Residential Segregation of European and Non-European Migrants in Sweden: 1990-2012

Bo Malmberg, Michael M. Nielsen, Eva Andersson and Karen Haandrikman

ResSegr Working Paper 2016:1
Abstract: In this paper we analyse how a migrant population that is both expanding and changing in composition has affected the composition of Swedish neighbourhoods at different scales. The analysis is based on Swedish geo-coded individual level register data for the years 1990, 1997, 2005, and 2012. This allows us to compute and analyse the demographic composition of neighbourhoods that range in size from encompassing the nearest 100 individuals to the nearest 400,000 individuals. First, the results confirm earlier findings that migrants, especially those from non-European countries face high levels of segregation in Sweden. Second, large increases in the non-European populations in combination with high levels of segregation have increased the proportion of non-European migrants living in neighbourhoods that have high proportions of non-European migrants. Third, in contrast to what has been the established image of segregation trends in Sweden, and in an apparent contrast to the finding that non-European migrants increasingly live in migrant-dense neighbourhoods, our results show that segregation, when defined as an uneven distribution of different populations across residential contexts, is not increasing. On the contrary, for both European migrants from 1990 and non-European migrants from 1997, there is a downward trend in unevenness as measured by the dissimilarity index at all scale levels. However, if unevenness is measured as variation in the neighbourhood proportion of migrants across neighbourhoods, segregation has increased.

Key words: ethnic residential segregation; foreign-born; migration; multi-scalar; EquiPop; Sweden
1. Introduction

Since the 1980s, Sweden has experienced high and increasing levels of international migration, with, in recent years, about 100,000 immigrants entering Sweden every year. As a result, one sixth of the Swedish population is currently foreign-born. In addition, an increasing proportion of the migrant population originates from non-European countries. In this context, the aim of this paper is to analyse how a migrant population that is both expanding and changing in composition has affected the population composition of Swedish neighbourhoods in different parts of the country and at different geographical scales.

The analysis will be based on a critical assessment of how segregation patterns are measured and evaluated. Our critique will focus both on conceptual and methodological issues. In contrast to demographic measures such as fertility and mortality rates there is still an on-going debate about how to best measure segregation. A de facto standard does exist, the dissimilarity index, but the severe shortcomings of this measure are generally acknowledged. There also exists an established view that segregation can be measured and comprehended along different dimensions. This view was laid out by Massey and Denton (1988) and has been generally accepted, and it emphasizes the importance of unevenness, exposure, concentration, centralization and clustering. As pointed out in a recent survey by Wong, the development of segregation measures has reflected that the data analysed is based on aggregate indicators of the population compositions of geographical units with well-defined boundaries (Wong 2016). Recently, however, alternative data sources have become available that open up new approaches to segregation measurement. Geo-coded, individual level register data make it possible to re-conceptualise what is meant by segregation using a first-person perspective. In this paper, we rely on data of the latter type, and this has led us to propose a new framework for how segregation trends can be assessed.

First, we suggest a redefinition of the neighbourhood concept that brings segregation research and contextual effect research into closer contact. Building on the tradition of the Chicago school, neighbourhoods have tended to be seen as separate communities and geographical sub-divisions used for statistical purposes (Wright et al. 2014). With individual level geo-coded data, however, a neighbourhood can instead be seen as a geographical context that is specific for every individual.
Second, with this redefinition of what is meant by a neighbourhood, segregation can be conceptualised as variation in the geographical context of individuals. The idea that segregation can be seen as variation in geographical context has recently been taken up by a group of British geographers who have proposed that variance measures estimated using multilevel modelling should be used to determine levels of segregation (Manley et al. 2015). In this paper we will not use multilevel modelling. We will instead use percentile plots to capture variation in the demographic composition of individualized neighbourhoods and how this variation has changed over time. Conceptualising segregation as variation in geographical context links studies of segregation trends more closely to contextual effect studies, since increasing variation in geographical context implies that there will be a greater potential for life outcomes to vary depending on where individuals live (Andersson and Malmberg 2016).

Third, even if neighbourhoods are conceptualised as being the geographical context of individuals there is still a need to address the question of scale. Since it is difficult to argue, a priori, that a certain neighbourhood scale is more important than others, we have adopted a multi-scalar approach; hence, we will evaluate segregation trends for different scale levels. Moreover, we have chosen to use population size as our preferred measure of scale. Thus, we analyse the population composition of individualized neighbourhoods that vary in scale from encompassing the nearest 100 neighbours to the nearest 409,600 neighbours (Östh et al. 2014). An advantage of this multi-scalar approach is the possibility to differentiate between locations that experience local increases in the migrant population from locations that experience increases in the migrant population at the scale of entire urban areas (towns, cities, conurbations).

