demographic processes and social mobility changes, capturing both spatial mobility and *in situ* changes of and within neighbourhoods (Bailey 2012). In contrast, studies based on census data for a relatively large administrative units tend to measure residential segregation as an outcome of the socio-spatial structuring process. Thus, the aggregate outcome resulting from a mixture of (often contradictory) processes at various spatial scales is evaluated. According to a recent review by Kovács (2020), empirical analyses of socio-economic segregation are relatively rare, with a majority of the studies building on area-level census data stymied with analytical limitations (for example: MAUPs – Modifiable Area Unit Problems – Nielsen and Hennerdal 2017; occupational structure classification or educational attainment classification as a proxy for income – Maloutas 2007). Notwithstanding the data issues, research on both capital and second-tier cities has shown that the socio-economic segregation of population groups tends to increase but that historically developed urban structures and low residential mobility prevented full materialisation of this trend (Marcińczak 2012; Marcińczak, Musterd and Stepniak 2012).

Current research on urban segregation has three distinct but interrelated foci with regard to immigration and ethnicity in post-socialist countries, where socio-economic and ethnic segregation are differently related to each other (Musterd, Marcińczak, van Ham and Tammaru 2017). Firstly, the most common are studies of socio-economic segregation, where ethnicity or immigrant status are of secondary importance. As explained by Kovács (2020), due to historical developments, ethnicity played a subordinate role in post-socialist cities. Thus, in contrast to Western Europe or the US, CEE studies measure socio-economic segregation without having race and ethnicity at the core of the analysis. The second and third groups of studies focus primarily on the ethnic dimensions of segregation which intersect to a different degree with socio-economic differences between the majority and the minority populations. The second group of studies focuses on the residential segregation of established minorities. The time dimension is a crucial factor distinguishing old and established minorities from new immigration groups that present a novel integration challenge. This group includes primarily studies conducted in Baltic countries with large Russian minority populations (e.g. Burneika and Ubarevičiene 2016; Krišjāne, Bērziņš and Kratoviš 2016; Tammaru, Kährik, Mägi, Novák and Leetmaa 2016) as well as other established minorities. The third group of studies (including this study) explores a new immigration, where former socio-spatial patterns are disrupted by the in-migration of foreign citizens. For example, new immigration shapes residential segregation in capital cities and more broadly in countries with recent migration growth such as Czechia or Poland (e.g. Jaskulowski and Pawlak 2020; Přidalová and Ouředníček 2017). In sum, progress in solving the contradictions of segregation in post-socialist countries can build both on improving data quality and on an advanced insight into the ethnic, social and economic intersectionality of population register data.

The Czech context of ethnic residential segregation

Ethnic residential segregation has long been on the agenda of researchers of the post-socialist space, although they have mostly focused on national minorities, including the Roma (Křížková and Šimon 2021). Residential segregation research focusing on new immigrants in the region has rarely been conducted because the Central European post-socialist region has long been typical of emigration rather than immigration (Okólski 2012). The migration balance of post-socialist countries is positive only in a few cases, Czechia being the pioneering country (Eröss and Karácsonyi 2014). Thus, research into ethnic residential segregation is only just emerging in the region (Přidalová and Ouředníček 2017; Šimon, Křížková and Klsák 2020), predominantly covering capital cities with rising ethnic diversity and socio-economic polarisation, Kashnitsky and Gunko 2016; Sageata 2014; Toruńczyk-Ruiz 2014). Processes of neighbourhood change capturing both social and spatial mobility and shaping segregation have not been explored in detail nor measured and compared across cities.

Czechia recently became a new immigration country in the post-socialist context, where a vast majority of the country's foreign citizens arrived as labour migrants in the past two decades (Drbohlav and Lesińska 2014). The number of immigrants grew from 210,000 to 460,000 between 2001 and 2015, resulting in a 4.4 per cent share of foreign citizens in the Czech population in 2015. The number of foreign citizens (i.e., immigrants) has been growing despite the economic crisis of 2008 and the tightening of migration policy in the years that followed. The fast recovery of the national economy led to an increasing demand for foreign workers and a further growth in net migration after 2013 (a similar trend was also observed in Poland by Duszczyk and Matuszczyk 2018).

In general, migrants going to Central and Eastern Europe are more similar – in terms of socio-economic status, cultural background and appearance – to the destination-country population than migrants going to old EU states and North America (Ouředníček 2016). The countries in the CEE region lack international colonial history or *Gastarbeiter* ties to distant countries that continue to shape migration patterns and ethnic diversity in established immigration countries to this day.² The mix of migrants therefore differs from that in traditional immigration countries in their cultural distance, language differences and the economic gap between them and the majority population³ as well as in their length of stay. Less-extreme differences between immigrants and host societies thus provide fewer incentives for spatial segregation. For instance, the limited economic distance of the migrant population and the Czech majority results in both groups operating within a unified housing market. In turn, no one group is more eligible for social housing than the other, a mechanism known in some Western European countries (Andersson, Malmberg, Costa, Sleutjes, Stonawski and de Valk 2018).

Most immigrant groups in Czechia originate from regions of Central and Eastern Europe, the former Soviet Union and Vietnam. The largest groups include Ukrainian (105,000 in 2015), Slovak (100,000) and Russian citizens (35,000). The Vietnamese (56,000) constitute a single numerically significant immigrant group from a culturally distant environment. The foreign population is concentrated in urban areas – particularly in large cities with sufficient labour-market opportunities – and in the borderlands (Janská, Čermák and Wright 2014). More than 60 per cent of foreign citizens live in the 14 largest cities (see Table 1). A third of all foreign citizens live in the capital city of Prague, including a major concentration of citizens from Western countries. The remaining 13 second-tier cities comprise a smaller and less diverse set of immigrant groups, roughly proportional to the main immigration groups at the country level. The exception is Karlovy Vary, a spa city with a large Russian minority. Only the more immigrant-dense cities apply immigrant-related policies, which mostly focus on immigrant social integration and on supporting intercultural events; none of the cities targeted immigrants as a specific group in need of support due to economic or housing needs (Šimon *et al.* 2020).

