A Comparative Study of Segregation Patterns in Belgium, Denmark, the Netherlands and Sweden: Neighbourhood Concentration and Representation of Non-European Migrants

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Abstract: In this paper we use geo-coded, individual level register data on four European countries to compute comparative measures of segregation that are independent of existing geographical sub-divisions. The focus is on non-European migrants, and using aggregates for egocentric neighbourhoods with different population counts, small-scale, medium-scale, and large-scale segregation patterns are assessed. At the smallest scale level, corresponding to neighbourhoods with 200 persons, patterns of over- and under-representation are strikingly similar. At larger scale levels, Belgium stands out as having relatively strong over- and under-representation. More than 55% of the Belgian population lives in large-scale neighbourhoods with moderate under- or over-representation of non-European migrants. In the other countries, the corresponding figures are between 30 % and 40%. Possible explanations for this pattern are differences in housing policies and refugee placement policies. Sweden has the largest and Denmark the smallest non-European migrant population, in relative terms. Thus, in both migrant-dense and native-born dense areas, Swedish neighbourhoods have a higher concentration, and Denmark a lower concentration of non-European migrants than the other countries. For large-scale, migrant-dense neighbourhoods, however, levels of concentration are similar in Belgium, the Netherlands, and Sweden. Thus, if this pattern is linked to a high concentration of disadvantaged population groups, it shows that these countries are facing similar policy challenges with respect to neighbourhood contexts. Contexts that can have negative effects on outcomes such as employment, income and education.

Key words: segregation; comparison; non-European immigrants; concentration; representation; Belgium; Denmark; the Netherlands; Sweden

1. Introduction

The aim of this paper is to compare levels and patterns of non-European migrant segregation in four different countries: the Netherlands, Denmark, Sweden and Belgium. Comparing residential segregation between countries helps scholars to analyse causes of segregation and the consequences of segregation, and also helps them to suggest policy measures against segregation. Three questions will be in focus. (1) To what extent are there differences in the concentration and representation of non-EU migrants across various spatial scales? (2) How can differences in segregation patterns across four national contexts be explained by differences in structural factors? (3) To what extent has spatial segregation reached such levels that the social cohesion of different member states is endangered?

Residential segregation implies the relatively strong presence of a specific group in some spatial units combined with a relatively low presence in others (Massey and Denton 1988). Segregation by definition implies spatial concentration: the over-representation of a group in a certain spatial unit compared to the proportion in the entire city (Van Kempen and Özüekren 1998). The phenomenon can involve the spatial concentration of socioeconomic categories such as rich and poor (socioeconomic segregation) or of different migrant communities (ethnic segregation) (Musterd 2005; Musterd and Ostendorf 2009). Both types of segregation are generally regarded as problematic. Through 'neighbourhood effects', residential segregation is assumed to negatively affect, among other things, the labour market opportunities, language abilities, social relations and integration of minority groups in society (Musterd and Andersson 2005). The debate on ethnic segregation and the assumed neighbourhood effects resulting from it has flourished since Wilson's (1987) study on the largely mono-ethnic ghettos in the large metropolises of the United States (Musterd and Van Kempen 2009). In addition, segregation is considered a threat to social inclusion and the welfare state in Europe and beyond (Andersson and Malmberg 2015; Lichter et al. 2012).

In particular the spatial segregation of non-European migrants is a topic of academic and policy debate in several countries across Europe. However, the level of segregation and the specific spatial patterns are different across countries, and across different cities and regions within these countries. These different spatial patterns may be explained by large differences in the size and composition of the non-European migrant population across countries, but also by cross-national differences in structural conditions. A recent comparative study identified globalization, social inequalities,

welfare regimes, housing systems and occupational structures as the main structural factors shaping socioeconomic segregation (Tammaru et al. 2016).

Making country comparisons is important since this makes it possible to discuss the influence of national policies on segregation patterns. Although the countries we study are similar in terms of welfare policies, there are large differences in terms of the housing market, placement policies and in the composition of non-European migrants which may be reflected in different spatial segregation patterns.

Earlier comparative studies on residential segregation have usually been made on the geographical level of cities or city regions. Examples are the study by Musterd and Van Kempen (2009) on ethnic segregation, the recent study by Tammaru et al. (2016) on socioeconomic segregation and the work of Musterd and Ostendorf (1998) and Musterd (2005) on both types of segregation. However, some of the factors that previous studies identified as crucial for shaping spatial segregation – social inequality, welfare regimes and housing market policies (Tammaru et al. 2016) – play a role at the national scale and are just as likely to influence segregation both within and across non-metropolitan areas and metropolitan areas. Segregation is a phenomenon present wherever there is population and is thereby not limited to only the large metropolitan areas or big cities. In fact, patterns of segregation are also visible in small towns and cities. Even, segregation between quite rural settlements might exist. Indeed, a number of recent studies have highlighted residential segregation in non-metropolitan areas as well (Lichter et al. 2012; Östh et al. 2014). It is therefore interesting to compare differences in segregation patterns between different countries, while focusing on urban, suburban and rural areas.

One important finding in our study is that segregation patterns at the lowest geographical scale are remarkably similar, almost identical, across the four countries we study. This is a finding that we have not seen reported before and it points to a strong need to consider how such similar outcomes can result in different countries. At larger scales we find that the level of segregation is markedly higher in Belgium compared to Denmark, Sweden, and the Netherlands. This points to the possibility that differences in policy are more important for large-scale patterns than for small-scale patterns of segregation. Our analysis also shows that the proportion of the population that lives in migrant-dense neighbourhood is higher in countries with a large non-European migrant population. This is not unexpected but underlines that segregation can become a greater challenge in such countries. On the other hand, in Sweden and the Netherlands, relatively high proportions

of non-European migrants are also found in neighbourhoods dominated by natives and European-born persons, a pattern suggesting that policies that are in place in these two countries have had some success in preventing segregation. Overall, the results we present show that, using methods that ensure comparability and a multiscalar approach, opens up possibilities for evaluating competing theories of segregation and for assessing the impact of different policies.

2. Previous comparative studies on segregation patterns and causes

Several previous studies have made cross-country comparisons of residential segregation. Some studies compared segregation in Europe to the US context, and the common conclusion in such studies is that segregation levels in Europe are more modest (Friedrichs et al. 2003; Musterd and Ostendorf 1998). Musterd and Ostendorf (1998) studied segregation in different Western cities, including Stockholm, Amsterdam and Brussels. They concluded that segregation is stronger in Brussels than in Amsterdam and Stockholm, but levels are low compared to the American and South-African contexts.

Musterd and Van Kempen (2009) stressed that mono-ethnic neighbourhoods exist in the US, but are largely absent in European cities. Wacquant (2007) arrived at similar conclusions after his comparison of US 'ghettos' and French 'banlieues'.

Also the spatial patterns of segregation are different across both contexts: whereas in the US the inner-city districts are generally the most deprived parts of the city, in European cities the most distressed areas are generally found in post-war districts on the urban fringes, generally overlapping with the locations of social housing (Friedrichs et al. 2003).

A number of studies compared segregation across metropolitan regions in Europe. Musterd (2005) compared scores on the dissimilarity index (DI) between different European cities, based on a results review (late 1990s and early 2000s). The main result from this comparison of ethnic segregation was that German cities, as well as Oslo and Vienna, have the lowest segregation levels (DI), followed by Dutch cities with the exception of Rotterdam. Belgian cities generally have higher segregation levels. In a later, similar study, Musterd and Van Kempen (2009) again collected DI-scores from European cities for several years and stated that the dissimilarity indices were stable over time, and even decreased somewhat. In another comparative work, no less than 17 cities with a large variety of political regimes/ welfare systems were studied (Kazepov 2008).

