

# Ethnic and Socioeconomic Segregation in Belgium: A Multiscalar Approach Using Individualised Neighbourhoods

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Published online: 6 April 2018

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**Abstract** Segregation may have profound effects when it is paired with an accumulation of inequalities. This is namely the case when ethnic and socioeconomic segregation overlap. Few studies in Europe have, however, addressed the relationship between ethnic and socioeconomic segregation in a comprehensive manner. This paper first aims at investigating the interrelation between ethnic and socioeconomic segregation in Belgium. Second it looks into the role of scale in the relationship between ethnic and socioeconomic segregation. The analyses are based on the newly available geocoded data from the 2011 Belgian census. These data were used to construct individualised neighbourhoods at nine scales with a nearest-neighbours approach for the urban agglomerations of Brussels, Antwerp, and Liege. Ethnic and socioeconomic indicators calculated for these individualised neighbourhoods were then inputted in independent factor analyses for each agglomeration. The results reveal remarkably similar segregation patterns in the three cities. Our analyses give way for three main conclusions: there is an undeniable process of spatial isolation of deprived migrants in Belgium's inner cities; despite the central location of neighbourhoods with high concentration of migrants and poverty, the scope of isolation is considerably high, both in extension and in population density; and macro/national factors such as housing policies and territorial processes seem to shape the segregation patterns in Belgian cities.

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**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s10680-018-9480-6>) contains supplementary material, which is available to authorized users.

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**Keywords** Individualised neighbourhoods · Belgium · Residential segregation · Census · Scale

## 1 Introduction

Residential segregation is a persistent reality in European cities (Bolt 2009; Cassiers and Kesteloot 2012). Different segments of the population often live in separate neighbourhoods, according to their migration background or socioeconomic status. Segregation may have profound effects when it is paired with accumulation of inequalities. This is the case if ethnic and socioeconomic segregation overlap: when ethnic minorities or migrants are clustered in disadvantaged neighbourhoods and experience deprivation. These situations not only endanger social cohesion in cities (Cassiers and Kesteloot 2012), but also hinder individuals' chances in terms of employment (Andersson 2004; Dujardin et al. 2008), educational attainment (Andersson and Malmberg 2015; Crane 1991), and civic participation (Murie and Musterd 2004; Kühn 2015). The potential outcome is a self-perpetuating process of ethnic, socioeconomic, and spatial exclusion from which it is difficult to escape (Andersen 2002; Phillips 2007).

Few studies in Europe have addressed the interaction between ethnic and socioeconomic segregation in a comprehensive manner (Arbaci 2007; Tammaru et al. 2015a). Moreover, the vast majority of the existing work has examined segregation based on predefined areal units such as census tracts and statistical wards. Because these usually differ in size, function, and distribution, accurate analyses of segregation with these units are hard to make (Reardon and O'Sullivan 2004; Wong 2004). The use of areal units may also conceal processes that operate at different scales, from individuals' immediate surroundings until larger urban areas (Andersson and Musterd 2010; Östh et al. 2015).

In this paper we investigate the overlap of ethnic and socioeconomic segregation in Belgium. This is the first work in Belgium to use the new geocoded individual data from the 2011 Census. These data allow us to study segregation patterns based on geographic coordinates instead of areal units, and to adopt a multiscale perspective. With these innovative data and approach, we address two main questions: (i) how do ethnic and socioeconomic segregation overlap in Belgium's largest cities; and (ii) how does the scale of segregation influence the relationship between ethnic and socioeconomic segregation.

We focus on Belgium's three largest urban agglomerations: Brussels, Antwerp, and Liege. Although the ethnic and socioeconomic configuration of Brussels has been broached in a number of studies (Corijn and Vloeberghs 2013; De Winter and Musterd 1998; Kesteloot and Van der Haegen 1997), little is known about segregation patterns in Antwerp (Gsir 2010) and even less about Liege. Each of these cities has its particular historic backgrounds and yet belong to the same macro/national context. Therefore, their comparative study contributes to the understanding of how ethnic and socioeconomic segregation might be linked.

For each city, we employ geocoded data to construct individualised scalable neighbourhoods. These are obtained by defining buffers around each individual's coordinate until they contain a determined number of nearest neighbours: in our case, from the 200 to the 51,200 neighbours. The resulting samples of neighbours are then characterised by their composition in terms of socioeconomic conditions and migration background. Subsequently, the final set of indicators at different scales is inputted into independent factor analyses for each agglomeration.

Even though our purposes are largely descriptive, the innovative data and approach produce a detailed picture of the intricate interactions between ethnic and socioeconomic segregation in Belgium, with an unprecedented level of geographic precision. This richness of detail on the three urban cases provide insights into the potential mechanisms that produce and sustain ethnic and socioeconomic segregation.

## 2 Background

### 2.1 Ethnic and Socioeconomic Segregation in Europe

Previous studies have shown that ethnic and socioeconomic segregation are linked in many European cities: people with a migration background are often more likely to live together in deprived neighbourhoods and in worse off conditions (Arbaci 2007; Tammaru et al. 2015a). The overlap between migration and deprivation can be traced back to long-term economic shifts in Europe. The transition towards a post-industrial economy considerably increased social and spatial inequalities within European cities, especially amongst migrants (Cassiers and Kesteloot 2012; van Kempen 1994). During this period, the cities' role of good production was gradually repurposed for the provision of services (Cassiers and Kesteloot 2012; De Winter and Musterd 1998). Whereas the new service economy required both low- and high-skilled workers, there were fewer opportunities for workers with modest education. As a consequence, the middle-class formerly employed in urban manufacturing jobs bifurcated between a new class of high-paid professionals and low-paid service workers (Massey and Fischer 2000). This led to increasing inequalities and poverty, the segmentation of the housing market, and thus to a rise in residential segregation (Cassiers and Kesteloot 2012; Tammaru et al. 2015b). The consequences in terms of segregation and poverty were harder on migrants. First, these groups were often overrepresented amongst the displaced middle-class that was pushed towards ill-paid jobs and cheaper neighbourhoods. Second, the continuing demand for low-skilled jobs in Western cities kept attracting new migrants, who often established themselves in ethnic deprived neighbourhoods (Arbaci 2007; Logan et al. 2004).

Aside from these long-term processes, empirical studies have identified other mechanisms that produce and sustain segregation of migrants in European cities today, namely discrimination, differential residential preferences amongst migrants, and cumulative neighbourhood disadvantage. Research on the UK for example suggests that, for some migrant groups, discrimination is an obstacle for both

economic and spatial integration. Phillips' study (1998) highlights the difficulties of structural integration of ethnic groups in the housing and labour markets. This is especially the case for Pakistanis and Bangladeshis, who experience considerable isolation both in terms of occupation and of access to better-off neighbourhoods. These results are consistent with findings for London: Peach (1999) shows that ethnic segregation in the city can be partly explained by socioeconomic status, but other forces of exclusion—such as discrimination—are also at play.

Discrimination and ethnic residential preferences both influence segregation in the Netherlands. Boschman and van Ham (2015) investigated the determinants of inter-neighbourhood movements of Surinamese, Antillean, Turkish, and Moroccan migrants. They find that these movements are largely determined by housing market constraints. However, preferences might also have an impact: immigrants are more likely to move to neighbourhoods in which their own group is concentrated, net of other variables. In addition, the authors suggest that Turks and Moroccans might face discrimination in the housing and mortgage markets, as they have narrower choices in neighbourhood location and tend to move to neighbourhoods where other migrant minorities are concentrated.

Another mechanism that may sustain ethnic and socioeconomic segregation concerns cumulative neighbourhood disadvantage. Individuals socialised in a deprived neighbourhood may have lower chances in the future in terms of educational and professional attainment (see Phillips 2007; Sampson et al. 2002). In this process, deprived neighbourhoods become increasingly isolated both socially and economically from the rest of the city (Andersen 2002; Cassiers and Kesteloot 2012). In the cases in which deprived neighbourhoods are also those with high proportions of migrants, socioeconomic and ethnic segregation may result in an accumulation of disadvantage related to the neighbourhood: migrants and their descendants can difficultly escape their neighbourhood and their deprived conditions. Such negative neighbourhood effects have been reported amongst others in Denmark (Andersen 2002), Britain (Harrison and Phillips 2003), Belgium (Dujardin et al. 2008), and Sweden (Andersson and Subramanian 2006; Andersson and Malmberg 2015, 2016).

## 2.2 The Role of Scale in Residential Segregation

The vast majority of quantitative studies on segregation has typically used predefined areal units, such as municipalities, census tracts, and statistical wards. Because these units often differ in size, function and distribution across different regions and over time, their use yields biased measures of segregation—a problem known as the modifiable areal unit problem (MAUP) (Openshaw 1984; Reardon and O'Sullivan 2004; Wong 2004). In addition, fixed areal units may conceal processes related to segregation operating at different scales—both below and above the units' level.

Over the last decades, there has been an increasing awareness of the importance of scale in segregation processes (Andersson and Musterd 2010; Fischer et al. 2004). Reardon et al. (2008) argue that ethnic differential preferences for neighbourhood composition may be more apparent at very local scales, rather than on the larger

urban area. On the other hand, discrimination in the housing market might operate at larger scales, whereas macro-level segregation may affect the access of different groups to economic resources (Reardon et al. 2008). Fowler (2016) suggests that segregation must be seen as a multiscalar process, in which ‘People experience segregation at multiple scales and those experiences, from their home to the regional labour market, operate simultaneously and in concert with one another to impact opportunities’ (Fowler 2016, p. 22). The ways people interact in the city also depend on the scale of segregation: as Clark et al. (2015) observe, the patterns and intensity of contacts amongst people from different groups depend on the composition of their own immediate neighbourhood as well as that of the wider urban area.