The spatial distribution and level of residential mobility in Czechia differ between immigrant groups (Přidalová and Hasman 2018). For example, immigrants from Ukraine tend to concentrate in large cities due to their occupational specialisation in manufacturing and housing construction. In contrast, immigrants from Vietnam are more evenly dispersed all over the country due to their largely retail occupations (Janská, Čermák and Wright 2014). Moreover, recent internal and external developments may lead to changes in immigrant spatial behaviour in Czechia. The gradually increasing share of permanent stay permit-holders among immigrants suggests that they tend to settle in the country (see e.g. Drbohlav 2015). Family growth may increase local immigrant isolation, as shown in more-established immigration countries (Finney and Simpson 2009). Another important factor influencing immigrant spatial patterns is the global economic crisis of 2008 and the subsequent changes in the Czech migration policy. Although the global economic downturn did not affect the Czech economy greatly, foreign workers were impacted on to a considerable extent. Shortly after the crisis burst, many lost their jobs, which made their subsequent stays illegal; others left the country. Furthermore, issuing new residence permits for a foreign workforce was halted and their stays were more closely monitored (Ministry of the Interior of the Czech Republic 2009).

A considerable effort has been made to understand the spatial distribution and mobility of immigrants in Czechia (Drbohlav and Valenta 2014; Janská and Bernard 2018; Janská *et al.* 2014; Křížková and Ouředníček 2020; Šimon, Křížková and Klsák 2021). In general, immigrants are more concentrated in cities than the majority population, which is consistent with the predominantly working-age structure of the immigrant population. Although most Czech cities experienced a minor population decrease due

to suburbanisation, their population and economic development are relatively stable, partially thanks to population replacement by immigrants.

Table 1. Foreign citizens in Czech cities in 2015

City	Total population	Number of grid squares	Foreign population			
			Total	As % of city population	% of permanent residents	% of change in foreign citizens 2008–2015
Praha	1,288,147	8,321	168,852	13.1	52.2	25.3
Brno	400,977	3,978	24,570	6.1	50.0	36.6
Ostrava	301,503	3,666	9,845	3.3	58.3	0.1
Plzeň	171,526	2,378	13,025	7.6	51.5	9.0
Liberec	105,896	1,877	6,518	6.2	58.9	-0.3
Olomouc	102,392	1,865	3,547	3.5	50.2	15.5
Ústí nad Labem	96,170	1,729	4,185	4.4	66.2	-4.6
České Budějovice	95,377	1,022	3,819	4.0	57.9	35.3
Hradec Králové	94,071	1,851	3,572	3.8	57.2	-2.1
Pardubice	90,160	1,527	4,532	5.0	41.1	65.4
Zlín	76,607	1,847	1,785	2.3	59.7	16.4
Kladno	70,022	928	3,833	5.5	64.0	35.3
Karlovy Vary	51,025	1,085	5,647	11.1	65.3	18.3
Jihlava	51,003	1,588	1,731	3.4	62.4	16.6

Source: Ministry of the Interior (2017); Czech Statistical Office (2017), own elaboration.

However, existing research on ethnic residential segregation suffers from two major shortcomings: the reliance on census data and the use of administrative units for spatial analysis. Firstly, due to the previous unavailability of register-based data, knowledge on residential segregation was limited to census snapshots (see Ouředníček, Pospíšilová, Špačková, Kopecká and Novák 2016; Sýkora 2009) thus preventing researchers from grasping the dynamics of the residential change in between censuses. Census data on the spatial distribution of immigrants in neighbourhoods tell us a little about which individual-level processes are at play; however, we only capture their aggregated outcome. For example, an increase in the differences – between two consecutive censuses – between urban neighbourhoods in the level of education tends to be interpreted as a sign of socio-economic polarisation. However, without the ability to decompose internal and external underlying demographic changes occurring in the ten-year period (Bailey 2020) we are unable to identify which micro-level processes are responsible for this change (social and spatial mobility, physical and functional characteristics of a neighbourhood, within-neighbourhood changes). Other researchers opted for survey-based research (Drbohlav and Džúrová 2017) and for case studies of particular localities or focused on particular immigrant groups (Šnajdr and Drbohlav 2016) instead.

Secondly, the use of data available for administrative units such as municipalities or city boroughs in quantitative research limited the level of spatial detail for the analysis of residential segregation. Previously, there were no detailed data about the internal differentiation of immigrants for Czech cities (except Prague) and only total numbers of foreign citizens in each city were available. Moreover, the