In a study of segregation patterns including 16 European countries, clustered into different welfare regimes (social-democratic, corporatist, liberal or Latin Rim), until the mid-1990s, Arbaci (2007) concluded that "welfare arrangements are critically important" (p. 429). Generally, cities in corporatist welfare systems have the lowest levels of spatial segregation because of their 'unitary' or 'integrated' rental system, and cities in liberal welfare states have the highest degree of segregation due to a 'dualist' rental system (Arbaci 2007). In dualist systems, public housing is a restricted sector for low-income households, whereas social housing is competing on even terms with private renting in unitary rental systems (Kemeny 2006; Skifter Andersen et al. 2016).

Comparing 13 major cities in both Eastern and Western Europe, Tammaru et al. (2016) concluded that levels of socioeconomic segregation in European cities are rising, but are still modest compared to the situation in the Americas, Africa and East-Asia. They explained the increase in segregation by neoliberal welfare state transformations and the embeddedness of some European capital in strong global networks. Welfare state arrangements were traditionally meant to redistribute wealth and diminish social inequalities. However, many countries have acknowledged a shift towards more-market oriented welfare regimes to stimulate the economy, resulting in more social inequality and more segregation. City-specific aspects and historical development paths also play a role. The degree to which the city is affected by globalization has a particularly important influence on the degree of segregation, but also the social and physical upgrading of neighbourhoods shapes social segregation. Furthermore, national or local housing market policies, as well as the local housing composition, may affect the spatial distribution of socioeconomic groups across space (Tammaru et al. 2016).

Generally, groups with a low socioeconomic status are over-represented in the social rented sector, which is also not equally distributed across urban space (Friedrichs et al. 2003; Tammaru et al. 2016). Since non-Western migrants are over-represented in the lower socioeconomic strata, ethnic segregation is expected to overlap closely with socioeconomic segregation. The availability of housing, and the opportunities for different ethnic minority groups to get access to this housing market was mentioned as the main drivers of ethnic segregation in literature from the US (South et al. 2011) and Europe (Musterd and Van Kempen 2009; Skifter Andersen et al. 2016).

In Germany and to some extent Sweden, the poorest households live in public housing, allocated by non-profit housing corporations (or companies with social responsibilities), which is predominantly located in peripheral housing estates (Friedrichs et al. 2003). In the Netherlands, the

public housing market is much larger, better dispersed across neighbourhoods, and also not restricted to the lowest incomes.

Skifter Andersen et al. (2016) compared ethnic segregation in four Nordic capitals – Stockholm, Copenhagen, Helsinki and Oslo– which have similar social-democratic welfare state systems but different housing markets and spatial distributions of housing tenures. They found that generally the degree of ethnic segregation increases with the size of the immigrant population: the strongest segregation was found in Stockholm, with the largest immigrant population. However, a lack of local mixing of tenure types also influences the level of segregation. Still, there is no straightforward relationship between the housing system and the level of segregation. Ethnic segregation is stronger in a restricted social sector, but if housing policies guarantee a mixture of tenure in neighbourhoods, the level of segregation for the neighbourhood as a whole may be lower, as the example of Helsinki showed (Skifter Andersen et al. 2016).

The majority of previous comparative studies have focused on socioeconomic segregation. Although ethnic segregation has a socioeconomic component, this only partly explains why certain ethnic groups are concentrated in certain districts (Musterd 2005). Other cultural and historical backgrounds are important for understanding these concentrations. Moreover, discrimination, accessibility of housing and jobs (Musterd 2005; Peach 1999) and choice mechanisms may also play a role for concentration (Van Ham and Clark 2009). Rather than simply following class and income patterns, ethnic segregation results from a combination of choices and constraints (Massey and Denton 1988; Musterd and Van Kempen 2009; Van Ham and Manley 2010). An example of choice elements is ethnic minority members choosing to live among co-ethnics in the same neighbourhood, despite having better housing opportunities elsewhere, as was shown in a case study on the Pakistani community in the UK (Van Ham and Clark 2009). Historically grown migrant communities may reinforce concentrations of certain migrants in specific neighbourhoods (Van Ham and Manley 2010; Zorlu and Latten 2009).

Avoidance or flight by natives also influences the degree of segregation. In the European context some evidence of a higher likelihood for natives to leave multi-ethnic neighbourhoods was found for the UK (Van Ham and Manley 2010) and Denmark and Sweden (Skifter Andersen et al. 2016), and a large number of studies suggests that natives tend to avoid such areas (Bråmå 2006; Zorlu and Latten, 2009). Examples of constraints that lead to the concentration of ethnic groups in

certain neighbourhoods are restrictive housing allocation systems and welfare state mechanisms (Musterd and Van Kempen 2009; Van Ham and Manley 2010).

Furthermore, the segregation of migrant groups often coincides with other, generally socioeconomic, inequalities. Specific ethnic groups are faced with integration problems in both the labour and housing markets (Kandylis et al. 2012). Several studies have identified segregation patterns with respect to the occupational structure of the population (Marcińczak et al. 2012), and the over-representation of (specific groups of) migrants in certain occupations is therefore also reflected in their residential patterns (Arapoglou and Sayas 2009; Maloutas 2007). Other studies have found overlaps between segregation patterns of (non-Western) migrants and concentrations based on average income or dependency on welfare benefits (Hartog and Zorlu 2009).

Based on previous studies, differences in segregation patterns between Belgium, Denmark, the Netherlands and Sweden will thus depend basically on how factors such as the housing market, the welfare state and spatial planning are arranged in each national context. Regarding the welfare state system, Denmark, Sweden and the Netherlands fall into a social-democratic welfare cluster, whereas Belgium can be characterised as a corporatist welfare state (Arbaci 2007). This is also reflected in the housing market structure. Belgium has a dualist rental system, with a very limited social rental sector, accounting for only 6.9% of the total housing stock (De Decker 2008; Kesteloot and Cortie 1998; Vanneste et al. 2008), which is considerably lower than the number of families eligible for public rented housing (De Decker 2008; Kesteloot and Cortie 1998). Already in 1998, different segregation outcomes between Belgium and Sweden were said to be "in part based on the different nature of the housing system" (Van der Wusten and Musterd 1998, p. 240). The same study also concluded that an important public housing component can have "a softening effect on segregation levels" (p. 246).

Although the Netherlands, Sweden and Denmark have unitary rental systems with a large stock of public housing, there are still considerable differences between the three housing markets. In 2011, 44 per cent of the total housing stock in the Netherlands belonged to the public rented sector: subsidized dwellings offered by housing corporations, with rents below approximately 600 euros. In the cities, this proportion has always been higher: in Amsterdam, it was approximately 67 per cent in 2011 (Statistics Netherlands 2011). The Dutch social rented sector is considered attractive because of the large proportion of single-family housing and the often good state of dwellings. Although units are generally allocated to low-income households, tenants cannot be evicted when

their income increases. As a result, the tenants are mixed in terms of income (Bolt et al. 2008). In recent years, however, urban policies have been aiming at reducing the stock of social rented dwellings (Savini et al. 2016). The large and diverse Dutch social rented sector explains why segregation levels in Dutch cities are much more modest compared to cities in the UK (Murie and Musterd 1996), where the social rented sector is smaller and spatially more concentrated. Kesteloot and Cortie (1998) compared ethnic segregation in Amsterdam and Brussels for Turkish and Moroccan migrants and concluded that these groups are more strongly segregated in Brussels. Due to the small social rented sector in Brussels and their generally lower incomes, Turkish and Moroccan migrants in Belgium depend on the private rented sector, which is mainly found in a restricted number of working-class neighbourhoods.

There are also differences in the composition of the non-European migrant population as well as their housing situation in the studied countries. For example, Belgium and the Netherlands both have a significant, and country-specific, migrant population from former colonies (migrants from Congo in Belgium; from Indonesia, Surinam, the former Netherlands Antilles and Aruba in the Netherlands (Van Mol and De Valk 2016)). Belgium and the Netherlands both have considerable communities of Moroccan and Turkish migrants, while Denmark and to a lesser degree Sweden also have notable Turkish communities. The dominant non-European migrant groups in Sweden are former Yugoslavians, Iraqis and Iranians (Musterd and Andersson 2005, p. 333), although recently Syrians have replaced former Yugoslavians in the top three (Statistics Sweden 2015). In Denmark, Turks, Iraqis, Lebanese and Bosnians are the dominant immigrant groups (Statistics Denmark 2015). In all four countries, ethnic minorities are over-represented in the rental sector and under-represented in the owner-occupied housing market (Musterd and Van Kempen 2009). Nevertheless, there is support for differences in pathways and speed of entering the housing market between immigrants born in different countries (Magnusson Turner and Hedman 2014; Skifter Andersen et al. 2016). For Sweden, Magnusson Turner and Hedman (2014) showed that Sub-Saharan African immigrants took the longest time to enter home-ownership tenure.