The increasing availability of geocoded data—especially in Europe—opens up new possibilities of assessing segregation at different scales using individualised neighbourhoods that are independent of fixed areal units (see Östh et al. 2015). Descriptive studies on ethnic segregation profiles at different scales have demonstrated the complexity of residential segregation, in which isolation of migrant groups coexist with diversity (Clark et al. 2015; Fowler 2016). Concerning the consequences of segregation, multiscale studies in Sweden (Andersson and Malmberg 2015, 2016) have demonstrated that large-scale segregation has stronger effects on individuals’ outcomes such as risk of poverty. However, one may argue that if there is large-scale segregation of certain migrant groups but small-scale deprivation, negative contextual effects may play a lesser role. Scale may therefore be important for better understanding how and in what ways ethnic and socioeconomic segregation interact.

### 2.3 Territorial Processes, Migration, and Segregation in Belgium

From previous research it is known that Belgium’s largest cities have high levels of ethnic and socioeconomic segregation compared to other European countries (Musterd 2005; Musterd and van Kempen 2009), and that ethnic and socioeconomic segregation usually overlap in the inner cities (De Winter and Musterd 1998). These specific patterns stem from long-term territorial processes, especially the housing policies of and migration history to the country.

The promotion of home ownership has always been a cornerstone of the Belgian housing policies (De Decker 2008). Most of the public investment in housing was directed towards tools to enable middle-class families to buy or build their own house—such as cheap loans—and towards infrastructures in the fringes and suburbs of the cities to facilitate urban sprawl—such as commuting facilities to the city centres (Kesteloot and Cortie 1998). At the same time, investment in the public rental sector remained very limited, as attested by the lack of social housing in Belgium (De Decker 2008; Kesteloot and Cortie 1998). Home ownership policies contributed to large-scale suburbanisation, especially during the economic growth after World War II (De Decker 2008). As more and more high-income households left the cities, inner neighbourhoods started to decline (De Decker 2008; Kesteloot and Van der Haegen 1997).

Mass suburbanisation reached its peak in the 1960s fostered by the economic boom (De Decker 2008). During the same period, due to the prosperous economic

situation, Belgium like many other northern European countries started to recruit international migrants to fill in the ill-paid (mostly industrial) jobs (Kesteloot and Van der Haegen 1997; Kesteloot and Cortie 1998; Van Mol and de Valk 2016). The Belgian government arranged bilateral agreements with countries in southern Europe and the Mediterranean, first from Italy and Spain and, in the late 1960s, from Turkey and Morocco. Most of these labour migrants established themselves in the nineteenth century neighbourhoods left behind by the Belgian middle-class and marked by cheap, low quality dwellings of the private rental market (De Winter and Musterd 1998; Kesteloot and Van der Haegen 1997).

The economic crisis of the 1970s led to a halt of the 'guestworkers' agreements in 1974. International immigration continued nonetheless by other means, namely the inflow of European citizens free to work in the country and Turks and Moroccans via family reunion (Martiniello 2003; Van Mol and de Valk 2016). These last two groups continued to cluster in deprived nineteenth century neighbourhoods (Kesteloot and Van der Haegen 1997).

The spatial duality in Belgian cities was reinforced during the economic shifts following the 1970s crisis. As in most industrialised countries, cities' transition to a post-industrial economy led to a polarisation of the urban labour market between high- and low-skilled jobs (De Winter and Musterd 1998). In the case of Brussels, this transition was also marked by the new positioning of the city in the global scene, hosting international institutions such as the European Commission, the European Parliament, and the NATO headquarter, and attracting a new class of affluent migrants (Corijn and Vloeberghs 2013; De Winter and Musterd 1998). As a considerable share of the new urban jobs were filled by high-skilled suburban commuters and international workers, there were fewer opportunities for the low-skilled urban populations in the labour market (Corijn and Vloeberghs 2013). Turks and Moroccans are amongst the groups that suffered most from the economic changes, and for which upward mobility was most difficult. Therefore, these groups were compelled to stay in the neighbourhoods where they had initially settled (Kesteloot and Cortie 1998).

Even today, newly arrived migrants from non-European countries tend to settle in these same central areas, where the housing stock is older and cheaper, socioeconomic conditions are worse, and ethnic concentration of their own group is stronger (Gsir 2010; Rea 2013). Moreover, due to the lack of public housing in Brussels and the long waiting lists, these migrants are virtually absent from public rentals. Newly arrived migrants with modest conditions are therefore pushed to the private rental market with the lowest-quality housing stock, often located in the same inner neighbourhoods previously occupied by the industrial workers and earlier migrants (Kesteloot and Van der Haegen 1997).

Besides the long-term processes, there is scattered evidence of concrete mechanisms that drive ethnic and socioeconomic segregation in Belgium. Research clearly showed for example discrimination of non-Western migrants in the housing market of Ghent and Antwerp (Van der Bracht et al. 2015) as well as in the labour market in Brussels (Rea 2013). Furthermore, negative neighbourhood effects are reported: Turks and Moroccans socialised in segregated neighbourhoods are less likely to have access to jobs (Dujardin et al. 2008). Preferences can play a role as

well, not only in the neighbourhood choices of ethnic minorities, but also in the avoidance of suburban 'white' Belgians to live in mixed neighbourhoods, as in the case of Ghent (Schuermans et al. 2014). But, despite the scattered empirical evidences and the alleged correlation between ethnic and socioeconomic segregation in Belgium, no study to date has investigated the subject in a comprehensive manner.

## 2.4 Study Aim and Hypotheses

The main purpose of this study is to investigate the links between ethnic and socioeconomic segregation in Belgium's three largest cities: Brussels, Antwerp, and Liege. These cities are chosen as representing the different regions in Belgium (the main city of Flanders, the main city of Wallonia and the capital region of the country) based on their different geographic and linguistic context. At the same time, they share the larger federal context, housing market structure, and are also similar in the sense that for long they have been main entry and settlement places for migrants in Belgium. In total 52% of migrants live in one of these three urban agglomerations (2011); these cities reflect thus the reality of a substantial group of the migrant population in Belgium. Our aim is to provide a comprehensive picture of segregation patterns with a high level of geographic detail. The analyses address three main hypotheses based on the literature discussed before and applied to the specific Belgian context.

First, non-European migrants in Belgium are likely to face barriers for spatial integration: less opportunities of socioeconomic mobility, discrimination in the labour and housing markets, and being subject to cumulative disadvantages of negative neighbourhood effects on educational, professional and residential attainment. European migrants, in contrast, are less likely to face economic and social constraints: they would have more chances of spatial assimilation. Therefore, we hypothesize that *ethnic and socioeconomic segregation strongly overlap in Belgium, but that this is especially the case for non-European migrants compared to other migrant origins* (H1).

Second, each of the three cities has its own historical, social, linguistic and economic particularities. Still, they were subjected to similar structural trends: they shared common (national) housing policies, underwent similar territorial processes, and hosted the same non-European migrant groups. Moreover, there are no reasons to believe that forces as discrimination or cumulative disadvantages would considerably differ amongst these cities. Hence, we expect that *patterns of ethnic and socioeconomic segregation will be similar for Brussels, Antwerp and Liege* (H2), with the highest concentrations of migrants and deprivation overlapping in central neighbourhoods. But apart from these similar spatial patterns, we do expect that levels of segregation in each of the cities may be different, due for instance to the different compositional effects of the population.

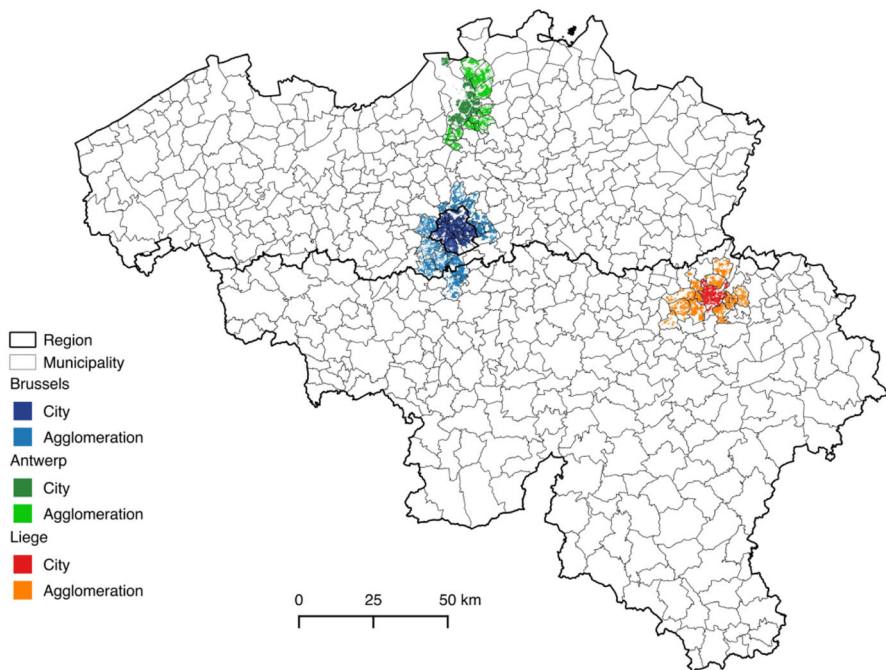
Third, in line with recent studies (Clark et al. 2015; Fischer et al. 2004; Fowler 2016; Reardon et al. 2008), we give particular attention to the scale of segregation. In fact, there is increasing awareness that different processes related to segregation might operate simultaneously at different scales: for example, individuals' social

interactions might encompass the surrounding streets, whereas the forces of housing market and discriminative practices may extend over much larger areas (Andersson and Musterd 2010; Östh et al. 2015). What concerns us here, more precisely, is to what extent scale plays a role in the relationship between ethnic and socioeconomic segregation. Situations in which ethnic and socioeconomic segregation overlap at all scales (i.e. extending over large populated areas) could be particularly worrisome for social cohesion. Given the fact that the most segregated neighbourhoods in Belgium are historically located in dense inner cities, we expect that *socioeconomic and ethnic segregation of non-European migrants overlap independently of scale* (H3).