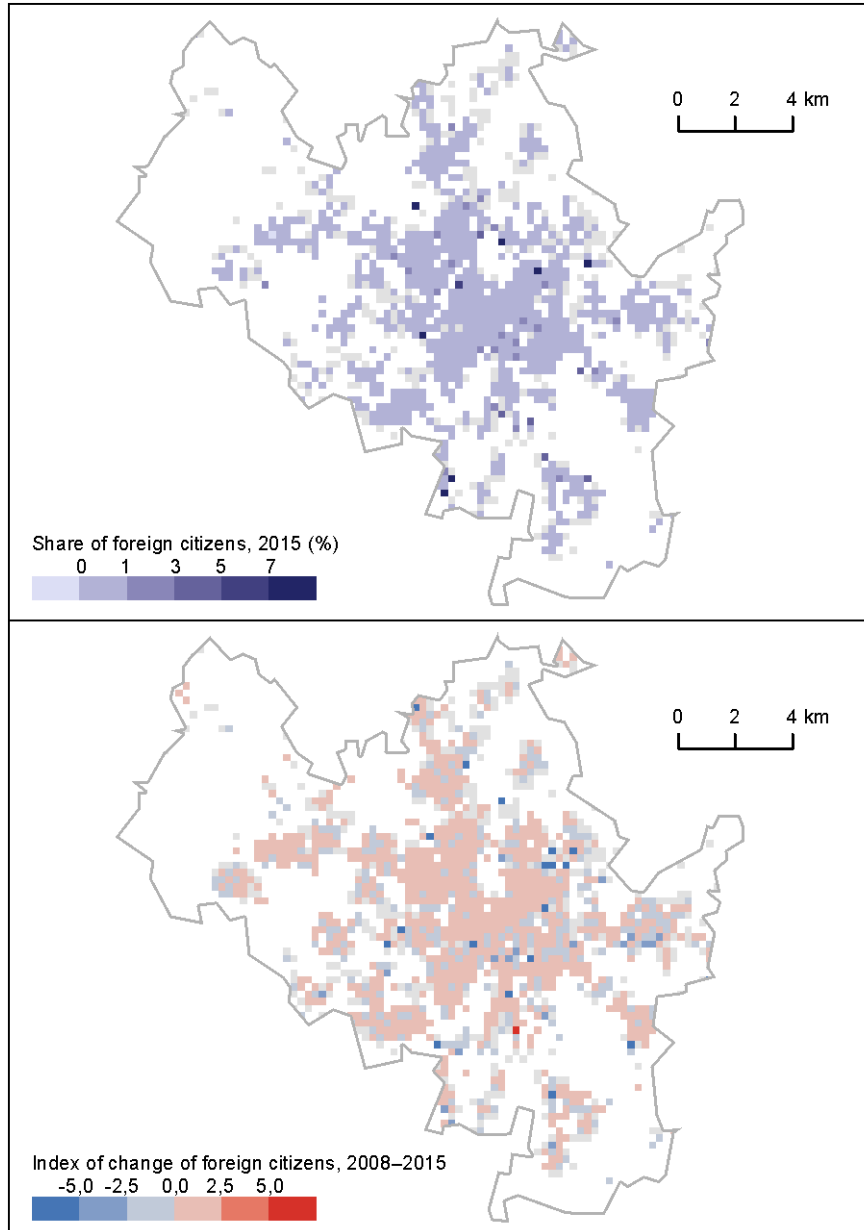
differences in the size and shape of spatial units influences the value of segregation indices (Wong, Lasus and Falk 1999) and limits the comparative research of segregation. For these reasons, patterns and trajectories of the segregation of new immigrants and their differences between cities in Czechia remain a gap to be filled. The overall descriptive analysis at city level needs to be supplemented by studies of the social and spatial mobility processes creating neighbourhood change, which are enabled by register data and further complemented by the qualitative research of segregation mechanisms. City-level analysis – including this study which combines three measures to explore segregation development across cities and a previous study by Šimon, Křížková and Klsák (2020) using one segregation metric to explore group differences and the scale effects of segregation – are initial steps in that direction.

Data and methods

The current study introduces a new data source enabling the longitudinal analysis of ethnic residential segregation in Czechia. The database provided by the Foreign Police of the Czech Republic contains geocoded information on all foreign citizens with registered residence⁴ in Czechia between 2008 and 2015. The data on the Czech population are based on the official housing registry of the Czech Statistical Office, where information about the number of foreign citizens is subtracted from the total population to obtain the number of Czech citizens. The anonymised population data were aggregated to grid squares covering the whole territory of the 14 cities analysed here (see Figure 1). The median value of the population in a grid cell ranges from 28 to 108 (the average population from 104 to 289) for the cities. The grid square size of 250m ensures the anonymity of residents while improving the validity of the segregation measurement considerably.

Moreover, the use of grid data reduces discrepancies stemming from the use of pre-determined administrative units that often involve a great variability in the number and size of units (the Modifiable Area Unit Problem – MAUP), which has been a major obstacle in comparing the results of segregation studies across regions and countries (Andersson *et al.* 2018; Openshaw 1984).

To measure the two key dimensions of residential segregation (Massey and Denton 1988), we employ two widely used indexes recommended by Reardon and O'Sullivan (2004): the index of isolation as a measure of exposure and the index of dissimilarity as an indicator of spatial evenness between the minority group (foreign citizens registered to reside in the selected Czech cities) and the majority population (Czech citizens).⁵

Figure 1. Population grid for segregation measurement – example of Brno

Note: This figure serves as an illustration of the spatial grid used in our segregation analyses. The grid square size is 250m.

Source: Ministry of the Interior (2017), own elaboration.

The dissimilarity index measures differences in the relative group presence for the two groups and shows how different the share of the minority population in each neighbourhood is from the share of the minority population in the whole city. The outcome of such a measurement is an aggregate-level description of the unevenness of distribution. Strictly speaking, the index indicates possible consequences stemming from the unevenness of distribution but it neither reports on processes of segregation nor informs on changes at the individual or household levels. The index of dissimilarity (D) is computed according to the formula (1), where e_i denotes the size of the minority population living in neighbourhood i , ne_i denotes the size of the majority population living there, E denotes the total size of the minority population and NE the total size of the majority population in the city.