Another factor influencing segregation patterns is differing immigration and settlement policies that regulate the number of people entering the country, where immigrants locate, when they can enter, who can enter, as well as the support to immigrants living in the country. Sweden, Denmark and the Netherlands have policies aiming at the dispersal of refugee populations (Andersson 2003; Robinson et al. 2004). Concerning the number of entering non-European migrants, Denmark, was

renowned for its low levels of immigration before 2015, whereas Sweden, the Netherlands and Belgium have accepted larger numbers. In earlier studies, Scandinavian countries together with the Netherlands were portrayed as similar concerning the organization of housing, and in many ways also concerning their welfare systems (Esping-Andersen 1990; Van der Wusten and Musterd 1998). As regards welfare systems, Belgium has also been characterised as a western European welfare state (Esping-Andersen 1990). This welfare state classification in some ways indicates similarities rather than differences between the countries in our study.

3. The role of spatial scale for segregation measurement

Over the past two decades, an increasing number of studies have addressed how residential segregation relates to spatial scale. Van der Wusten and Musterd (1998) concluded that their study on segregation in Western cities cannot be considered truly comparative due to barriers related to data acquisition, differences in spatial units and different definitions of ethnic categories. In relation to the scale-dependent nature of segregation effects, he observed that:

> *"When either income or ethnic status differences are very pronounced, exclusion is supposed to follow. In the case of segregation, opinions are more divided. It depends on the spatial scales involved: the larger the units, the higher the probability of exclusion. A major reason why this seems convincing is the provision of a self-sufficient environment within larger units with no incentives to use urban space at large." (*Van der Wusten and Musterd 1998, p. 241*)*

Similar conclusions were drawn by Musterd (2005), whose study compared levels of ethnic segregation across metropolitan areas in different European countries, and acknowledged both conceptual issues and problems related to the scale of measurement and time points in measurement. The different ways in which statistical units are constituted across different areas is referred to as the Modifiable Areal Unit Problem (MAUP) (Openshaw 1984; Östh et al. 2014). MAUP prevents reliable comparisons of segregation levels and patterns between areas of different sizes but also between different countries. Ideally, comparative studies should be conducted using uniform units of measurement (Musterd 2005).

Most studies on residential segregation have thus far focused on patterns in metropolitan areas and have used administrative (neighbourhoods) and statistical (census tracts) units for segregation measurement. Krupka (2007) argued that the often found relationship between high segregation levels and large city size is spurious and caused by differences in neighbourhood size between

larger cities and smaller towns. Census tracts in metropolitan areas generally consist of a single neighbourhood, while neighbourhoods in smaller towns have fewer inhabitants and have to be combined in order to fill a census tract of comparable size. Krupka (2007) measured segregation at different spatial scales and found that using smaller areas of analysis diminished the differences between large cities and small ones.

The plea for multiscalar measurements of segregation has intensified over the past few years. Fowler (2015) recently argued that there is no 'correct' scale for measuring segregation: it is continuous across scales and should be measured accordingly. Single scalar measurements may also ignore the fact that smaller units are embedded in larger spatial contexts. Within larger entities with low or moderate segregation levels, strong concentrations may exist at smaller spatial scales, or vice versa. Focusing on only one spatial scale may overlook specific ethnic concentrations (Fowler 2015). Furthermore, fixed borders may lead to over- or underestimations of very specific concentrations that occur at the border of two administrative or statistical districts (Clark et al. 2015).

The increased availability of geo-coded individual data offers opportunities for solving boundary and scale issues, by constructing scalable individualized neighbourhoods. These districts are 'egocentric': the exact residential location of an individual is taken as the centroid, from where a buffer is constructed that consists of a predefined distance radius (Reardon et al. 2008) or a k-number of nearest neighbours (k-levels) (Andersson and Malmberg 2015; Östh et al. 2014). The resulting sample of individuals is then used to compute aggregate statistics, such as the share of people within a buffer belonging to a certain migrant group (Clark et al. 2015). Since the distance radius or the number of nearest neighbours within the buffer can vary, individualized neighbourhoods of different sizes seen from the same location can be studied, enabling analysing residential segregation from a multiscalar perspective.

Scale can be of importance both with respect to concentration and representation. If there is a high concentration of non-European migrants at small neighbourhood scales (for example, among the nearest 200 neighbours) but not on a larger scale (for example among the 1,000 or 10,000 nearest neighbours) this can, as suggested by Van der Wusten and Musterd (1998), have consequences for the way people living in the neighbourhood interact with different groups. Even if interaction with the closest neighbours will be mostly with non-European migrants, interaction in workplaces, at shopping centres, cafés etc. can be with a more mixed population. If, on the other

hand, the concentration of non-European migrants is high also for larger scale neighbourhoods including the 50,000 nearest neighbours, this can result in much larger proportions of individuals' daily and weekly activities taking place in a context where the concentration of non-European migrants is high. This will allow the typical mechanisms discussed as important for neighbourhood effects such as role models, to influence norms, or it will allow network formation to have a greater effect on individuals. Studies on Swedish data using multiscalar measures of neighbourhood contexts suggest that this reasoning is valid (Andersson and Malmberg 2015; 2016). Large-scale elite environments and large-scale deprived areas tend to have a more pronounced effect on individual level outcome compared to small-scale contexts.

A similar argument can be made with respect to small-scale and large-scale, under- and over-representation of non-European migrants. Certainly, high levels of small-scale, under- and over-representation of non-European migrants are problematic since they signal a principle of separateness and may also reflect a negative attitude towards mixing in the local area. Still, if the under- and over-representation of non-European migrants at higher scale levels is less strong, this can signal preparedness for sharing a broader urban environment with groups of different origins. Strong under- and over-representation at larger scales, for example among the nearest 50,000 neighbours, could make under-represented groups feel unwelcome. Living in an area where large-scale under-representation is strong also implies that there is little opportunity, even if moving outside your immediate neighbourhood, of getting to know the under-represented group.

4. Data and methods

The empirical analysis of this paper focuses on non-European migrants, with Europe defined as consisting of the 28 European Union member states plus the four EFTA countries, Norway, Switzerland, Iceland and Liechtenstein[1]. Migrants are defined by country of birth. That is, we study only first-generation immigrants and not their descendants. In all the countries, data on country of birth are from population registers (the central population register in Denmark, the national register of natural persons in Belgium, municipal population registers in the Netherlands, and the total population register in Sweden).

[1] Persons born in Andorra or Serbia are considered non-Europeans.

In Denmark, Belgium, and the Netherlands, residential coordinates for individuals in the population registers were obtained by matching addresses in the population registers with addresses in building registers or land registers (Den Offentlige Informationsserver (OIS) in Denmark, Land registry of the General Administration of Patrimonial Documentation in Belgium, and Basisregistratie Adressen en Gebouwen in the Netherlands). In Sweden, permanent residents are registered to specific real estate properties and residential coordinates were obtained by matching with the land registry on the basis of the property registration numbers. In Sweden, the individual geo-coded data was made available to researchers through an online database created for the Department of Human Geography by Statistics Sweden (Geostar). In the Netherlands, the data is a part of the System of Social Statistical Datasets (SSD) created by Statistics Netherlands. In Belgium, the linkage between the population register and the geo-coordinates is administered as a part of the 2011 register-based census. In each country, the total population was taken into account (Nielsen et al. 2017).