### 3 Data and Methods

#### 3.1 Study Context

Figure 1 depicts the inhabited areas in the agglomerations of Brussels, Antwerp, and Liege. The definition of agglomeration is based on the 2001 Census (Luyten and



**Fig. 1** Study context: Brussels, Antwerp, and Liege agglomerations. *Note* The map depicts the inhabited 100 m × 100 grids in the three urban agglomerations. Agglomerations are defined as the cities themselves and the adjoining municipalities with contiguously built area extending from the urban core. Reproduced with permission from Luyten and Van Hecke (2007)



Van Hecke 2007): it refers to the built area that extends from the city centres, with a maximum of 200 metres between dwellings.

Brussels, the capital of Belgium and Europe, is the largest agglomeration in the country with 1,600,562 inhabitants (1st January 2015). Antwerp, in the north, is the largest agglomeration of the Dutch-speaking region of Flanders (763,338 inhabitants) and an important port city in the European context. The French-speaking Liege (south) is the largest urban area in the region of Wallonia (496,475 inhabitants) and has been a prominent industrial city before the decline of the iron industry in the twentieth century. Together, the three agglomerations host 25% of the Belgian population (11,209,044).

### 3.2 Data and Measures

For this study, we benefited from the newly available geocoded data from the Belgian 2011 Census.<sup>1</sup> These allowed us to construct individualised neighbourhoods of equal population counts at several scales, which are independent of administrative boundaries.

This approach offers many advantages over fixed areal units. As mentioned above, the choice of the administrative units has an influence on the outcomes of quantitative analysis of segregation (MAUP). Another drawback of administrative units is that individuals living close to the boundaries are assigned to their unit of residence, even though they may be influenced by, socialise, and circulate in the adjacent units (Fischer et al. 2004). Also, processes occurring at a fine scale might be blurred in higher-level units (Andersson and Musterd 2010). In using individualised neighbourhoods we attempt to overcome these problems and to work with a very high level of geographic detail.

Individualised neighbourhoods were constructed as follows. First, we divided the Belgian territory into grids of 100 m × 100 m. Second, we used geocoded individual data to identify the population inside each grid by their  $x$ - $y$  coordinates. Third, neighbourhoods were constructed for each grid with the EquiPop software (see Östh et al. 2015). This software adds up adjacent grids until it reaches the  $k$ -nearest neighbours. Finally, the resulting samples of neighbours were used to compute ethnic and socioeconomic indicators.

Individualised neighbourhoods were constructed for each inhabited grid in Brussels ( $N = 25,379$ ), Antwerp ( $N = 14,039$ ) and Liege ( $N = 14,257$ ) at nine different scales:  $k = 200; 400; 800; 1600; 3200; 6400; 12,800; 25,600; \text{ and } 51,200$ .

For this study, seven indicators were computed with the 2011 Census data for each individualised neighbourhood at the nine scales. Two indicators correspond to the ethnic composition of individualised neighbourhoods:

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<sup>1</sup> The 2011 Census is the first one in Belgium that is entirely based on administrative sources. It covers the whole population and the data is considered to be of high quality. For more details on the census and data quality, see <http://census2011.fgov.be/> and <http://ec.europa.eu/eurostat/web/population-and-housing-census/census-data/2011-census>.

- Non-EU migrants: share of the population born outside the European Union (EU) or the European Free Trade Agreement (EFTA) countries<sup>2</sup>;
- EU migrants: share of the population born in EU or EFTA countries.

The other five indicators represent the socioeconomic profile of neighbourhoods' inhabitants:

- Tertiary education: share of people aged 25–64 who have successfully completed higher education;
- Employment: share of people aged 30–59 in employment;
- At risk of poverty: share of people aged 25 and above with disposable income below the poverty threshold, i.e. 60% of the national median income;
- High income: share of people aged 25–64 with income in the highest national decile;
- Social assistance: share of people aged 18–64 who received full-time social assistance in 2011.

The final dataset contains 63 variables (i.e. each of the seven indicators at nine different scales) corresponding to the 53,675 coordinates of the 100 m × 100 m grids in the three agglomerations.

### 3.3 Methods

We take a systemic approach based on factor analysis (which has also been used by Andersson and Malmberg (2015) and Clark et al. (2015) for the study of ethnic segregation). This means that we do not impose any predetermined relationship amongst variables nor scales. We believe this approach is appropriate to disentangle the complex interactions between the several indicators at the different scales.

The analyses<sup>3</sup> were carried out in three steps. First, factor analyses were made separately for each of the three urban agglomerations. Next, the results were analysed using two complementary tools: a graphic of the indicators' factor loadings by *k*-level and a map of the grids' factor scores. Whereas the former indicates the most prominent features of each factor, the latter allows us to locate the areas which score high or low in the factors. All maps were made using the same criteria, based on the number of standard deviations in the factors scores' distribution. This was preferred over quantiles for matters of comparability between cities and factors. In particular, the mapping of high-score grids identified with a fixed criterion evidences the intensity, extent, and location of significant clusters. Finally, in the third step, we focussed on the outliers in each factor—i.e. highly homogeneous areas according to the factors' features—and observed the level of the seven socioeconomic and ethnic indicators in these areas.

<sup>2</sup> Although this category includes immigrants of non-European Western countries (US, Japan, etc.), these are only a very small share of the population. The indicator mainly includes non-Western immigrants, among which Turks and Moroccans account for the most important share.

<sup>3</sup> All the analyses and illustrations were carried out with open source software: R for quantitative methods (R Core Team 2015) and QGIS for mapping (QGIS Development Team 2009).

## 4 Findings

### 4.1 Descriptive Results

Before turning to the multivariate analysis, we first present the dataset obtained by the construction of individualised neighbourhoods. Figure 2 illustrates the distribution of individualised neighbourhoods for the seven indicators calculated for the three cities at the lowest and highest scales: 200 and 51,200 nearest neighbours. Variations in neighbourhoods' composition are wide in all indicators, except for social assistance, which concerns a small share of the population. As it could be expected, distributions are consistently smoother at the highest scale ( $k = 51,200$ ), while variations are wider at the local level ( $k = 200$ ). Moreover, the three cities present fairly similar distributions for all variables.

Concerning the ethnic clustering in individualised neighbourhoods, there is particularly high variation in the share of non-European migrants in the cities. Concentrations range from a complete absence of migrants to values higher than half the population at the lowest scale and one quarter of the population at the highest scale. European migrants are also concentrated in neighbourhoods, although extreme values are less frequent in the three cities compared to non-European migrants.