(1)

$$D = 100 * \frac{1}{2} * \sum_{i=1}^N \left| \frac{e_i}{E} - \frac{ne_i}{NE} \right|$$

The isolation index measures the probability of interaction with a member of a different group – i.e., how likely a minority group member is to interact with the majority if interaction between groups reflects only their neighbourhood presence. The isolation index is dependent both on spatial distribution and on the proportions of the minority and the majority. The lowest values of the isolation index occur when both groups are of equal size and are evenly distributed in neighbourhoods. Contrary to this, the highest values of the isolation index occur when the minority group is small and only located in one neighbourhood. The index of isolation (P) is computed according to the formula (2), where e_i denotes the size of the minority population living in neighbourhood i , E denotes the size of the minority population in the city and f_i the total size of the population of neighbourhood i .

(2)

$$P = 100 * \sum_{i=1}^N \left(\frac{e_i}{E} * \frac{e_i}{f_i} \right)$$

Therefore, exposure (measured by the isolation index) can be interpreted as the extent to which individuals are exposed to members of their own group, whilst evenness (measured by the dissimilarity index) can be understood as the proportion of minority members who would have to move to achieve an even distribution. The two measures tend to be highly correlated but, in extreme cases, the isolation index can be high in an area with low levels of segregation as measured by the dissimilarity index and *vice versa*. Given the indices' calculation, the isolation index is more sensitive to group size than the dissimilarity index (Hess 2020)⁶. We therefore refrain from assessing the segregation of ethnic subgroups, although we acknowledge the different spatial behaviour of immigrants coming from different regions that was observed in other studies (Šimon, Křížková and Klsák 2020).

The trajectories of residential segregation are measured for the period from 2008 to 2015, which is further broken down into two shorter periods that had specific impacts on immigration to the country: the crisis (2008–2011) and post-crisis regrowth (2011–2015, see Křížková and Ouředníček (2020) for a similar delimitation). The trajectories are captured by the change in indices of dissimilarity (D) and of isolation (P) for each city. The analysed set of cities includes Prague – the Czech capital – and 13 regional cities, the largest one in each self-governed administrative district of the country. The cities were delimited using their administrative boundaries. Thus, suburban municipalities beyond the city borders were not considered.

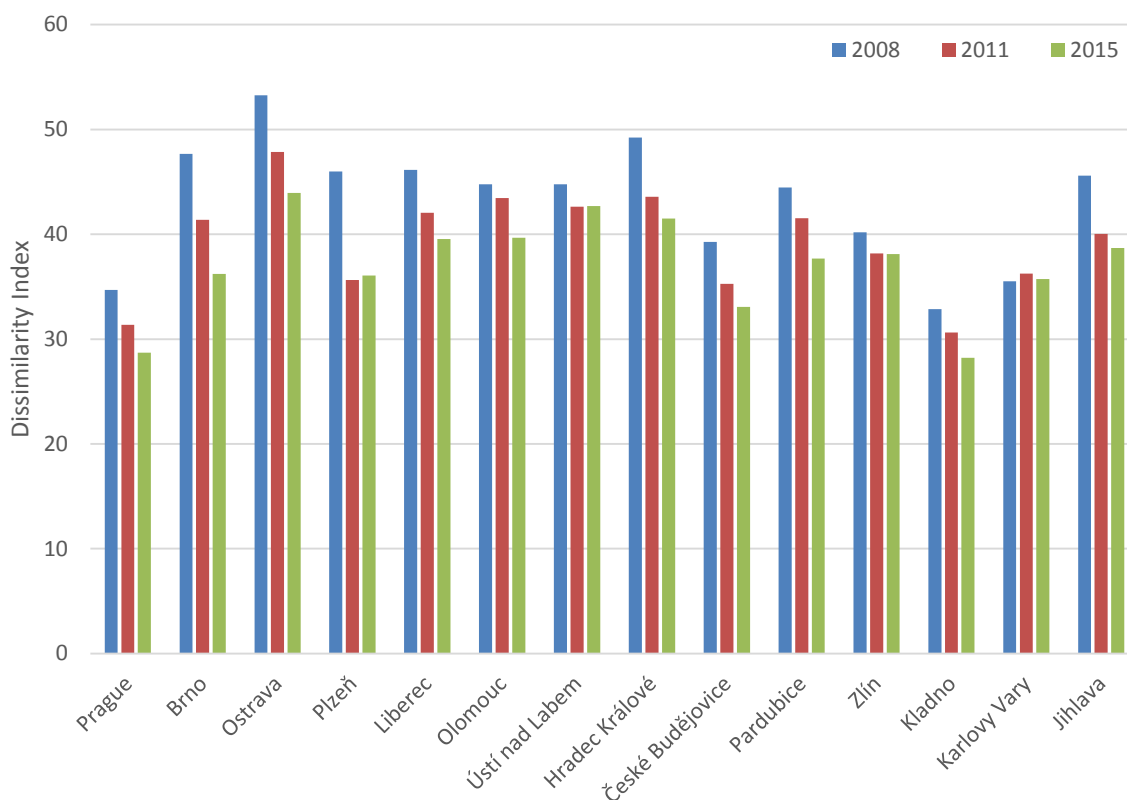
Results

Index of dissimilarity

First, we analysed the overall level of spatial dissimilarity between the minority (immigrants) and the majority population. Figure 2 shows that the level of dissimilarity is considerably lower in the capital city of Prague and in Kladno, which is a part of the larger Prague metropolitan area, as opposed to the other large cities. The dissimilarity-index values indicate that, in Prague and Kladno, around 30 per cent

of the population would have to move in order to achieve an equal spatial distribution, whilst this percentage is on average between 35 and 53 in the other large Czech cities.