Table 1. The gridded populations, descriptive statistics

	Number of populated grid squares	Median population	Maximum population	Median number of non-European migrants	Maximum number of non-European migrants	Total population
Belgium	608,850	9	1,753	0	516	11,000,638
Denmark	421,365	5	1,129	0	275	5,566,100
Netherlands	559,504	11	1,105	0	771	16,727,659
Sweden	202,067	157	4,114	7	1345	9,466,727

The processing of the register data was carried out in the same way in all four countries. In the first step, the individual level data was aggregated to a geographical grid of 100 meters by 100 meters (in Denmark, the Netherlands, and Belgium) and, for Sweden, to a geographical grid of 250 meters by 250 meters (in densely populated areas, due to data restrictions), or 1000 meters by 1000 meters (in sparsely populated areas), see Table 1. For each square the number of non-European migrants and the total population number were computed.

Table 2. Size of individualized neighbourhoods, radius in meters

	Belgium	Denmark	Netherlands	Sweden
Percentile	k=200	k=200	k=200	k=200
10	100	100	100	0
25	100	100	100	0
50	141	141	100	250
75	224	224	141	250
90	424	1,000	224	1,414
95	608	1,513	500	2,236
99	1,105	2,200	1,265	5,000
	k=51,200	k=51,200	k=51,200	k=51,200
10	1,500	1,664	1,712	2,000
25	2,865	3,354	2,302	3,162
50	5,049	7,912	3,612	10,050
75	7,200	15,008	6,379	22,472
90	9,411	20,132	9,080	35,609
95	12,394	23,308	10,515	44,294
99	20,096	36,111	14,091	104,346

Note: Percentiles based on population count.

In the second step, the Equipop software (Östh et al. 2014) was used to process this gridded population data. What Equipop does is to expand a buffer around each populated grid cell until the total population count in the buffer reaches a threshold level of *k* nearest neighbours. When this threshold is reached, Equipop computes the proportion of non-European migrants in the buffer population. If calculations for multiple k-levels are requested, the software then continues to expand the buffer until the next threshold is reached, computes the proportion of non-European migrants, and continues to expand the buffer and calculate proportions until values for all the requested k-values are obtained. In the current study, proportions of non-European migrants were computed for the 200, 400, 800, 1600, 3200, 6400, 12800, 25600, 51200 nearest neighbours.

Since the individualized neighbourhoods are expanded until a specific population threshold is reached, their geographical size/radius in meters will vary depending on population density. Table 2 provides information about this variation. Some neighbourhoods will be very large, much larger than the areas one conventionally regards as neighbourhoods. Thus, our concept of neighbourhood is stretched in its meaning. They are neighbourhoods in virtue of being areas that reach a pre-defined number of closest neighbours.

One important conclusion from Table 2 is that in spite of very large differences in overall population density, people in the four countries live in local neighbourhoods that are similarly structured. 50% of the population have their closest 200 neighbours within around 200 meters from their dwelling or less, and 90% of the population have their closest 200 neighbours within around 1000-1500 meters or less; in Belgium as close as within a 400-meter radius. It is only around 1% of the population in Sweden that lives in a location where the distance to the closest 200 neighbours is much greater than in Denmark, Belgium, or the Netherlands.

If, however, the neighbourhood scale is expanded to encompass the closest 51,200 neighbours, the picture changes somewhat. For 25% of the population there is essentially no difference. Their distance to the nearest 51,200 neighbours is about 3 km or less in all four countries. Instead, the largest differences in population density are found for the 25% of the population that live in the sparsely populated areas. In Sweden, for this population the neighbourhood area needs to be given a radius of at least 22.5 kilometres in order to encompass 51,200 neighbours, whereas 11 km or more will suffice to reach 51,200 for the Dutch and Belgians living in the 25 % most sparsely populated neighbourhoods. And the differences are even larger for the 1% most sparsely populated individualized neighbourhoods. In Sweden, this group would need to attract all neighbours within a radius of at least 100 km in order to generate a crowd of 51,200 people, whereas in the Netherlands a radius of 16 km would suffice. Thus, in spite of large differences in population density, national differences in the geographical structure of the neighbourhoods are unlikely to influence segregation patterns at small neighbourhood scales. But it could be argued that in sparsely populated parts of Sweden, the presence of non-European migrants among the closest 51,200 neighbours implies that there is not even cycling distance between them and individuals from the majority population.

Concentration

The values obtained as output from the Equipop processing correspond to the concentration measure of segregation: the proportion of the local neighbourhood's population that consists of non-European migrants. In order to compare differences in concentration across countries we look at the percentile values of this proportion. One important point to remember here is that when neighbourhood values are computed for individualized neighbourhoods, the number of neighbourhoods will correspond to the number of individuals in the population. Each individual

has its own neighbourhood. Thus, if the 10th percentile of the local neighbourhoods' population that consists of non-European migrants is 1 %, this signifies that 10 % of the population lives in neighbourhoods with less than 1 % non-European migrants. Percentile values across different countries and across k-values will, therefore, provide a detailed and comparable picture of how segregation in terms of local concentration of non-European migrants varies between countries.

Representation of non-European migrants

Representation is measured as the proportion of the total non-European migrant population that is living in a neighbourhood. If this proportion is lower than that neighbourhood's proportion of the overall total population, then non-European migrants are under-represented. To assess this representation of non-European migrants in different neighbourhoods, the data resulting from the Equipop processing was aggregated into 100 different neighbourhood types, or bins, based on the proportion of non-European migrants, each bin representing 1 % of the total population. That is, the first bin is an aggregation of the individualized neighbourhoods that have a concentration of non-European migrants that is lower than the first percentile. The second bin consists of the neighbourhoods that have a concentration of non-European migrants higher than the first percentile but lower than the second percentile. And so on. The mean of non-European migrants in the first 99 bins was computed by taking the mean of the lower and upper percentiles of each bin. However, for the 100th bin, with the highest proportion of non-European migrants, the mean proportion was estimated as the 99th percentile plus the difference between the 98th and 99th percentiles. (The motive for using this estimate was that the Equipop values for egocentric neighbourhoods with values above the 99th percentile tended to be clustered closer to the 99th percentile than to the maximum[2].)

Based on these grouped neighbourhoods, the representation of non-European migrants in different types of neighbourhoods was computed as:

[2] Note that in the data used to calculate representation the minimum value (0 percentile) was imputed from the 1st and 2nd percentile values. If the 1st percentile was zero, then the 0 percentile was set to zero. Otherwise the 0 percentile value was computed as the product between the 1st percentile and the ratio of the 1st percentile to the 2nd percentile. In the Swedish case we compared the values computed using percentiles with the values obtained using non-aggregated data for the egocentric neighbourhoods. The results show that the adjusted method for the 99th to 100th percentile works well.

$$\frac{NonEuropeans_i}{\sum_{i=0}^{99} NonEuropeans_i} \quad (1)$$

where $NonEuropeans_i$ is the number of non-European migrants living in bin i. Expression (1), thus, is the proportion of the total non-European migrant population, $\sum_{i=0}^{99} NonEuropeans_i$, that is living in bin i. Since each bin contains one percent of the total population, equal representation is achieved when the value of expression (1) is one percent. If the proportion is lower than one percent, non-Europeans are under-represented. If the proportion is higher than one percent, non-Europeans are over-represented.

Patterns of over- and under-representation of non-European migrants were analysed using plots that showed the variation in representation across neighbourhood bins. Two sets of plots were produced; one set focusing on neighbourhood bins where non-European migrants are under-represented, and one set of plots focusing on neighbourhood bins where non-European migrants are over-represented, that is, where the representation of non-European migrants is above one percent. Moreover, we suggest, due to reasons of interpretation, that representation values above 2 % and below 0.5 % can be designated as cases of *moderate* over- or under-representation respectively, and that representation values above 5 % and below 0.2 % can be designated as cases of *strong* over- and under-representation. Interpreting the numbers, one can say that 0.5% representation is half of what would be equal representation and 2%, twice the size of the equal representation value. Similarly, 0.2% is one-fifth of the norm, and 5% is five times the equal representation norm. Given the distribution of representation values in the four countries under study these cut-off values, included in the graphs (Figure 2), provide good benchmarks.