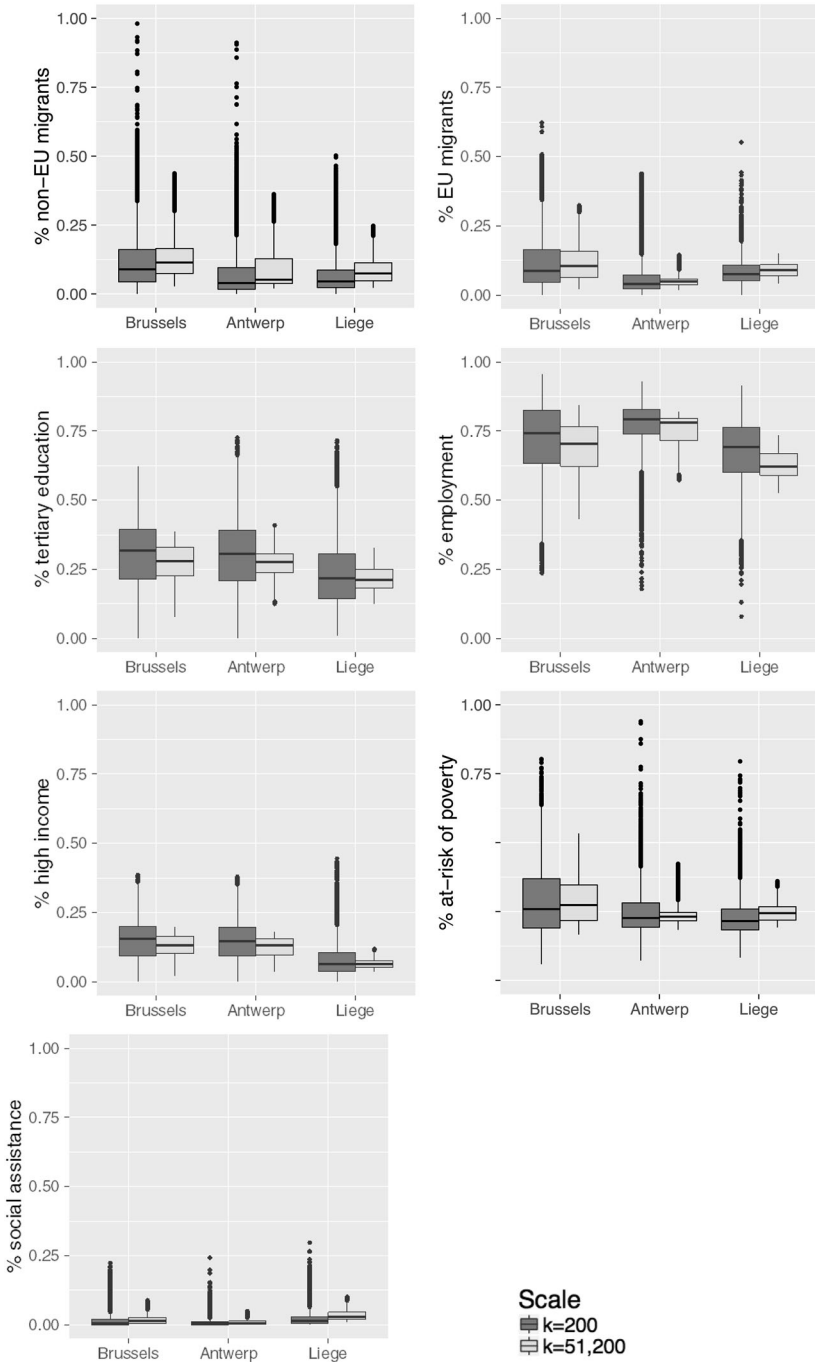
The distributions of socioeconomic indicators contain extreme values as well, namely of deprived places with very low employment ( $< 50\%$ ) or high shares of people at risk of poverty ( $> 50\%$ ), and well-off neighbourhoods clustering relatively high-educated or high-income inhabitants.

The correlation matrices in Table 1 show the bivariate interactions between indicators in each of the three cities, again at the highest and lowest scales. Not surprisingly, correlations are stronger at the highest scale because neighbourhood variations are smoothed as we consider an increasing number of nearest neighbours. Still, many of the correlation values amongst the seven indicators are high even at the local level ( $k = 200$ ), and are consistent to what one might expect.

First, socioeconomic indicators are mutually correlated in the three cities. This suggests that individualised neighbourhoods cumulate specific disadvantaged or advantaged characteristics: for instance, high concentrations of people who benefit from social assistance are associated with lower education and employment; on the other hand, high-income neighbourhoods have higher shares of high-educated people, higher employment, and low poverty, and so on.

Second, in line with hypothesis 1, neighbourhoods' ethnic composition is clearly associated with their socioeconomic profile. In particular, high concentrations of non-European migrants in the three cities are associated with lower education and employment, higher risk of poverty, higher shares of people dependant of social assistance, and weaker presence of high-income groups.

The clustering of European migrants in Brussels and Antwerp is also related to unfavourable conditions: European neighbourhoods in Brussels are marked by low employment; in Antwerp and Brussels they are associated with high poverty risk. However, this is certainly due to particularities of the data and of these populations'



◀ **Fig. 2** Migration background and socioeconomic composition of individualised neighbourhoods: distribution of indicators calculated at the lowest and highest scales ( $k = 200$  and  $k = 51,200$  nearest neighbours) in Brussels, Antwerp and Liege, 2011. *Source:* Census 2011 data; authors calculations

profiles. In Brussels, income and employment of international workers for example do not appear in the Belgian statistics, nor does the presence of their accompanying spouses. Likewise, high poverty risk of Antwerp's Europeans may reflect the presence of Dutch cross-border commuters, retirees, and other segments whose income is invisible in the official figures. In sum, whereas the correlations suggest that these groups are in a worse economic position, it is more likely that their socioeconomic situation is simply not captured well in our data as a result of the mentioned limitations.

## 4.2 Ethnic and Socioeconomic Segregation Patterns in Brussels, Antwerp, and Liege

The multivariate analysis provides a clearer picture of the intricate relationships between ethnic and socioeconomic segregation within a multiscale perspective. In this subsection, we first describe the factor analyses' main results. After that, we focus on the neighbourhoods with extreme values on the factors, where ethnic and/or socioeconomic concentration is relatively strong.

The factor analyses carried out independently for the three urban agglomerations produced remarkably similar results. Four factors were extracted in each city (those with eigenvalue  $> 1$ ), accounting for most of the common variation of the 63 variables: 92% in Brussels, 86% in Antwerp, and 87% in Liege.

The first factor before rotation (not shown but available upon request from the first author) in all cities had very high loadings on all variables and captured around 60% of their common variance. We thus operated an oblique rotation (varimax) in order to facilitate the interpretation. It is noteworthy, nonetheless, that the first factor before rotation reflected the divide between, on the one hand, neighbourhoods with high proportions of non-European migrants and which cumulate disadvantageous conditions (low education and employment, high risk of poverty) and, on the other hand, well-off neighbourhoods where there is an accumulation of advantage but where the presence of migrants is low, particularly of non-European migrants. Furthermore, factor loadings were high at all scales. These preliminary results suggest that ethnic and socioeconomic segregation indeed overlap in the three cities (in line with H1) independently of scale (H3).

The four rotated factors are summarised in Table 2. For the sake of clarity, the factors were rearranged according to what they represent, even though their order in the cities varies in terms of eigenvalue and variance explained. They are named after the most distinguishing feature that they represent in individualised neighbourhoods: 'Non-European', 'European', 'well-off' and 'enclaves'. Given the high amount of information—i.e. four factors in three cities depicting multiple variables and scales—we emphasise here the most important factors in respect to our aims and hypotheses. These are namely the 'non-European' and the 'enclaves' factors. Below, these two factors in each city are presented with two tools: a graph

**Table 1** Correlation matrices at  $k = 200$  and  $k = 51,200$ . *Source:* Census 2011 data; authors calculations

<i>Brussels</i>							
( $k = 200$ )	1.	2.	3.	4.	5.	6.	7.
1. Non-EU migrants	–						
2. EU migrants	0.34	–					
3. Tertiary education	– 0.72	– 0.17	–				
4. Employment	– 0.81	– 0.61	0.60	–			
5. High income	– 0.68	– 0.13	0.90	0.57	–		
6. At risk of poverty	0.68	0.76	– 0.35	– 0.85	– 0.32	–	
7. Social assistance	0.76	0.15	– 0.64	– 0.67	– 0.64	0.47	–
( $k = 51,200$ )	1.	2.	3.	4.	5.	6.	7.
1. Non-EU migrants	–						
2. EU migrants	0.46	–					
3. Tertiary education	– 0.84	– 0.16	–				
4. Employment	– 0.92	– 0.69	0.72	–			
5. High income	– 0.84	– 0.19	0.98	0.73	–		
6. At risk of poverty	0.81	0.85	– 0.47	– 0.92	– 0.48	–	
7. Social assistance	0.97	0.35	– 0.89	– 0.89	– 0.9	0.72	–
<i>Antwerp</i>							
( $k = 200$ )	1.	2.	3.	4.	5.	6.	7.
1. Non-EU migrants	–						
2. EU migrants	0.14	–					
3. Tertiary education	– 0.52	– 0.00	–				
4. Employment	– 0.81	– 0.29	0.55	–			
5. High income	– 0.59	0.13	0.83	0.58	–		
6. At risk of poverty	0.59	0.60	– 0.19	– 0.68	– 0.16	–	
7. Social assistance	0.68	0.07	– 0.41	– 0.65	– 0.51	0.40	–
( $k = 51,200$ )	1.	2.	3.	4.	5.	6.	7.
1. Non-EU migrants	–						
2. EU migrants	0.61	–					
3. Tertiary education	– 0.65	– 0.34	–				
4. Employment	– 0.95	– 0.70	0.69	–			
5. High income	– 0.87	– 0.42	0.86	0.89	–		
6. At risk of poverty	0.88	0.86	– 0.53	– 0.90	– 0.69	–	
7. Social assistance	0.94	0.63	– 0.57	– 0.93	– 0.82	0.88	–
<i>Liege</i>							
( $k = 200$ )	1.	2.	3.	4.	5.	6.	7.
1. Non-EU migrants	–						
2. EU migrants	0.61	–					
3. Tertiary education	– 0.37	– 0.45	–				
4. Employment	– 0.68	– 0.42	0.71	–			
5. High income	– 0.38	– 0.41	0.90	0.67	–		

**Table 1** continued

6. At risk of poverty	0.76	0.34	- 0.48	- 0.79	- 0.45	-	
7. Social assistance	0.80	0.23	- 0.37	- 0.73	- 0.39	0.76	-
( <i>k</i> =51,200)	1.	2.	3.	4.	5.	6.	7.
1. Non-EU migrants	-						
2. EU migrants	0.52	-					
3. Tertiary education	- 0.11	- 0.64	-				
4. Employment	- 0.85	- 0.70	0.44	-			
5. High income	- 0.43	- 0.74	0.92	0.66	-		
6. At risk of poverty	0.94	0.61	- 0.26	- 0.93	- 0.53	-	
7. Social assistance	0.97	0.46	- 0.08	- 0.89	- 0.40	0.96	-