Figure 2. Dissimilarity Index for all immigrants in Czech cities in 2008, 2011 and 2015



Note: Cities are sorted according to population size from largest (left) to smallest (right).

Source: Ministry of the Interior (2017), own elaboration.

Second, we looked at the dynamics of immigrant dissimilarity from 2008 to 2015. The main finding here is that the dissimilarity index decreased between 2008 and 2015 across the selected large Czech cities. The only exception from this trend is Karlovy Vary, a spa city with a long history of internationalisation and a large share of the immigrant population. The development of Russian minority in Karlovy Vary could have been influenced by the Russian aggression in Ukraine in 2014 (Klsák 2020).

The intensity of the decline in segregation differs considerably, nevertheless, between cities. The larger second-tier cities such as Brno, Plzeň and Ostrava experienced a faster pace of desegregation than was observed in Prague (Figure 2). Conversely, desegregation was much slower in smaller second-tier cities. For example, a slower pace of desegregation was observed in Ústí nad Labem and in Zlín, cities peripheral in both the economic and the geographical sense. These findings suggest that cities closest to the top of the urban hierarchy adopt the trends occurring in the capital city more rapidly than the peripheral ones.

Importantly, the level of segregation decreased more rapidly in the economic crisis period of 2008–2011 – when volumes of immigration to Czechia were smaller – and decreased more slowly in the period 2011–2015, when economy recovered and immigration started to intensify again (Kurkin, Němečková and Štyglerová 2020). Thus, the changes in the dissimilarity index as a measure of the unevenness of spatial distribution cannot be attributed only to growing numbers of immigrants (Table 1) but also to actual residential changes.

Since the values of the dissimilarity index can be biased if the share of a minority group is small (Voas and Williamson 2000), we also measured spatial evenness by an alternative indicator – the entropy index. The results, however, are generally consistent with our results for the dissimilarity index. We therefore only present the details on the calculation of the entropy index and its empirical results for the selected Czech cities in Appendix 1.

Index of isolation

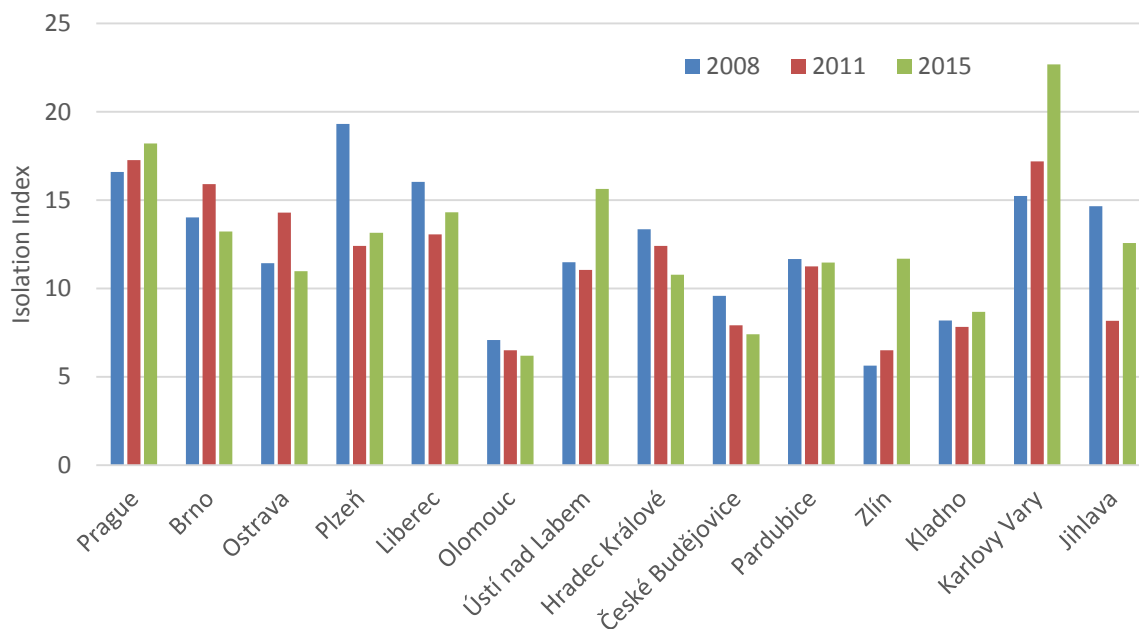
Contrary to the relative uniformity in the values and development of the dissimilarity index, there was greater variability in the spatial isolation of immigrants in large Czech cities in 2008–2015 (Figure 2). The average exposure of foreign citizens to other foreigners ranged between 6.6 and 18.4 per cent. The highest values were observed in Prague and Karlovy Vary, cities which also feature the highest proportion of foreigners in the population. Although the isolation index and the proportion of foreigners in the population are quite strongly correlated (Pearson $R^2 = 0.8$), the isolation-index values were also rather high in certain cities (e.g. Ostrava, Jihlava) with relatively few immigrants in the population.

The development of the isolation index between 2008 and 2015 was also far from uniform. While foreign citizens became more exposed to other immigrants in some cities over time than they were at the onset of the economic crisis, they became less so elsewhere. Regardless of the magnitude of change, most (nine) cities witnessed a decrease in the isolation index from 2008 to 2015 as opposed to five others where the isolation index increased. However, the change in many cities was almost negligible. A more substantial change – by more than 10 per cent – was recorded in just eight cities: three where the isolation index increased and five where it decreased. A substantial increase was observed in three cities (Zlín, Karlovy Vary and Ústí nad Labem), which differ in size, the proportion of immigrants in the city population as well as in the percentage change of growth in the immigrant population between 2008 and 2015. Similarly, the set of five cities where the isolation index decreased quite considerably (Plzeň, České Budějovice, Hradec Králové, Jihlava, Olomouc) is very diverse in terms of their immigrant share and growth and in city size.