The definitions of concentration and representation used in this paper are given in Table 3. Here it is clarified that the concentration measure relates the size of the neighbourhood non-European migrant population to the size of the total neighbourhood population, whereas the representation measure relates the size of the neighbourhood non-European migrant population to the total non-European migrant population in the country (Hennerdal and Nielsen 2017). Note also the different probability interpretations of concentration and representation that are given in Table 3.

Table 3. Concentration and representation explained

Concentration	Representation
$\frac{Non\ European\ migrants\ in\ neighborhood}{Total\ neighborhood\ population}$	$\frac{Non\ European\ migrants\ in\ neighborhood}{Total\ Non\ European\ migrant\ population}$
Probability interpretation: Selecting one individual randomly from the neighbourhood, what is the probability that the individual will be a non-European migrant?	*Probability interpretation*: Selecting one individual randomly from the non-European migrant population, what is the probability that the individual will live in this specific neighbourhood?

The dissimilarity index: An aggregate measure of over- and under-representation

The most widely used aggregate measure of segregation is the dissimilarity index (Duncan and Duncan 1955; Massey and Denton 1988; Park et al. 1925). With two population groups, *NE*, non-European migrants, and *E*, European-born persons, the dissimilarity index can be defined as:

$$DI = \frac{1}{2} * \sum_{i=0}^{99} \left| \frac{ne_i}{NE} - \frac{e_i}{E} \right| \qquad (2)$$

where ne_i is the number of non-European migrants living in neighbourhood bin *i*, e_i is the number of European-born persons living in neighbourhood bin *i*, *NE* is the total non-European migrant population, and *E* is the total European-born population. An inspection of (2) shows that $\frac{ne_i}{NE}$ is our measure of representation for non-European migrants. In the same way, $\frac{e_i}{E}$ is the representation of European-born persons. This implies that the dissimilarity index, being the sum of the absolute difference between non-European migrant representation and European-born person representation, divided by two, is an aggregate measure of over- and under-representation. *DI* will be zero if both groups are equally represented in all neighbourhoods, and one if non-European migrants have zero representation in neighbourhoods where European-born persons live, whereas European-born persons have zero representation where non-European migrants live. Note that in this formula *NE,* ne_i*, E, and* e_i are not defined in the same way as when *DI* is computed for fixed geographical areas. Yet, the standard interpretation of *DI* as the share of the minority population that needs to move in order to arrive at an even distribution still applies.

Using the approach described above we computed dissimilarity indices for the four countries under study and for different k-values. A comparison of these indices will complement the analysis of over under- and over-representation based on percentile plots and help us to assess to what extent segregation patterns in these countries are similar or dissimilar.

5. Results

The first point of interest is how the inflow of non-European migrants has shaped the population *composition* of neighbourhoods in the four countries under study. This concentration can be analysed using bin plots for the proportion of the neighbourhood population that consists of non-European migrants. Another point of interest is to what extent the non-European migrant population is evenly distributed across neighbourhoods. That is, the analysis focuses on the degree to which non-European migrants are *over*- and *under-represented* in neighbourhoods.

The non-European migrant population in Belgium, Denmark, the Netherlands, and Sweden

There are few studies that have systematically studied to what extent segregation levels differ between countries. Therefore, the aim of this study is to compare levels and patterns of non-European migrant segregation in the four different countries.

Non-European migrants in the four countries are more similar in terms of their origins compared to European migrants, whose origins are more diverse and distance-related. If there is a crisis e.g. in a Middle-Eastern country, immigrants will enter all countries examined in this study. Differences between the European migrant populations also occur because European immigrants are dominated by the closest neighbouring countries, like Finns and Norwegians in Sweden for example. These immigrants often dominate in border regions.

Also, non-European migrants are an especially vulnerable group when it comes to employment, welfare and discrimination. Non-European migrants generally have a less favourable position in terms of employment, income, and education, as well as higher welfare benefit dependency. Therefore, strong concentrations of these groups are generally considered problematic and receive widespread attention from the media, policy-makers and academia (Andersson and Malmberg 2015; Musterd 2005). In addition, this interplay between ethnic and socioeconomic indicators makes this group relatively vulnerable to the assumed negative neighbourhood effects that are

generally associated with living in a neighbourhood with a high concentration of non-European migrants.

Table 4. Population share of non-European migrants in Denmark, Belgium, the Netherlands, and Sweden, 2011 and 2015

Country	2011	2015
Denmark	4.8%	6.9%
Belgium	7.3%	8.5%
Netherlands	8.0%	8.7%
Sweden	9.1%	11.1%

Source data 2011: respective authors' data – see methods section.
Source data 2015: Eurostat. Data pertains to persons born in a non-members state, Jan 1.

The total population in Denmark in 1990 was 5,135,409 and in 2011 it was 5,560,628, and the proportion of immigrants increased over the same period. Among all immigrants, the proportion of non-EU immigrants has risen the fastest, from 1.9 in 1990 to 4.8 in 2011 (and 5.7 in 2016).

The total Swedish population increased from 8,590,701 in 1990 to 9,555,892 in 2012. Compared to Denmark, Sweden had a higher proportion of both European and non-European migrants at the beginning and at the end of the period. An important difference is that in Sweden, during this period, the proportion of European migrants was higher compared to Denmark, where non-European migrants represented the majority of migrants.

In the Netherlands, the composition of migrants is similar to Denmark in that the proportion of non-European migrants is larger than the proportion of European migrants. The four largest non-Western groups in the Netherlands are Moroccans, Antilleans, Surinamese and Turks (Hartog and Zorlu 2009).

In Belgium, Europeans make up the majority of migrants, coming mostly from the neighbouring countries as well as from Italy. However, the largest increase in numbers in recent years was East-Europeans after the successive enlargements of the EU since the 1990s. The largest groups of non-European migrants in Belgium are of Turkish, Moroccan and, to a lesser extent, Congolese origin (Phalet et al. 2007).

Neighbourhood level concentration of the non-European population: By percentiles

In Figure 1, percentile plots for different scales (k-levels) show how the concentration of non-European migrants varies between neighbourhoods in the different countries. The percentile plots are split into two parts: one plot showing percentiles 0 to 80 (presented in the left-hand column of Figure 1) and one plot showing percentiles 70 to 99 (presented in the right hand column). By splitting the plots, *different scaling of the vertical axes* can be used, making it easier to read the concentration values for low percentiles. In the discussion below we first look at percentiles with the highest proportions of non-European migrants, especially the 10% most immigrant-dense areas. Thereafter, we look at percentiles consisting of neighbourhoods with low proportions of non-European migrants.

Concerning the rank of the proportions in the various countries, please see the right column, first diagram in Figure 1, for k 200 and the 90 to 99 % of the population living in most non-European-dense areas. The line for Sweden is above the others, showing the highest concentrations of immigrants in these immigrant-dense neighbourhoods. The reason for this is based on the fact that Sweden has the highest proportion of non-European migrants overall, while the Netherlands and then Belgium and finally Denmark have lower levels, Table 4. However, the most important message is that the patterns of the proportions across neighbourhoods of non-European migrants are very similar in the countries; it is almost exclusively the difference between the overall proportions that makes the difference between lines in the graphs.

In Denmark, in the 10 % most migrant-dense areas, proportions vary from 13 % up to the value of 36 % (at the k 200 level), for the 90^{th} to 99^{th} percentiles (Table 5). These proportions are lower compared to the most immigrant-dense areas in the other countries. In Belgium, the proportions are a little higher: 21 % to 44 % non-European migrants in the densest areas. For the Netherlands, again the proportions are higher, the equivalent numbers are 21% to 47% non-European migrants in the 10% most immigrant-dense neighbourhoods. In Sweden, the percentage for 2011 is the highest and varies between 26% and 55% non-European migrants in the most immigrant-dense areas, Table 5 and Figure 1. Thus, concentrations of non-European migrants in the Netherlands and Sweden are high in certain neighbourhoods.