Residential segregation conceptualised as variation in geographical context is linked to both the exposure and unevenness dimensions of segregation (Massey and Denton 1988). The link to exposure is clear given that the population composition of individualized neighbourhoods suggests the quality and type of exposure or contact between neighbours. The dimension of unevenness is captured by the variation in population composition across neighbourhoods.

Statistically, variation in population composition can be measured by computing the standard deviation of migrant proportions. In this paper we will argue that this measure of variation captures important aspects of how unevenness is experienced by urban dwellers.
segregation literature, however, unevenness is often conceptualised as the difference in the way groups are distributed across geographical sub-units. Clearly, differences in distribution translate into variation in population proportions and vice versa. One important difference, though, is that pure measures of differences in distribution such as the dissimilarity index are insensitive to group size, but this is not the case for the standard deviation in migrant proportions. This implies that assessments of segregation trends based on measures of variation need not yield the same results as assessments based on measures of differences in distribution. But to rely on only the latter can be problematic, given the potential importance of variation in geographical context for inequalities in individual level outcomes.

2. Earlier studies

A good overview of early segregation studies is Musterd (2005). Studies that analyse the effect of large immigration flows on segregation patterns have recently been carried out in the United States (Hall 2013; Iceland and Scopilliti 2008; Iceland et al. 2014; Lichter et al. 2010: 2015), the United Kingdom (Sabater 2010; Simpson 2007; Simpson et al. 2008), France (Shon and Verdugo 2015), Germany (Glitz 2014), Spain (Martori and Apparicio 2011), New Zealand (Grbic et al. 2010), and the Netherlands (Musterd and Ostendorf 2009). The results vary to some extent but a common finding is that levels of segregation, as measured by the dissimilarity index, are not increasing and may even be declining. Findings of stable or declining segregation are for example reported for Hispanics and Asian in the United States (Iceland et al. 2014), for migrants from Sub-Saharan Africa, North Africa, East Asia, and the Middle East in France (Shon and Verdugo 2015), for most migrant groups in the UK (Simpson 2007), and for Turks, Surinamese, and Moroccans in Rotterdam and the Hague (Musterd and Ostendorf 2009). But there are also findings of increasing segregation, for example, for Turks and global south migrants in Germany (Glitz 2014), for Asians, but not for Pacific migrants, in New Zealand (Grbic et al. 2010), and Turks, Surinamese, and Moroccans in Amsterdam (Musterd and Ostendorf 2009).
3. Trends in Sweden

Ethnic residential segregation levels in metropolitan areas of Sweden have been characterised as rather low compared to levels found in North America (Marciniczak et al. 2015; Murdie and Borgegård 1998), and perhaps with levels more comparable to Australian and Canadian metropolitan areas (Murdie and Borgegård 1998). Migrants from the global south have the highest levels of residential segregation from Swedish-born, and in general there is a growing neighbourhood mix, with a decrease of native neighbourhoods and a concurrent increase of mixed neighbourhoods (Marciniczak et al. 2015).

Most longitudinal studies of ethnic residential segregation in Sweden focus on metropolitan areas. These studies are of different types. First, there is a group of studies that measures segregation trends in a single metropolitan area using administratively defined areas such as SAMS areas or parishes, and the dissimilarity index or the index of segregation (Andersson, Brämå et al. 2007; Andersson et al. 2009; Andersson, Hedman et al. 2007; Andersson and Kährik 2015; Marciniczak et al. 2015; Murdie & Borgegård 1998). Second, there are studies on segregation trends that focus both on residential segregation and school segregation (Böhlmark et al. 2015; Holmlund et al. 2014; Lindbom 2010; Lindbom and Almgren 2007; Nordström Skans and Åslund 2010; Östh, Andersson, & Malmberg, 2013). Third, there are studies published by the Swedish National Board of Health and Welfare that use the entropy index to study trends in ethnic segregation (Biterman 2006; 2010; Biterman and Franzén 2007). Fourth, a few media organisations have initiated their own studies on the question of whether segregation is increasing (Dagens Nyheter 2015; Sveriges Radio 2012). And, finally, recent studies have been published using individualized neighbourhoods to analyse segregation trends in Stockholm county and Skåne county (Niedomysl et al. 2015; Stockholms Läns Landsting 2014).