Furthermore, the developmental trend is without a clear tendency to increase or decrease in the two partial periods – the immediate years following the crisis (2008–2011) as well as the period of new growth (2011–2015). Figure 3 indicates that the isolation-index values changed considerably across the periods and cities with a variable immigrant structure and dynamics. However, the values and dynamics of the isolation index allow us to delimit three groups of large Czech cities with specific characteristics. First, the main immigrant gateway cities of Prague and Karlovy Vary constantly show high isolation-index values and a growing immigrant isolation throughout 2008–2011–2015. The second group, consisting of Olomouc, České Budějovice, Zlín and Kladno, scores the lowest isolation-index values and shows its decrease in the crisis period, followed by an increase in the regrowth period. However, the general trend in isolation-index change from 2008 to 2015 in this group was an increase in immigrant isolation (though this is probably driven by the substantial increase in Zlín, as the values for Olomouc and České Budějovice declined). The remaining eight cities form a third cluster with moderate isolation-index values

and a trend to decrease in 2008–2011 followed by an increase in 2011–2015. Nevertheless, the overall tendency in this group was towards a decrease in the isolation index between 2008 and 2015.

Figure 3. Isolation Index for all immigrants in Czech cities in 2008, 2011 and 2015



Note: Cities are sorted according to population size from largest (left) to smallest (right).

Source: Ministry of the Interior (2017), own elaboration.

While the levels of immigrant isolation seem to relate to the overall proportion of immigrants in the local population, the differentiated dynamics in city groups can partly be explained by the extent of support which each city offers to immigrants. While the first cluster mentioned above witnessed a growing number of immigrants, including those with temporary residence permits, in 2008–2011 the second group was mostly typical, with a decline in temporarily resident immigrants. Although some immigrants with temporary residence permits left the country, some could have moved from foreigner-sparse cities to immigrant gateways with a more-resilient labour market. In the latter, they were more likely to find the support of fellow immigrants and a greater choice of work opportunities (Horáková 2010), infrastructure and services like immigrant counselling. This flow could have contributed to an increased isolation in both groups of cities. In immigrant-scarce cities, the minority population declined, increasing the likelihood of them being segregated, as a small population can naturally only reside in a limited number of places. In the migration gateways, the newcomers could have joined the pre-existing immigrant clusters, thus increasing their exposure to their fellow immigrants. The continued growth in the isolation index in the main immigrant gateway cities might be due to the time lag whereby migrants react to the economic conditions with some delay.

Discussion: the nature of segregation in CEE compared to Western European cities

Hoping to provide the first study of systematic quantitative research into the ethnic residential segregation of new minorities (immigrants) using register data in Central and Eastern Europe, this article

enables the comparison of segregation in Czechia as a CEE case with segregation in immigrant-destination countries in Europe. Although the overall trend towards desegregation across the Czech urban context appears robust, its interpretation must remain both cautious and preliminary. First, the early stage of the immigration process allows only a limited interpretation of the data. Current ethnic spatial patterns reflect, to some extent, the initial residential choice of immigrants and its change is limited in the Czech super-housing-ownership society with a limited renting sector (Stephens, Lux and Sunega 2015). Initial residential choices are probably informed by a different set of heuristics and economic resources than subsequent residential mobility. Thus, patterns of segregation are not fully crystallised as yet. Second, the city-level measurement using segregation indices is a-spatial – based on aggregated indices – and thus limits our insight into the individual-level processes of social mobility and residential attainment. Such process-focused studies aimed at assessing the exact mechanism of segregation have not yet been conducted (Šimon *et al.* 2020). Third, urban diversity and multiculturalism are not foundational cornerstones of policy narratives and frameworks in Czech cities (cf. Raco and Kesten 2018; Raco and Tasan-Kok 2019). Instead, the lack of a social-housing law and the crisis of housing availability dominate the policy discourse in Czechia. The housing policy of cities is focused on the socially excluded Czech population and immigrants are usually not eligible for municipal housing. Thus, the places of poverty of the majority population and of immigrants do not necessarily overlap.

The results of our study show that the evenness in the immigrant spatial distribution in Czech cities resembles closely that in other European cities. The dissimilarity-index values observed in large Czech cities ranged between 30 and 50 per cent, similar to the values calculated for Italian and Spanish cities by Benassi, Iglesias-Pascual and Salvati (2020) and slightly lower than in some Western European, e.g. British, cities (Benassi, Corrado, Frank, Fabio 2020). Despite the structural differences between CEE and Western Europe, ethnic residential segregation seems to unfold in similar ways in both regions. Segregation levels, notably that of dissimilarity, for the immigrant population are similar, as are their predominant dynamics towards desegregation. Thus, development in time towards desegregation in Czech cities, expected by spatial assimilation theory, seems to be more relevant in this study than factors explaining the persistence of immigrant clusters and the diverse dynamics of segregation like ethnic preference or public policies. Although spatial assimilation theory is currently an apt theoretical framework for explaining the general desegregation trend in Czech cities, stratification frameworks and individual preferences apply simultaneously in shaping the segregation outcome in the local context.