**Table 2** Descriptive results of factor analysis per factor and city. *Source:* Census 2011 data; authors calculations

Factor	City	Eigenvalue	% variance	N. highest <sup>a</sup>	N. lowest <sup>a</sup>
Non-European	Brussels	16.48	26	641	0
	Antwerp	26.73	42	274	0
	Liege	26.7	42	382	0
Enclaves	Brussels	1.59	3	26	32
	Antwerp	2.19	3	51	35
	Liege	3.45	5	226	33
European	Brussels	19.95	32	298	0
	Antwerp	12.06	19	353	0
	Liege	8.58	14	161	0
Well off	Brussels	19.94	32	0	0
	Antwerp	13.44	21	0	0
	Liege	16.3	26	223	0

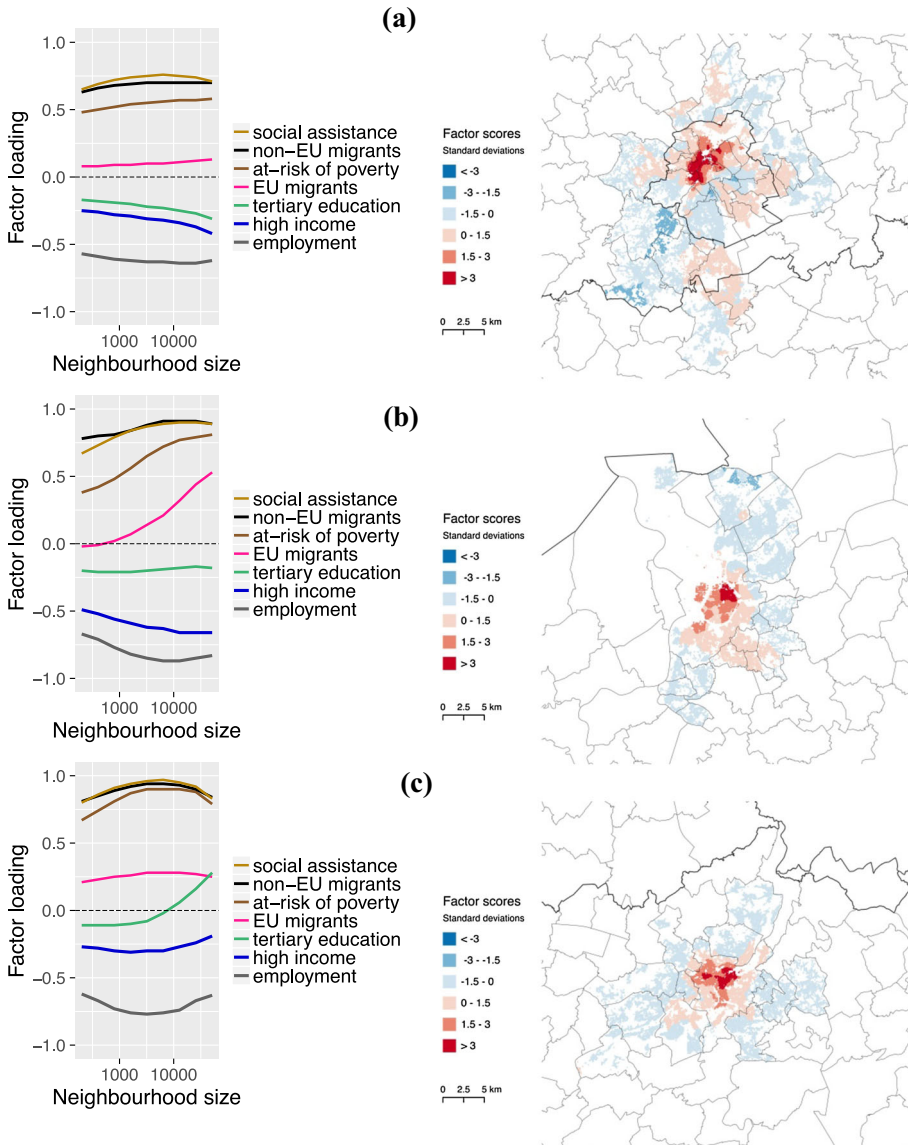
*N* Brussels = 25,379; *N* Antwerp = 14,039; *N* Liege = 14,257

<sup>a</sup>Number of units (grids) with factor scores higher/lower than 3 standard deviations

of indicators' factor loadings by scale and a map of the factor scores in the 100 m × 100 m grids. The full results for the 'European' and 'well-off' factors can be found in the online appendix to this article.

The most relevant factor in terms of variance and in respect to our research is the 'non-European' factor (Fig. 3). It reveals the strong overlap between ethnic concentration and socioeconomic disparities. This factor captures a considerable share of the variables' common variance in the three cities (26% in Brussels,<sup>4</sup> and

<sup>4</sup> The fact that this factor captures less variance in Brussels compared to Antwerp and Liege is undoubtedly due to Brussels' position as the Belgian and European capital: the other factors related to European citizens and well-off areas are thus relatively more important. This does not mean, however, that the overlap between ethnic and socioeconomic segregation is weaker in Brussels.



**Fig. 3** ‘Non-European’ factor: ethnic-socioeconomic segregation at all scales. **a** Brussels. **b** Antwerp. **c** Liege. *Note* The graphs on the left represent indicators’ loadings on the factor as a function of scale (i.e. number of nearest neighbours); they provide a synthetic view of the factor in respect to its socioeconomic features as the scale varies. The maps on the right side depict the spatial distribution of grids’ factor scores in the three cities. In particular, they allow the location of spots with extreme values, where the factors’ features are most pronounced. *Source:* Census 2011 data; authors calculations

42% in Antwerp and Liege). It scores high—and at all scales—especially in the share of non-European migrants, social assistance, poverty, and scores low in employment. The corresponding maps in Fig. 3 depict the spatial distribution of

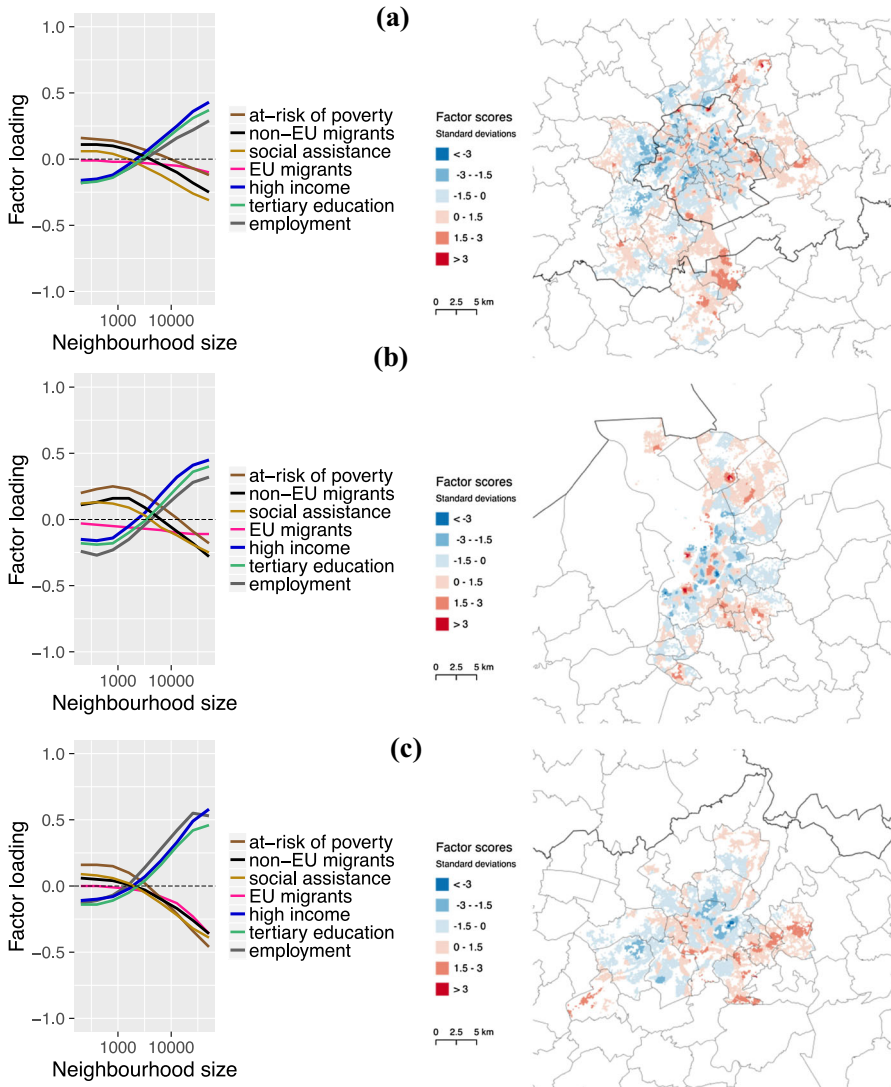


factor scores in the cities' grids. Grids in red represent the neighbourhoods that experience the highest ethnic and socioeconomic clustering, that is, spots that concentrate high shares of non-European migrants and deprivation (low employment, high poverty and high social assistance). As expected, these high-concentration spots are located in the inner cities, mostly in the nineteenth century blue-collar neighbourhoods. Despite their central location, these neighbourhoods seem to be marked by deep ethnic and socioeconomic isolation: due to their high population density, migrant clustering and deprived conditions overlap at all scales, encompassing a very large number of residents.