The results of these studies are difficult to compare since the studies use different geographical units, different measures of segregation, compare different time periods and use different definitions of migrant groups. In general, however, these studies conclude that segregation has increased over time. For instance, Niedomysl et al. (2015: 4) conclude that in Skåne, “residential segregation of the foreign-born has increased over time”. Stockholm’s Läns Landsting (2014: 6) draws the same conclusion and adds that “visible minorities are more and more concentrated in
places that already have a high concentration of visible minorities”. In 2012, the news service of the Swedish national radio reported, based on a commissioned study, that “residential segregation has doubled during the last 20 years” (Sveriges Radio 2012). Similarly, Sweden’s largest newspaper examined ethnic segregation in the 30 largest municipalities in Sweden for the period 1991-2013 and concluded that “ethnic segregation has increased in all these municipalities except two” (Dagens Nyheter 2015). Biterman’s (2010) study of the three major metropolitan areas for the period 1990-2006 states that “segregation has increased in all three regions”. Nordström Skans and Åslund (2010: 91), after pointing to high levels of segregation, are somewhat more cautious, stating that “segregation seems to have increased over time, too”. In contrast, in their report on Malmö, Andersson, Bråmå et al. (2007) do not claim that ethnic segregation increased during the period 1990-2004, but discuss mechanisms behind segregation in a way that could suggest to the reader that segregation is increasing: “The report focuses on the behaviour of the majority population since their behaviour has decisive importance for ethnic residential segregation, partly because the majority leaves certain areas that gain a larger minority population, partly because the majority population avoids moving to minority dominated areas” (p. 6). Murdie and Borgegård (1998) examined ethnic segregation among 12 immigrant groups in Stockholm parishes using the dissimilarity index, and reported increased levels among some newly arrived groups in the 1990s, such as Ethiopians, Iraqis and Somalis, while segregation levels among other groups remained stable. A recent study on migrant segregation based on SAMS areas in Stockholm found increasing segregation levels for both native Swedes and migrants from former socialist countries but decreasing levels for migrants from the global south and Western countries, based on the index of segregation. And based on the dissimilarity index, the highest segregation levels were found for migrants from the global south compared to Swedish-born, and a growing neighbourhood mix (Marciniczak et al. 2015). Andersson and Kährrik (2015) report high but stable ethnic segregation levels among migrants from outside Europe in Stockholm, based on the dissimilarity index.

At the heart of describing segregation as an ever increasing phenomenon in media, political discussion and academic publications is the intention of describing segregation as important. As many studies have shown, a society with increasing levels of segregation can be seen as an inferior society characterised by exclusion. Researchers publishing results on increasing segregation
usually get publicity, and politicians gratefully accept research results that show increasing segregation, as it eases the redistribution of resources. In this way, the phenomenon of increasing segregation is a self-reinforcing issue.

On the other hand if results were to indicate that segregation is decreasing, researchers might worry that their studies would go unnoticed, that politicians would disregard them, and ultimately that such results may work against important programs aimed at spatial justice by responding to negative neighbourhood effects. The results of decreasing segregation might, of course, at the outset produce headlines and sighs of relief among politicians and those in authority, but would not change the reality of potential negative effects of segregation. Given that much research points to the existence of neighbourhood effects, a society that strives for spatial justice will still be under pressure to redistribute resources.

Since assessing segregation trends is such an important issue in research as well as politically and in planning, this paper will discuss in some detail in what terms changing segregation patterns should be described.

4. Study design, data and method

The analyses in this paper are based on register data in the GEOSTAR database, managed by the Department of Human Geography at Stockholm University. GEOSTAR includes all individuals in the Swedish population during the period 1990-2012 and includes a wide range of demographic, socioeconomic and geographic variables. All individuals are assigned coordinates based on primary residence. The coordinates in GEOSTAR are aggregated to 250 metre squares in urban areas, defined as towns with at least 200 residents (Statistics Sweden 2015), and 1000 metre squares in rural areas. The number of 250 metre squares increased from 90,922 in 1990 to 96,043 in 2012, whereas the number of 1000 metre squares decreased from 111,185 in 1990 to 106,047 in 2012.

How ethnic residential segregation is measured depends to a large extent on definitions by statistical offices on race, ethnicity and migrant background. In Sweden, guidelines recommend using the country of birth of a person and his or her parents, alternatively citizenship, as defining characteristics (Statistics Sweden 2002). The term ‘race’ is very rarely used in contemporary
Swedish society and research, although the idea of Swedishness based on historical and cultural claims still exists (Osanami Törngren 2011). Ethnicity indicates some kind of shared culture, and is often ascribed to people who look non-Western; with the majority population in Western countries not usually identifying themselves as “ethnic” (Frankenberg 1993). According to Mattsson (2005), Swedishness is strongly connected to visible European whiteness. In research on segregation concerning immigrants, the concept of ethnicity is often used and we will sometimes adhere to that term as well. However, ethnicity is related to belonging to a group formed by origin or culture that in some way can be seen as distinct from other groups. In this sense, origin might be kinship, history or geographical origin. Assuming ethnicity from country of birth is thus not possible.