Furthermore, the differences in ethnic segregation between city sizes seem to be in line with previous studies. The index of dissimilarity tends to be lower in the largest metropolitan areas as opposed to the smaller urban areas, which is the case in most of the Western European countries analysed by Benassi *et al.* (2020). In Belgium and Sweden, the index of isolation tends to be greatest in the largest capital cities (Imeraj, Willaert and de Valk 2018; Östh, Clark and Malmberg 2015). We argue, however, that this result is highly dependent on the proportion of the minority population examined and its position on the labour market. Group size plays an important role in the resulting values of the isolation index (Hess 2020; Lan, Kandt and Longley 2020). The share of immigrants in Czech cities is proportional to the attractiveness of a particular metropolitan labour market, with Prague having the highest number and largest share of immigrants.

The dynamics of ethnic segregation following a crisis period were examined in several countries. A decrease in the dissimilarity index was identified across selected immigrant gateways of England and Wales between 2008 and 2015 for most ethnic groups (Lan *et al.* 2020). In the Amsterdam metropolitan region, a moderate drop in the dissimilarity index was observed in the 2009–2014 period for non-European migrants (Sleutjes, Ooijevaar and de Valk 2019). This article shows a decrease in segregation in

Czech cities after 2008. This suggests that an economic downturn does not have to be associated with an increase in immigrant unevenness. However, our results indicate that the picture is less clear in the case of immigrant isolation, the dynamics of which were more diverse and perhaps indeed related to current economic conditions. This tentative statement, however, needs to be supported by further analyses that control for the different sizes of immigrant groups within cities. One explanation for the opposite result can be the variegated behaviour of the individual minority groups in Czechia. Some migrants, arguably the most vulnerable ones who lost their jobs and lacked kin and community support, left the country, which contributed to a decrease in spatial inequality between the minority and the majority. Those who found support from family and the immigrant community could have temporarily increased their spatial isolation by joining other fellow immigrants in the main gateway cities.

This Czech study represents a case from CEE; however, it is questionable whether its findings are typical for this region. First, because Czechia is one of the main immigration countries in the region and is likely to feature greater proportions of immigrants in urban populations than cities elsewhere in CEE. Population stagnation and restrictive immigration policies typical of many CEE countries prioritise processes of urban change that do not include a strong immigration dimension. Secondly, previous research has shown that the post-socialist urban transition can result in highly heterogeneous patterns of local transformation, even within countries with a shared history (Malý *et al.* 2020). The cities in the CEE region share a common socialist past but faced rather variable challenges and fortunes shaping its social structure, built environment and governance in recent multiple transformations. Thus, the results presented here should not be generalised uncritically to the whole CEE region but are intended to open up a debate on ethnic segregation and its causes and consequences there.

The approach used in this article has methodological caveats that may have impacted on the comparison between countries and cities to some extent. Firstly, individual grid squares do not respect natural boundaries such as areas divided by rivers. Grid squares are as arbitrary as administrative boundaries and their use does not allow the avoidance of MAUP entirely. However, our robustness tests yield similar results when using differently sized grids, therefore they should not be biased by the geography used here. Secondly, using grid squares of equal area across the selected cities results in different numbers of grid squares in each city (Table 1) and in different numbers of the total population in each grid square. This should not harm our results either, as we use indicators that consider population proportions rather than absolute numbers. Thirdly, we acknowledge that using alternative units of segregation measurement such as individualised neighbourhoods would be more precise. Yet our more detailed analyses using different units are consistent with the results presented in this exploratory study.

The interpretation of residential segregation measurement is context-dependent in multiple ways, although the practice can use the same methods and same units of analysis in different contexts. First, the measurement and categories of analysis are context-dependent. For example, the risk of MAUP is more likely to matter in conditions of extreme segregation, where there are sharp block or neighbourhood boundaries, such as in US cities. In contrast, there are no sharp ethnic boundaries between neighbourhoods or city blocks with a predominantly ethnic population in Czech cities, where no legacy of racial zoning is present. Conversely, issues of group-size effects are more likely to matter in the CEE context, where new minorities are still relatively few in comparison to those in traditional immigration countries. Secondly, the social role of residential segregation in a neighbourhood and in a society is context-dependent. Institutional settings, the presence of public infrastructures, the perceived valuation of space and other localised factors shape the outcome of residential segregation and its impact (or a lack thereof) on everyday lives.

Concluding remarks

To bring evidence on ethnic segregation beyond the traditional research areas – i.e. the largest cities in established immigration countries – this article has explored residential segregation in the Czech urban context in the years following the economic crisis of 2008. Building on newly available register data and measures of segregation using a detailed spatial grid, this article contributes to the literature on the impacts of an economic downturn on migrant populations. While the impact on individuals and countries was highly debated – see e.g. Beets and Willekens (2009), Leontiyeva (2014) and Tilly (2011) – the literature on the consequences of economic crises for the spatial distribution of immigrant populations is surprisingly scarce.

Our first research question focused on ethnic residential segregation across Czech cities. According to our analysis, the proximity of the main metropolitan region seemed to be key distinguishing feature in the level of segregation, rather than city size. While spatial dissimilarity was the lowest in Prague, it was similar in a relatively small city that lies in its metropolitan region (Kladno) and higher in the largest second-tier cities. Furthermore, spatial isolation does not relate directly to city size but more to the proportion of immigrants there. Cities of varying sizes – e.g. Prague and Karlovy Vary – show similar levels of ethnic residential segregation. These findings highlight the importance of comparative analysis as suggested by the ordinary-cities approach (Robinson 2006).

Our second research question focused on segregation dynamics in the period 2008–2015. Interestingly, the segregation indicators of unevenness and exposure we used yielded complex patterns of population change with a decreasing trend towards spatial dissimilarity and isolation. Contrary to the expectations derived from the literature, we did not observe a general trend towards growing segregation at times of economic crisis. Immigrants as a vulnerable population are expected to be the most impacted on by an economic downturn (Andersson and Hedman 2016), which is believed to decrease their socio-economic status and, in turn, change their spatial distribution.