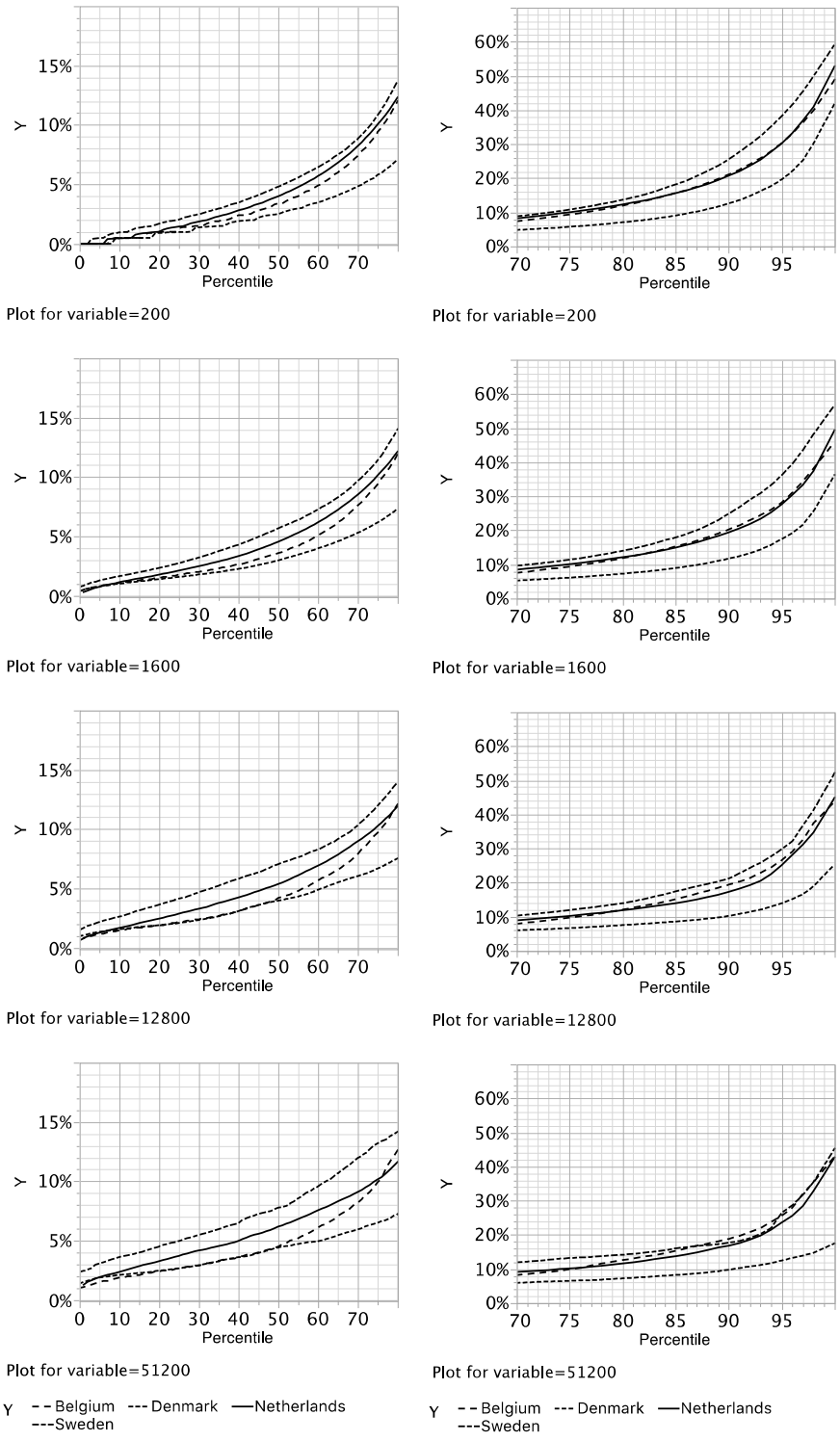

Figure 1. Concentration of non-European migrants in individualized neighbourhoods in Belgium, Denmark, the Netherlands and Sweden, 2011

Note: Percentile values for k-levels 200, 1600, 12800, and 51200. Lower percentiles in column one and percentiles above 70 in column two.

The left-hand column in Figure 1 shows the neighbourhoods with low proportions of non-European migrants, that is where natives and European migrants dominate. Continuing from the discussion above, the overall rank of countries' proportions in neighbourhoods has only a few deviations in this pattern, reflecting the national proportions. There are also two groups of countries, one including Sweden and the Netherlands and another including Denmark and Belgium. Seventy percent of the population (percentiles >30) in Sweden are living in diversifying neighbourhoods, that is, containing more than 5 % non-European migrants (k=12800, in Figure 1). The situation in Sweden can be considered as one in which there is a move towards spatial assimilation in that regard of having diverse neighbourhoods (even if this is only a cross-sectional measurement). Non-European migrants are living in the majority of neighbourhoods.

Belgium, on the other hand, shows a pattern of low proportions in neighbourhoods of about 50 % of its population but then there is an abrupt change to high proportions of non-European migrants in the rest of the 50% population (k=12800 in Figure 1). So, even if Belgium and Denmark have similar low levels of non-European migrants in low migrant-dense areas, the lines depart from 50% of neighbourhoods. This can be seen especially at higher scale levels of k12800 and 51200. In Belgium, the pattern indicates that large areas of the housing stock are inaccessible to non-European migrants. This may be due to the fact that many non-European newcomers are concentrated in central urban neighbourhoods with low-quality dwellings and are excluded from suburban areas with better housing conditions. The line for Belgium is in this regard at the same low proportion level as for Denmark, which has a much lower overall proportion of non-European migrants. However, the line for Denmark in Figure 1 continues at a lower level of non-European migrants in neighbourhoods in all the population.

Table 5. Concentration of non-European immigrants in Belgium, Denmark, Netherlands, and Sweden, percentiles for different scales (k-levels)

Percentile	Belgium	Denmark	Netherlands	Sweden
	k=200	*k*=200	*k*=200	*k*=200
10	0.5%	0.5%	0.5%	0.9%
25	1.3%	1.0%	1.4%	2.0%
50	3.4%	2.5%	4.0%	4.8%
75	9.4%	5.8%	10.0%	10.8%
90	21.1%	12.6%	20.7%	25.5%
95	30.3%	19.6%	30.2%	38.3%
99	44.4%	36.1%	46.8%	54.6%
	k=1,600	*k*=1,600	*k*=1,600	*k*=1,600
10	1.1%	1.0%	1.2%	1.7%
25	1.8%	1.6%	2.1%	2.8%
50	3.6%	3.0%	4.6%	5.7%
75	9.4%	6.2%	10.1%	11.4%
90	20.3%	11.7%	19.5%	24.9%
95	28.2%	17.5%	27.7%	36.2%
99	42.1%	31.0%	43.4%	52.6%
	k=12,800	*k*=12,800	*k*=12,800	*k*=12,800
10	1.5%	1.6%	1.7%	2.6%
25	2.2%	2.1%	2.9%	4.1%
50	4.2%	4.0%	5.4%	7.1%
75	9.7%	6.7%	10.2%	12.0%
90	19.4%	10.3%	17.3%	21.2%
95	26.6%	13.9%	25.1%	29.9%
99	40.6%	22.2%	39.8%	46.7%
	k=51,200	*k*=51,200	*k*=51,200	*k*=51,200
10	1.9%	2.1%	2.4%	3.6%
25	2.7%	2.7%	3.7%	5.0%
50	4.5%	4.4%	6.2%	7.8%
75	9.9%	6.5%	10.1%	13.2%
90	18.8%	9.8%	16.8%	17.7%
95	25.6%	12.5%	23.6%	26.5%
99	39.3%	16.1%	37.8%	40.4%

Representation of non-European migrants across neighbourhoods

Figure 2 shows, for different k-values, the *representation* of non-European migrants across neighbourhood types in Belgium, Denmark, the Netherlands, and Sweden. Again, in order to facilitate the analysis, the left-hand column shows this proportion for the 71 bins that have the lowest proportion of non-European migrants. The right hand column shows the proportion of non-European migrants living in the 41 bins with the highest proportion of non-European migrants. Remember also that each bin represents 1% of the total population in each country; that is why there should be 1% of non-European immigrants if they were evenly distributed across neighbourhoods.