The 'enclaves' factor (Fig. 4) expresses a different form of relationship between ethnic and socioeconomic segregation: one that depends on scale. Although assembling low shares of common variance (3–5%), this factor depicts interesting reversals in segregation profiles as the number of neighbours increases. If we consider up to the 1000 nearest neighbours, this factor has positive loadings in poverty risk, social assistance, and non-European migrants, and negative loadings in education, employment, and high income. As the scale increases above 1000, the trends are reversed, indicating higher socioeconomic levels and lower concentrations of migrants. In other words, it reflects enclaves in the urban areas where local ethnic and socioeconomic features are radically different from the surroundings. Moreover, this factor conveys once more the overlap between ethnic and socioeconomic segregation in the three cities, only at the very local level.

The two remaining factors also stand for important spatial patterns; however, they are somewhat less related to the overlap between ethnic and socioeconomic segregation (see online appendix). The 'European' factor is associated with the clustering of European citizens in Brussels, Antwerp, and Liege. Nevertheless, the interpretation of the socioeconomic profile of European neighbourhoods is problematic since many European citizens do not appear in the Belgian employment and income statistics (especially in Brussels and Antwerp, as mentioned above). Moreover, European migrants originate from different backgrounds: there is a traditionally strong presence of Dutch in Antwerp, Italians in Liege, and a diverse European population in Brussels (see Eggerickx et al. 2002). Still, it is noteworthy that they do tend to cluster in determined neighbourhoods, and that these neighbourhoods are considerably dense and extensive (independent of scale). This is in contrast with our first hypothesis where we expected that European migrants would be more spatially assimilated than non-European migrants.

Finally, the 'well-off' factor captures the socio-spatial duality in the cities: it depicts the well off areas in which important shares of inhabitants have high incomes and tertiary education. Nonetheless, the geographic extent and intensity of segregation in this case is not as high compared to the other factors (there are few grids with values greater than three standard deviations). This is certainly due to the fact that the highest concentrations of wealth are to be found in the suburban areas beyond our study space.



**Fig. 4** ‘Enclaves’ factor: local segregation, scale-dependent. **a** Brussels. **b** Antwerp. **c** Liege. *Note* The graphs on the left represent indicators’ loadings on the factor as a function of scale (i.e. number of nearest neighbours); they provide a synthetic view of the factor in respect to its socioeconomic features as the scale varies. The maps on the right side depict the spatial distribution of grids’ factor scores in the three cities. In particular, they allow the location of spots with extreme values, where the factors’ features are most pronounced. *Source:* Census 2011 data; authors calculations

### 4.3 High-Concentration Spots

Having identified the overall segregation patterns, we now address the ‘high-concentration spots’ in the three cities, where ethnic and socioeconomic segregation

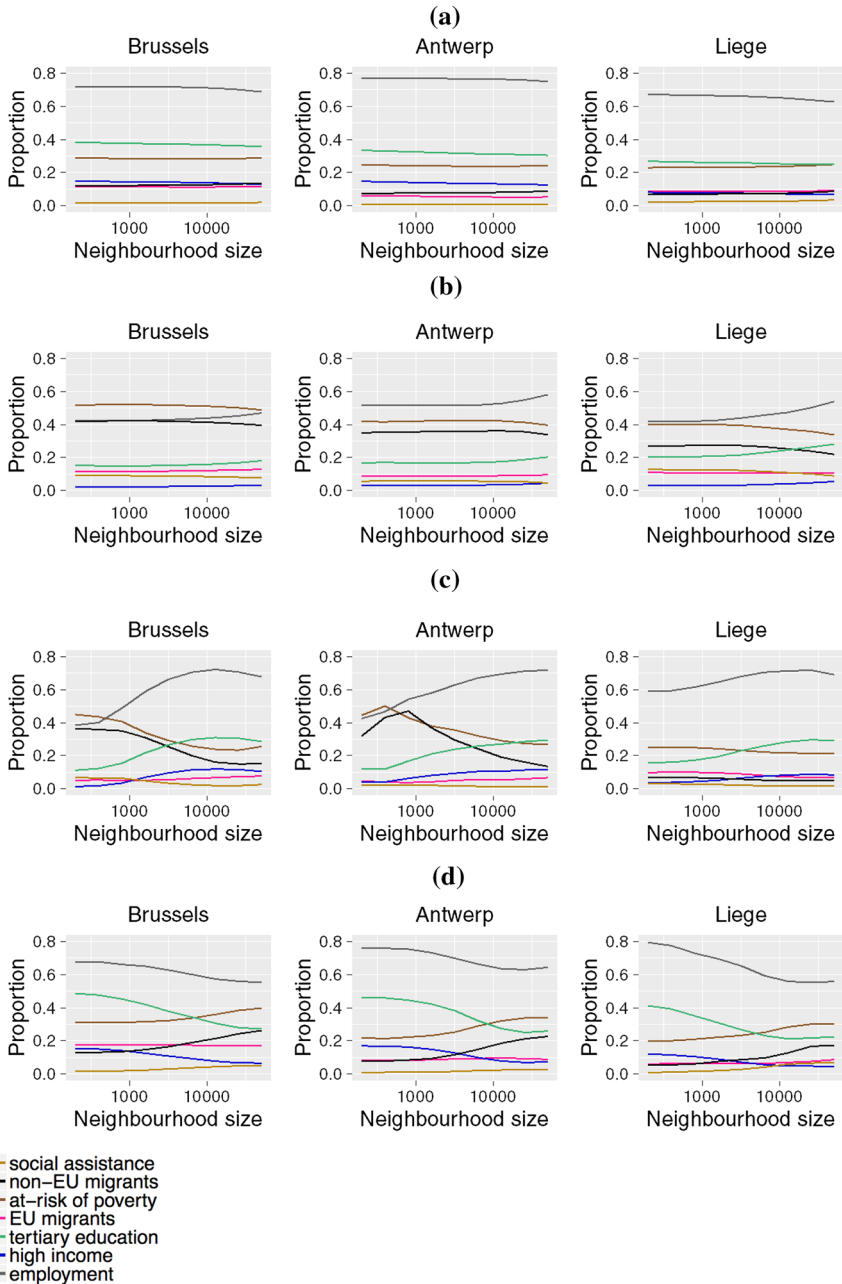
most overlap. These are the spots composed of grids that score higher/lower than three standard deviations of the factors, depicted in dark red/blue in the maps in Figs. 3 and 4. The number of outlier grids per factor and city is reported in Table 2.

Figure 5 goes back to the indicators values (as opposed to factor scores) in the high-concentration spots for the ‘non-European’ and ‘enclave’ factors. The graphics represent the ‘segregation profiles’ of the spots, i.e. the variation in indicators’ average values as we consider an increasing number of nearest neighbours around the spots. Averages for whole cities are shown in order to facilitate the interpretation.

The ‘non-European’ factor has outlier grids on the high side only (depicted in dark red in the maps in Fig. 3). These are the areas where concentration of non-European migrants and deprived conditions coincide. Relative to the cities’ average, non-European migrants represent a considerable share of the population in these red spots. Employment amongst the population in these areas is particularly low and an important proportion lives with low incomes; education levels are lower than the cities’ average, high incomes are virtually absent, and a relatively high share of the inhabitants depend on social assistance. In the three cities, these ethnic deprived spots are located in central neighbourhoods marked by bottom-quality dwellings where rental prices are more affordable. Interestingly, the segregation profiles are fairly flat in all cases. The intensity of ethnic clustering and deprivation does decrease as we consider a higher number of nearest neighbours (from 6400 or 12,800 on), but only slightly: indicators’ values remain rather stable regardless of scale. This attests to the high scope of ethnic and socioeconomic isolation in Brussels, Antwerp, and Liege, even despite the fact that the neighbourhoods concerned are located in central areas. The overlap between ethnic and socioeconomic segregation seems to be even stronger in Brussels, compared to Antwerp and Liege. The red zone is about twice as large in the capital (see Table 2) and inhabitants’ socioeconomic profiles deviate more from the city’s average: 40% of the inhabitants are non-European migrants, more than a half are at risk of poverty, only 40% are employed, just 15% have tertiary education, and nearly 10% rely on social assistance (against 1.5% in average for the city).

It is interesting to notice the particular tenure structure of these red spots. To estimate the proportion of inhabitants that rent their habitation in these spots, we examined the 2011 Census data available at the level of the statistical sectors, isolating those sectors that encompass red spots. A considerably high share of the population in these sectors live in rented dwellings: 65% in Brussels’ red spots (48% overall in the Brussels agglomeration), 54% in Antwerp’s (34% overall) and 58% in Liege (37% overall). This clearly indicates the vulnerability of these populations, who are pushed to the liberal private rental market of bottom-quality dwellings in old industrial neighbourhoods (De Decker 2008; Kesteloot and Van der Haegen 1997).