Although not without its limitations, this article hopes to serve as a springboard for further studies on ethnic residential segregation in Czechia and in Central and Eastern Europe. Such an undertaking would permit the enrichment of both urban and migration studies by evidence from a region which is gaining importance on the map of international migration.

Notes

¹ Other dimensions of segregation proposed by Massey and Denton (1988) include concentration, centralisation and clustering. The two former dimensions are not assessed in this paper due to space limitations; the latter – clustering – is understood here, in line with Reardon and O'Sullivan (2004), to be the opposite of evenness.

² In the Czech case, an exception to this is the Vietnamese, whose migration originated in the bilateral agreements between the-then socialist countries in the 1950s (Martínková 2011). The connection between the countries, established earlier, serves as a springboard for further migrations in the present day. Contrary to this, migration from other countries that exchanged workers and students with Czechia during socialism decreased to a negligible level.

³ The circularity of migration, a high labour activity and strategies of saving allow some minority groups in Czechia to keep substantial proportions of their earnings, producing a quite small economic distance between them and the majority population (Křížková and Šimon 2021; Janská, Pauknerová and Koropecová 2017).

⁴ Unregistered foreign citizens such as citizens of EU countries who decide not to register, short-term migrants from third countries staying in the country for less than 90 days and undocumented migrants are not considered. The citizens of EU countries are obliged to report to the Czech authorities if their stay in the country is to exceed 30 days. Unless wishing to apply for a permanent residence permit, they are not liable to register for residence in Czechia. Only persons with either a temporary or a permanent residence permit are included in the database. This data source differs from that used in studies of other countries, which use data on race or country of birth to measure ethnic segregation.

⁵ Fossett (2017) provides a comprehensive review of segregation measurement with a broad range of computational options. Notwithstanding the debate on the advantages and disadvantages of the indices, the measurement of urban segregation is far more complex, involving topics like identity group classification, MAUP and activity space, the framing of inequality and segregation discourse, the historical legacy and current power relations, links between group differences and individual-level attainment and several others (Ellen and Steil 2019; Krysan and Crowder 2017; Lloyd, Shuttleworth and Wong 2014; Musterd 2020).

⁶ The computation of the adjusted index of isolation, which introduces a simple adjustment based on a minority proportion at city level (as in Johnston, Poulsen and Forrest 2005) provided highly similar results to the unadjusted version of the isolation index. Due to this high consistency, only an unadjusted index of isolation is presented here.

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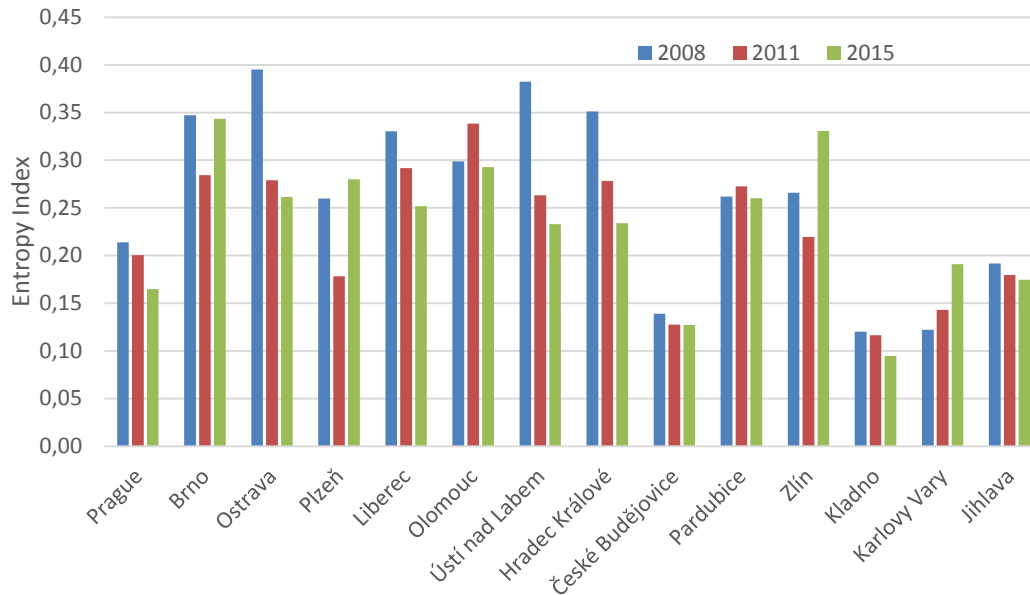
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Appendix 1

Figure 4. Entropy index for all immigrants in Czech cities in 2008, 2011 and 2015



Note: Cities are ranked according to population size from largest (left) to smallest (right).

Source: Ministry of the Interior 2017, own elaboration.

The entropy index h for a neighbourhood is:

$$h_i = - \sum_{j=1} p_{ij} * \ln(p_{ij})$$

Where p_{ij} is a proportion of the population of j^{th} ethnicity in neighbourhood i ($=n_{ij}/n_i$); n_{ij} is the size of the population of j^{th} ethnicity in neighbourhood i ; and n_i is the total size of the population in neighbourhood i .

The entropy index of a city is then:

$$H = \frac{(\hat{H} - \bar{H})}{\hat{H}}$$

Where \hat{H} is the entropy index for the city as a whole and \bar{H} is the average of the individual neighbourhoods' values of h , weighted by population.

The values of the entropy index of a city (H) range from 0 to 1. Cities with a uniform ethnic distribution have low values of H whereas cities with a less-uniform ethnic distribution have higher values of H .