Looking, first, at the left-hand column Figure 2, these graphs show how large parts of the population in the four countries live in neighbourhoods with *a lower proportion* of non-European migrants than one would expect if every bin had the same proportion of non-European migrants (top of graph is equal to 1 %).

If the proportion of the total population of non-European migrants in the different bins had been close to 1 % percent, this would indicate low levels of segregation. But the graphs show that large parts of the population in all these four countries live in neighbourhoods where the proportion of non-European migrants is very much lower than would be expected if there was no segregation. This is especially true for low k-levels. For k=200, about 50 % of the population in Belgium, Denmark, the Netherlands and Sweden live in neighbourhoods whose proportion of non-Europeans is less than half (0.5%) of what would be expected with an equal distribution of non-Europeans across neighbourhoods. Along these lines, 20 % of the population in all Denmark, the Netherlands and Sweden, and close to 30 % of the population in Belgium live in neighbourhoods whose proportion of non-European migrants is less than one-fifth of what would be expected with an equal distribution. What is striking here is that the figures are very similar across Denmark, the Netherlands and Sweden (Figure 2). Belgium has an even stronger under-representation.

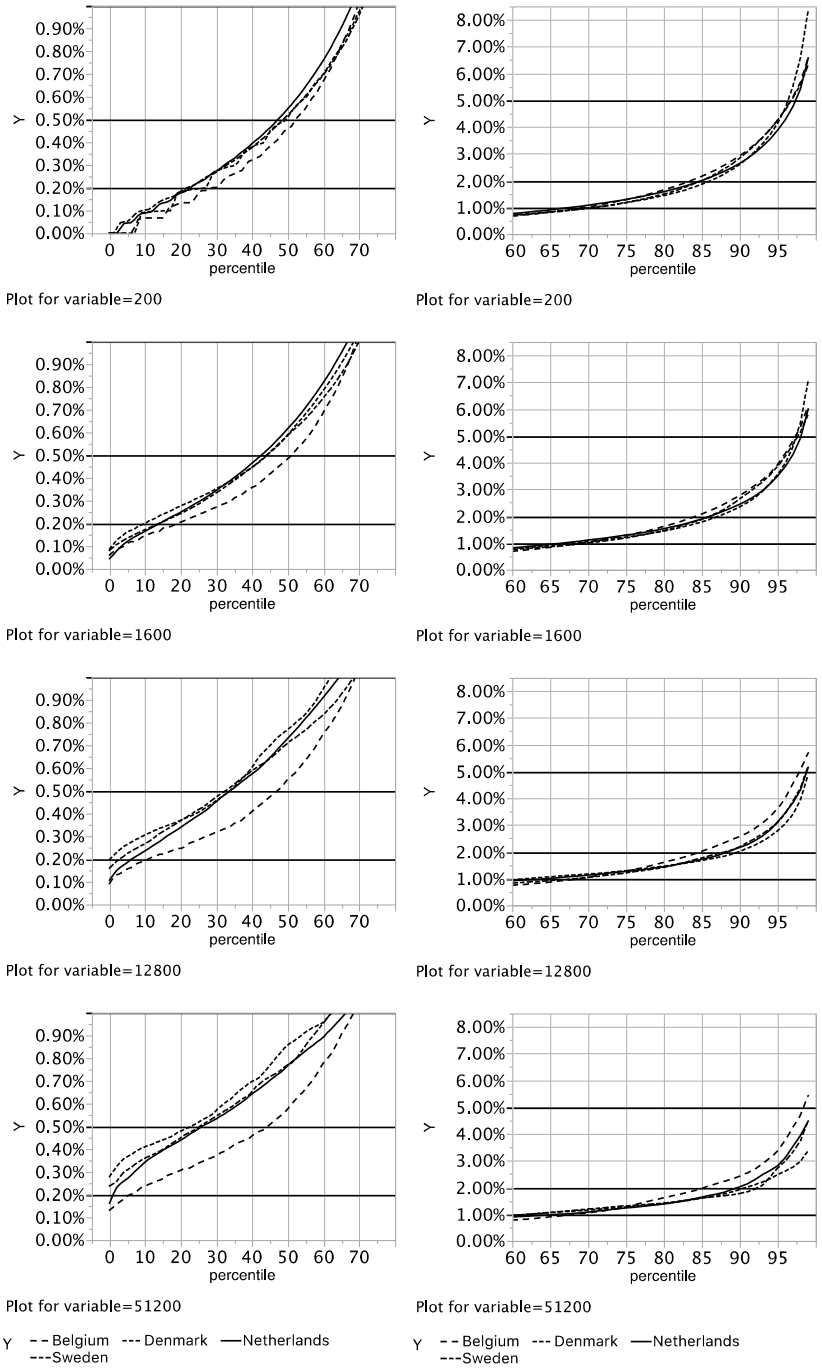

Figure 2. Representation of non-European migrants in 1 % population bins.

Note: Population bins sorted according to proportion of non-European migrants and diagrams showing different k-values. Left column showing under-representation (below 1 %, which is at the top of the diagram) and moderate and strong under-representation with 0.5 % and 0.2 %. Right column illustrating over-representation above 1 % and moderate and strong over-representation at 2.0 % and 5.0 % non-European migrants in a bin.

For larger k-values, segregation levels are less strong, at least in Denmark, the Netherlands and Sweden. Thus, for k=51,200, less than 25 % of the population in Denmark, the Netherlands and Sweden live in neighbourhoods whose proportion of non-European migrants is less than half of what would be expected with an equal distribution. And almost no one lives in areas where the proportion of non-Europeans is less than one-fifth of what would be expected with an equal distribution. Again Belgium differs. Here, almost 45 % of the population lives in neighbourhoods whose proportion of non-Europeans is less than half of what would be expected with an equal distribution. And about 5 % of the Belgian population lives in neighbourhoods where the representation of non-European migrants is less than one-fifth of what would be expected with an equal distribution.

Now, turning to the right hand column, we can focus instead on segregation patterns in areas where there is an over-representation of non-European migrants. As can be seen in these graphs, this over-representation starts around the 70th percentile for low k-values and at around the 60th percentile for the highest k-values. However, for k=200, only about 15 % of the population in Denmark, the Netherlands and Sweden (and somewhat more in Belgium) lives in neighbourhoods whose proportion of the total non-European population is twice as high as it would be with no segregation. For higher k-values this percentage is even lower, at least if Belgium is excluded. In Sweden, for k=51,200, about 7.5 % of the population lives in neighbourhoods where the representation of non- Europeans is twice the level of equal representation. In Denmark and the Netherlands, 10 % of the population lives in such neighbourhoods, whereas in Belgium about 15 % of the population lives in areas with such over-representation. Moreover, in Belgium, 2 % of the population lives in k=51,200 neighbourhoods where the over-representation of non-European migrants is even more extreme, 7.5 times the level that would correspond to equal representation.

Dissimilarity index

The dissimilarity index (DI) shows to what extent the spatial sorting of the non-European migrant population is stronger in some of our studied countries than in others. The smaller the number of nearest neighbours, the larger the measured dissimilarity index. This is the regular consequence of small populations more easily becoming homogenous than large populations and areas. The larger the population, the more likely there will be a larger mix and a lower dissimilarity index. This is undoubtedly the most obvious result when measuring dissimilarity at several scales,

and points to the importance of having detailed multiscalar data when measuring segregation (Table 6).