The ‘enclaves’ factor has outliers in both high and low values (respectively, depicted by the scattered dark red and dark blue spots in Fig. 4). What characterises the segregation profiles of these spots is the reversal in socioeconomic features as we consider an increasing number of nearest neighbours (Fig. 5). Many of the red spots in the maps correspond to social housing neighbourhoods with a more



deprived population and higher presence of migrant groups compared to the adjacent neighbourhoods. These spots of local-level clustering have low levels of employment and tertiary education, lower incomes, and high shares of non-European migrants; as the scale goes up to 5000 nearest neighbours, however,

◀ **Fig. 5** Segregation profiles of high- and low-score grids: indicators' mean values as a function of scale (neighbourhood size). **a** City average. **b** Non-European factor: high outliers (grids with factor scores higher than 3sd). **c** Enclaves factor: high outliers (grids with factor scores higher than 3sd). **d** Enclaves factor: high outliers (grids with factor scores lower than 3sd). *Note* Graphs depict segregation profiles, that is, the variation in neighbourhoods' socioeconomic and migration features as the scale increases. For matters of comparison, **a** the indicators' mean values at the city level. **b** Presents the segregation profiles of high-score grids of the 'Non-European factor' (which correspond to the red spots on the maps in Fig. 3). Similarly, **c**, **d** present the segregation profiles of high- and low-score grids in the Enclave factor (respectively, the red and blue spots on the maps in Fig. 4). *Source*: Census 2011 data; authors calculations

indicators approach the cities' average levels. Conversely, the blue spots convey the opposite situation: the local-level clustering of highly educated, native individuals inside worse off ethnic areas. As the scale increases, indicators values are smoothed towards the cities' average levels. In Brussels, many of these blue spots correspond to gentrification areas and the presence of new high-standing real estate projects in otherwise poorer zones (see Van Criekingen 2008, 2009).

## 5 Discussion and Conclusion

The purpose of this paper was twofold: first it aimed at investigating the ways in which ethnic and socioeconomic segregation overlap; second it looked into the role of scale in the relationship between ethnic and socioeconomic segregation in Belgium. We relied on original geocoded data from the 2011 Belgian census to answer these questions. Individualised neighbourhoods were constructed at nine scales with a nearest-neighbours approach for the urban agglomerations of Brussels, Antwerp, and Liege. Ethnic and socioeconomic indicators calculated for these individualised neighbourhoods were subsequently inputted in independent factor analyses for each agglomeration. In this way we were able to study the underlying structure of ethnic and socioeconomic segregation in these cities with a detailed geographic level and operating at multiple scales. The analyses point at two main conclusions: there is an undeniable process of spatial isolation of ethnic deprived groups in Belgium's inner cities; and despite the central location of segregated neighbourhoods, the scope of isolation is considerably high, both in extension and in population density.

The results corroborate our first hypothesis: segregation of non-European migrants strongly overlaps with socioeconomic segregation in Belgian cities. Neighbourhoods with high shares of non-European migrants are also those where employment and tertiary education are lowest, the share of the population with low income is highest, and a relatively high share of individuals rely on social assistance. Complementary to this first hypothesis, we put forward that European citizens would not tend to be as segregated because they would face less economic and social obstacles for spatial assimilation. However, our results suggest that this is not case. Although the background of European populations is quite different in the three cities, they do tend to cluster together, even if their segregation does not seem to stem from socioeconomic disadvantage. This may suggest that residential

preferences are relevant over and beyond the factors studied here. With the census data we used in this paper we cannot shed light on this, but for future research it is essential to further explore how different origin groups (including those of European descent) make residential choices upon arrival and over time. More longitudinal in-depth data are needed to capture the mechanisms at work and their potential differential role across origin groups.

As expected from the second hypothesis, the results revealed nearly identical patterns of ethnic and socioeconomic segregation in Brussels, Antwerp, and Liege, especially for non-European migrants. Even though we carried out separate analyses for each city, the outcomes were remarkably similar: non-European migrants in deprived conditions are concentrated in dense inner neighbourhoods dominated by bottom-quality dwellings from the residual private rental market. These are the same neighbourhoods where non-European labour migrants from the first migration waves settled: they remain impoverished and keep attracting new migrants several decades later. The continuation over time may thus not only be the result of older waves of migrants settling there but seem to be perpetuated by new arrivals. Closer analyses of how international and internal mobility interact could shed further light on the developments of neighbourhoods.

Finally, our third hypothesis—that segregation of deprived migrant groups operates at a large scale—was also supported by the analyses. Indeed, the results point out that most of the overlap between ethnic and socioeconomic segregation in the three cities is scale-invariant. Because the areas with the highest concentrations of migrants and poverty are densely populated, the socioeconomic distribution of their inhabitants remains virtually unchanged as we increase the scale, from the 200 to the 51,200 nearest neighbours. However, when analysing our data we came across a second option alongside this large-scale pattern, namely local-level concentrations of deprived migrants in otherwise ‘average’ neighbourhoods. Scattered around the cities, these spots cluster a relatively high share of migrants living in poor conditions. This is no longer visible when we consider a higher number of nearest neighbours (over 6400). Change within a neighbourhood may thus be a very local issue that should be studied much more in terms of certain streets or blocks rather than the neighbourhood at large. More research and policy focus should be given to these low-scale levels to learn what are the success and fail factors in achieving change for residents in neighbourhoods.

Although our data are unique in that they cover the total population and allow to focus at very small-scale levels, the underlying processes that influence spatial clustering of deprived populations in Belgian cities remain difficult to address without a temporal or longitudinal dimension. Despite this we try to provide some explanations for our results in light of the existing literature.

From the spatial assimilation perspective, one could argue that the high-concentration neighbourhoods in the inner cities have a function of ‘transition neighbourhoods’: whereas migrants would tend to leave these deprived neighbourhoods to better-off zones as their socioeconomic conditions improve, these neighbourhoods would be constantly fuelled by new arrivals of non-Western migrants who cannot afford to live elsewhere (see Logan et al. 2002). However, this is unlikely to account for all segregation in Belgian cities. New migrants—

especially from Turkey and Morocco—do tend to settle in these neighbourhoods, but there is little evidence from previous research that old-established non-European migrants experience spatial assimilation. In reality, a considerable share of ‘old’ migrants and descendants still live in these areas (Arbaci 2007; De Winter and Musterd 1998; Gsir 2010; Rea 2013). There seems to be in fact a strong permanence of segregation in space and time in Belgian cities. As mentioned before, further analyses should investigate how international migration and internal mobility interact, and not only over the life course of migrants but also over successive generations of migrants’ descendants.

What is very telling from our findings is the similar patterns observed in Brussels, Antwerp, and Liege, even though these cities have fairly distinct social and economic landscapes. The fact that the three cities are so similar in terms of location of high-concentration spots and composition of their inhabitants suggests that macro processes have at least some impact on the clustering of deprived ethnic minorities. In particular, it is reasonable to argue that economic developments in the twentieth century, combined with the specific housing system in Belgium based on promotion of home ownership and deregulated rental market, set the conditions for segregation in these specific locations. Economic shifts and the housing system resulted in mass suburbanisation of middle-class households and their transition to the service sector; at the same time, immigrants filled up not only jobs but also the inner neighbourhoods formerly occupied by Belgians (De Winter and Musterd 1998; Kesteloot and Van der Haegen 1997). Because the housing policies remained all but unchanged over time, central neighbourhoods stayed more or less stable in terms of housing conditions, ethnic segregation and socioeconomic conditions.

Besides these general long-term processes, other factors operating at lower levels are likely to reproduce ethnic and socioeconomic segregation patterns in Belgium. Non-European migrants may face barriers both to economic and residential mobility. Discrimination in the labour and housing markets may be an obstacle to non-European households for socioeconomic and spatial integration. Moreover, it is possible that migrants’ networks and preferences influence their residential choices and their access to the labour market. Communities that share the same culture, religion and/or language also share information on housing possibilities and job opportunities. Finally, it is possible that negative neighbourhood effects further hinder migrants’ chances of escaping poverty and moving to better-off neighbourhoods. In the case of the deprived neighbourhoods in Belgium’s inner cities, where the scale of socioeconomic and ethnic isolation is very high, neighbourhood effects might be particularly strong. Migrants living in these areas, whose 50,000 or more nearest neighbours live in similar condition, may have less access to job networks, to education opportunities, to examples and relevant information, and thus less opportunities to be truly integrated socially and economically.

In this paper we made a start on analysing segregation with the newly released data from the Belgian 2011 Census. We focussed on the description of segregation patterns at one point in time only. Despite the rather descriptive nature of this article, our results combined with the existing literature suggest that different processes operate simultaneously at various levels and reinforce each other in perpetuating ethnic and socioeconomic segregation—from housing policies and long-term territorial

processes to migrants' networks and neighbourhood effects. Future research should further investigate the mechanisms through which socioeconomic and ethnic segregation are connected in Belgium as well as in other European countries.

**Acknowledgements** This work was part of and supported by the JPI Urban Europe ResSegr project "Residential segregation in five European countries– a comparative study using individualized scalable neighbourhoods"; Fonds Wetenschappelijk Onderzoek [FWOTM670]; JPI Urban Europe [ResSegr]. The use of geocoded data in our work was made possible by the valuable collaboration with Statistics Belgium. We are grateful for the encouraging comments of the two anonymous reviewers.