Table 6. Dissimilarity index in Belgium, Denmark, Netherlands, and Sweden

k-value	Belgium	Denmark	Netherlands	Sweden
200	51.2%	47.5%	48.7%	48.9%
1600	47.3%	40.4%	43.6%	44.1%
12800	43.7%	31.3%	37.5%	35.7%
51200	40.6%	25.3%	32.6%	29.7%

Starting at the number of 200 closest neighbours, i.e. rather small local areas, the dissimilarity index ranges from Denmark's 0.475 to the value for the Netherlands of 0.487, to the value for Sweden of 0.489 and the highest dissimilarity for Belgium of 0.512. The same order, with Denmark having the lowest, the Netherlands second lowest, Sweden third lowest and Belgium the highest measured DI is the rule throughout k equal to 200, 400, 800, 1600, 3200 and 6400. At the large-scale level of neighbourhoods with 12800 closest neighbours, the order is changed so that the Netherlands has the second highest value followed by Sweden and Denmark, and the same goes for k equal to 51200. In all cases, Belgium has the highest value for DI. While Sweden and the Netherlands by scale change from the second to third highest index value, Denmark increases the relative difference in DI value compared to Sweden and the Netherlands as the scale of neighbourhoods increases. In conclusion, Denmark has the lowest segregation of non-European migrants at all scale levels as measured by the dissimilarity index.

6. Discussion

Firstly, it must be said that the differences we find between countries are small and the similarities are especially pronounced at the lowest scale level. This is in sharp contrast to earlier studies that reported large differences in the dissimilarity index between urban areas (Arbaci 2007; Musterd 2005; Skifter Andersen et al. 2016). One reason for this could be that we focus on entire national areas, but it can also reflect that we have tried to measure segregation for comparable

migrant groups in a way that avoids the MAUP. Again, our contribution is that the results we present show that, using methods ensuring comparability and multiscalarbility, give possibilities for evaluating competing theories of segregation and for assessing the impact of different policies.

However, if one focuses on larger neighbourhood scales, we do find differences. Here, as is clearly evidenced by the dissimilarity index, Belgium stands out as the exception, whereas Sweden, Denmark, and the Netherlands, are remarkably similar. That the similarities are stronger for small-scale than for large-scale patterns underlines the importance of a using multiscalar approach to segregation measurement.

A possible explanation for the similarities in large-scale segregation patterns between Sweden, Denmark, and the Netherlands, as well as the contrast with Belgium, is how the housing sectors in these countries have developed since the 1950s. For an extended period, Sweden, Denmark, and the Netherlands put strong emphasis on the construction of relatively large housing estates that have provided relatively low-cost and accessible housing options. With increasing incomes, these housing options often became a secondary option for middle-income households preferring single-family housing, with the result that these dwellings have become an important alternative for newly arrived migrants with relatively low incomes. At the same time, the public housing sector in Sweden, Denmark, and the Netherlands is not restricted only to the poorest groups, and this may have stimulated some mixing. Social housing in Belgium, in contrast, is typically more exclusively for the poor and this may have contributed to a higher degree of segregation. Another difference is that housing allowances are much more widely available in Sweden, Denmark, and the Netherlands compared to Belgium (Juntto and Reijo 2010). Since housing allowances make housing options in less low-income dominated areas more available also for low-income households, this can make it possible for poor non-European migrant households to access neighbourhoods preferred by medium-income European-born households. However, it could be that differences in immigrant settlement policies have also played a role. Such policies have often been deemed to have little effect but there needs to be more detailed exploration of whether policies of dispersal have affected Denmark, Sweden, and the Netherlands to prevent the higher segregation levels at larger scales that characterise Belgium.

It can be more challenging to explain the similarities in small-scale segregation patterns across all four countries. Could it be that sorting at the level of the closest 200 neighbours is due to internal factors such as ethnic preferences, rather than external structural factors? Moreover, in this paper

we have argued that an analysis of ethnic segregation should not focus only on patterns of over- and under-representation but also on the variation in the concentration of non-European migrant across neighbourhoods. The argument here is that when it comes to considering the effects of segregation on individual level outcomes, it is concentration more than representation that is of interest. Moreover, in terms of concentration (Figure 1) the differences between the four countries we have studied are much larger than differences in the patterns of representation. The reason for this is that the relative size of the non-European migrant population differs between the four countries. Thus Sweden, having the highest proportion of non-European migrants in the population, also has the highest proportion of the population living in migrant-dense neighbourhoods, at least for small- to medium-sized neighbourhoods. Denmark, having the lowest proportion of non-European migrants in the population, also has the lowest proportion of the population living in migrant-dense neighbourhoods. The conclusion here is that by increasing the levels of concentration of migrants in migrant-dense neighbourhoods, an expanding migrant population may accentuate problems associated with segregation even in cases where there is no change in patterns of over- and under-representation.

However, analyses of segregation among foreign-born should focus not only on migrant-dense neighbourhoods but also on areas where migrants are under-represented. In many such areas, both Sweden and the Netherlands have relatively high concentrations of non-European migrants.

In Sweden, especially for larger scale levels, only very small parts of the population live in neighbourhoods with low concentrations of non-European migrants. For example, for k=51,200, less than 20 % of the population lives in neighbourhoods with fewer than 5 %. In Denmark and Belgium, more than 50 % of the population lives in such native- and European migrant-dominated neighbourhoods. Although spatial assimilation is a process that evolves over time, this pattern in Sweden could be interpreted as a sign of the start of spatial assimilation. The stronger persistence of neighbourhoods with very low concentrations of non-European migrants in Denmark and Belgium can be interpreted as a reflection of place stratification, that there are areas where non-European migrants are more or less excluded from entry. That both Denmark and Belgium have a lower proportion of non-European migrants of course contributes to this pattern, but it could also be the case that an expanding migrant population is an important factor affecting spatial assimilation. The expansion of a migrant population leads to a spill-over effect when early and established migrants settle in areas with lower concentrations. Here it should be noted, though, that

Belgium has a higher proportion of non-European migrants in the population than Denmark. That Belgium has the same high proportions of the population in neighbourhoods with few non-European migrants, therefore, is the result of stronger spatial sorting in Belgium. One interpretation of this pattern is that place stratification is stronger in Belgium than in Denmark.

Many studies have shown non-European migrants, especially newly arrived, to be over-represented in assessments of unemployment and residents with low income (Gorodzeisky and Semyonov 2014). Therefore, the high concentrations of non-European migrants found in the highest percentiles in the countries under study indicate a risk of negative neighbourhood effects because of this disadvantage. This is also one reason why the countries in our study have tried dispersal policies. Even though such dispersal policies can be seen as problematic concerning the individual's right to decide settlement. The policies can also be problematic if they assign individuals to areas with few employment opportunities. In the case of Denmark an infamous 'ghetto' debate was the result of such initial thoughts about high concentrations (Aner 2015). However, the present study shows no such evidence of Denmark having especially large segregation compared to the other studied countries. The smaller under-representation in native/European migrant neighbourhoods in Sweden in particular and in the Netherlands could be suggested to be a result of dispersal policies, although the causes of segregation patterns have not been analysed enough in this study.

Given that neighbourhood effects are probably stronger when there is strong segregation across scale levels, living in large housing estates built during the 1960s and 1970s might affect residents more. Large-scale segregation has the consequence of producing environments that meet most of the needs of their residents'. As mentioned as early as 1998 in the book edited by Musterd, a self-sufficient environment with larger units does not give any incentives to use the wider urban space. On the other hand, small-scale segregation, where among the 200 closest neighbours there is a high proportion of non-European migrants, might be small and difficult to interpret in terms of neighbourhood effects if the nearest neighbourhood has a very diverse population composition.

In the case of Belgium, where the dissimilarity index was particularly high, social cohesion might be a concern. Nationally, Belgium shows low levels of non-European migrants in many neighbourhoods but the gap in size of concentration is high in that there are also neighbourhoods with very high proportions of non-European migrant residents. Such pronounced residential

segregation patterns give fewer opportunities for diversity and mixing in neighbourhoods, which in the long run might hinder understanding and social cohesion.

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