## References

- Andersen, H. S. (2002). Excluded places: The interaction between segregation, urban decay and deprived neighbourhoods. *Housing, Theory and Society*, *19*(3–4), 153–169.
- Andersson, E. (2004). From valley of sadness to hill of happiness: The significance of surroundings for socioeconomic career. *Urban Studies*, *41*(3), 641–659.
- Andersson, E., & Malmberg, B. (2015). Contextual effects on educational attainment in individualised, scalable neighbourhoods: Differences across gender and social class. *Urban Studies*, *52*(12), 2117–2133.
- Andersson, E., & Malmberg, B. (2016). Segregation and the effects of adolescent residential context on poverty risks and early income career: A study of the Swedish 1980 cohort. *Urban Studies*. <https://doi.org/10.1177/0042098016643915>.
- Andersson, R., & Musterd, S. (2010). What scale matters? Exploring the relationships between individuals' social position, neighbourhood context and the scale of neighbourhood. *Geografiska Annaler: Series B, Human Geography*, *92*(1), 23–43.
- Andersson, E., & Subramanian, S. V. (2006). Explorations of neighbourhood and educational outcomes for young Swedes. *Urban Studies*, *43*(11), 2013–2025.
- Arbaci, S. (2007). Ethnic segregation, housing systems and welfare regimes in Europe. *International Journal of Housing Policy*, *7*(4), 401–433.
- Bolt, G. (2009). Combating residential segregation of ethnic minorities in European cities. *Journal of Housing and the Built Environment*, *24*, 397–405.
- Boschman, S., & van Ham, M. (2015). Neighbourhood selection of non-Western ethnic minorities: Testing the own-group effects hypothesis using a conditional logit model. *Environment and Planning A*, *47*, 1155–1174.
- Cassiers, T., & Kesteloot, C. (2012). Socio-spatial inequalities and social cohesion in European cities. *Urban Studies*, *49*(9), 1909–1924.
- Clark, W. A. V., Andersson, E., Östh, J., & Malmberg, B. (2015). A multiscale analysis of neighborhood composition in Los Angeles, 2000–2010: A location-based approach to segregation and diversity. *Annals of the Association of American Geographers*, *105*(6), 1260–1284.
- Corijn, E., & Vloeberghs, E. (2013). Brussels, a small world city. In E. Corijn & J. Van de Ven (Eds.), *The Brussels reader. A small world city to become the capital of Europe* (pp. 13–27). Brussels: VUB Press.
- Crane, J. (1991). The epidemic theory of ghettos and neighborhood effects on dropping out and teenage childbearing. *American Journal of Sociology*, *96*(5), 1226–1259.
- De Decker, P. (2008). Facets of housing and housing policies in Belgium. *Journal of Housing and the Built Environment*, *23*, 155–171.
- De Winter, M., & Musterd, S. (1998). *Towards undivided cities in Western Europe: New challenges for urban policy: Part 4 Brussels*. Delft: Delft University Press.
- Dujardin, C., Selod, H., & Thomas, I. (2008). Residential segregation and unemployment: The case of Brussels. *Urban Studies*, *45*(1), 89–113.
- Eggerickx, T., Poulain, M., & Kesteloot, C. (2002). *La population allochtone en Belgique*. Monography from the 1991 population census 3. Statistics Belgium, Brussels
- Fischer, C. S., Stockmayer, G., Stiles, J., & Hout, M. (2004). Distinguishing the geographic levels and social dimensions of U.S. Metropolitan Segregation, 1960–2000. *Demography*, *41*(1), 37–59.



- Fowler, C. S. (2016). Segregation as a multiscale phenomenon and its implications for neighborhood-scale research: The case of South Seattle 1990–2010. *Urban Geography*, 37(1), 1–25.
- Gsir, S. (2010). Housing and segregation of migrants: Antwerp in Belgium. In H. Fassmann & Y. Franz (Eds.), *Integration policies at the local level: Housing policies for migrants*. Examples from New York City, St. Paul, Antwerp, Vienna and Stuttgart. Contribution of a transatlantic discourse in the framework of a German Marshall Fund of the United States (GMF) Project (pp. 39–53). Vienna: Austrian Academy of Sciences Press.
- Harrison, M., & Phillips, D. (2003). *Housing and black and minority ethnic communities: Review of the evidence base*. Technical report. London: Office of the Deputy Prime Minister.
- Kesteloot, C., & Cortie, C. (1998). Housing Turks and Moroccans in Brussels and Amsterdam: The difference between private and public markets. *Urban Studies*, 35(10), 1835–1853.
- Kesteloot, C., & Van der Haegen, H. (1997). Foreigners in Brussels 1981–1991: Spatial continuity and social change. *Tijdschrift voor Economische en Sociale Geografie*, 88(2), 105–119.
- Kühn, M. (2015). Peripheralization: Theoretical concepts explaining socio-spatial inequalities. *European Planning Studies*, 23(2), 367–378.
- Logan, J. R., Stults, B. J., & Farley, R. (2004). Segregation of minorities in the metropolis. Two decades of change. *Demography*, 41(1), 1–22.
- Logan, J. R., Zhang, W., & Alba, R. D. (2002). Immigrant enclaves and ethnic communities in New York and Los Angeles. *American Sociological Review*, 67(2), 299–322.
- Luyten, S., & Van Hecke, E. (2007). *De Belgische stadsgewesten 2001*. Statistics Belgium, Working paper 14. [http://statbel.fgov.be/nl/binaries/p009n014\\_nl%5B1%5D\\_tcm325-34289.pdf](http://statbel.fgov.be/nl/binaries/p009n014_nl%5B1%5D_tcm325-34289.pdf). Accessed April 19, 2017.
- Martiniello, M. (2003). Belgium's immigration policy. *International Migration Review*, 37(1), 225–232.
- Massey, D. S., & Fischer, M. J. (2000). How segregation concentrates poverty. *Ethnic and Racial Studies*, 23(4), 670–691.
- Murie, A., & Musterd, S. (2004). Social exclusion and opportunity structures in European cities and neighbourhoods. *Urban Studies*, 41(8), 1441–1459.
- Musterd, S. (2005). Social and ethnic segregation in Europe: Levels, causes and effects. *Journal of Urban Affairs*, 27(3), 331–348.
- Musterd, S., & van Kempen, R. (2009). Segregation and housing of minority ethnic groups in Western European cities. *Tijdschrift voor Economische en Sociale Geografie*, 100(4), 559–566.
- Openshaw, S. (1984). *The modifiable areal unit problem*. Concepts and techniques in modern geography 38. Norwich: Geo Books.
- Östh, J., William, A. V., & Malmberg, B. (2015). Measuring the scale of segregation using *k*-nearest neighbor aggregates. *Geographical Analysis*, 47(1), 1–16.
- Peach, C. (1999). London and New York: Contrasts in British and American models of segregation. *International Journal of Population Geography*, 5, 319–351.
- Phillips, D. (1998). Black minority ethnic concentration, segregation and dispersal in Britain. *Urban Studies*, 35(10), 1681–1702.
- Phillips, D. (2007). Ethnic and racial segregation: A critical perspective. *Geography Compass*, 1(5), 1138–1159.
- QGIS Development Team. (2009). *QGIS geographic information system*. Open Source Geospatial Foundation
- R Core Team. (2015). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.
- Rea, A. (2013). Immigration and diversity. In E. Corijn & J. Van de Ven (Eds.), *The Brussels reader. A small world city to become the capital of Europe* (pp. 244–266). Brussels: VUB Press.
- Reardon, S. F., Matthews, S. A., O'Sullivan, D., Lee, B. A., Firebaugh, G., Farrell, C. R., et al. (2008). The geographic scale of metropolitan racial segregation. *Demography*, 45(3), 489–514.
- Reardon, S. F., & O'Sullivan, D. (2004). Measures of spatial segregation. *Sociological Methodology*, 34(1), 121–162.
- Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing “neighborhood effects”: Social processes and new directions in research. *Annual Review of Sociology*, 28(1), 443–478.
- Schuermans, N., Meeus, B., & De Decker, P. (2014). Geographies of whiteness and wealth: White, middle class discourses on segregation and social mix in Flanders, Belgium. *Journal of Urban Affairs*, 37(4), 478–495.
- Tammaru, T., Marciniak, S., van Ham, M., & Musterd, S. (Eds.). (2015a). *Socio-economic segregation in European capital cities: East meets west*. London and New York: Routledge.

- Tammaru, T., Musterd, S., van Ham, M., & Marcińczak, S. (2015b). A multi-factor approach to understanding socio-economic segregation in European capital cities. In T. Tammaru, S. Marcińczak, M. van Ham, & S. Musterd (Eds.), *Socio-economic segregation in European capital cities: East meets west* (pp. 1–29). London: Routledge.
- Van Criekingen, M. (2008). Réurbanisation ou gentrification? Parcours d'entrée dans la vie adulte et changements urbains à Bruxelles. *Espaces et sociétés*, 134(3), 149–166.
- Van Criekingen, M. (2009). Moving in/out of Brussels' historical core in the early 2000s: Migration and the effects of gentrification. *Urban Studies*, 46(4), 825–848.
- Van der Bracht, K., Coenen, A., & Van de Putte, B. (2015). The not-in-my-property syndrome: The occurrence of ethnic discrimination in the rental housing market in Belgium. *Journal of Ethnic and Migration Studies*, 41(1), 158–175.
- van Kempen, E. T. (1994). The dual city and the poor: Social polarisation, social segregation and life chances. *Urban Studies*, 31(7), 995–1015.
- Van Mol, C., & de Valk, H. A. G. (2016). Migration and immigrants in Europe: A historical and demographic perspective. In B. Garcés-Masareñas & R. Penninx (Eds.), *Integration processes and policies in Europe. Contexts, levels and actors* (pp. 31–55). Dordrecht: Springer.
- Wong, D. W. S. (2004). Comparing traditional and spatial segregation measures: A spatial scale perspective. *Urban Geography*, 25, 66–82.