This study defines a migrant as a person born outside Sweden, excluding those with one or more parents born in Sweden. To be able to study difference in segregation patterns based on origin of birth the migrant population was subdivided into two different categories: European migrants and non-European migrants. European migrants include all migrants born in the Nordic countries or in the rest of Europe, including Turkey. Non-European migrants are individuals born in Africa, South America or Asia. Migrants from North America, Australia and New Zealand have been excluded because of the small size of these migrant groups (below 5 % of the migrant population in all years). The exclusion of these migrant groups implies that the non-European migrant group will consist of individuals that in the Swedish context form a visible minority that can often experience housing and labour market discrimination (Molina 1997).
Figure 1 shows the changing composition of the Swedish migrant population for the years included in the study, by region of birth categories available in GEOSTAR. Overall, the proportion of European migrants among the total migrant population has decreased, which is also depicted in Figure 1. While in 1990, European migrants represented almost three-quarters of all migrants, in 2012 they made up 60 percent of the migrant population, as a consequence of the growth of the non-European migrant population and a decrease in migrants from the other Nordic countries, notably Finland and a decrease in EU28 migrants. This trend has not been changed by the fact that the proportion of migrants from the rest of Europe increased over time, especially from the former Yugoslavia from the second half of the 1990s, and from Eastern Europe, especially Poland, from the 2010s. Most non-Europeans originate from Asia; this proportion increased from 16 per cent of all migrants in 1990 to 26 per cent in 2012. Among Asians in Sweden, Iraqis form the largest group, followed by Iranians and Syrians. Summarizing, Sweden’s migrant population is increasingly characterised by diversity of country of birth.
**Individualized/egocentric neighbourhoods**

The EquiPop software was used to calculate the population composition of egocentric neighbourhoods. Using EquiPop, one can calculate, for each individual, the proportion of persons with a specific attribute among that individual’s k-nearest neighbours (Östh 2014; Östh et al. 2014). This means that in sparsely populated areas, compared to areas that are more densely populated, there is a need to cover a larger area to reach the k-nearest neighbours.

The population used for the calculations consisted of all registered residents in Sweden. Three different types of egocentric neighbourhoods were calculated for each individual in the Swedish population:

1. The proportion of migrants in the egocentric neighbourhood;
2. The proportion of European migrants in the egocentric neighbourhood;
3. The proportion of non-European migrants in the egocentric neighbourhood.

The three types of egocentric migrant neighbourhoods were calculated for the years 1990, 1997, 2005 and 2012, and for five different scale levels. Therefore, the final database contains 60 datasets, one for each combination of migrant group, neighbourhood size, and year.

**Percentile plots**

To analyse the variation in population composition across egocentric neighbourhoods we used percentile plots. Here it should be noted that when individualized neighbourhoods are used the number of neighbourhoods corresponds to the number of individuals in the study population. For example, in 1990 the resident population in Sweden was 8,590,701; thus, there existed a total of 8,590,701 individualized neighbourhoods. The percentiles have been computed as the value below which a given percentage of the individualized neighbourhoods are found. The percentile plots give a comprehensive picture of differences in neighbourhood composition by showing what proportion of the neighbourhoods can be found above or below certain values for the migrant proportion in the population. By comparing percentile plots for different years, changes in the neighbourhood composition can be analysed.
In addition to using all neighbourhoods we also study the neighbourhoods of three sub-populations: European migrants, non-European migrants, and the total migrant population. This allows an analysis of variation in neighbourhood composition from the perspective of all residents, European migrants, non-European migrants and all migrants. In order to assess if there was an increased variation in residential context from 1990 to 2012 we also computed standard deviations of the migrant proportions across neighbourhoods for different scale levels and migrant group for the different years we study.

**Dissimilarity index**
To measure levels of segregation, aggregate indexes have been calculated for all the 60 datasets using the dissimilarity index (Duncan and Duncan 1955). The indexes were constructed to be applied to situations with fixed geographical units but can be used for egocentric neighbourhoods by treating each person’s egocentric neighbourhood as equivalent to a fixed unit.

The dissimilarity index measures the evenness of the distribution of two groups across neighbourhoods (Massey and Denton 1988). It may be interpreted as the proportion of a certain (minority) group that would have to move to another area to achieve parity between the minority and majority group across all neighbourhoods, and is, in contrast to the isolation index, not sensitive to the size of the migrant population. The dissimilarity index is calculated using the formula:

\[ D = \frac{1}{2} \sum_{i=1}^{S} \left| \frac{m_i}{M} - \frac{n_i}{N} \right| \]

where \(i\) is an individual; \(S\) is the whole population studied; \(m_i\) is the proportion of migrants in the egocentric neighbourhood of \(i\); \(M\) is the sum of all \(m_i\); \(n_i\) is the proportion of non-migrants in the egocentric neighbourhood of \(i\); and \(N\) is the sum of all \(n_i\).

**Factor analysis and cluster analysis to reveal geographical patterns**
Although the percentile plots are good for analysing changes in neighbourhood composition they do not provide information about the geographical distribution of different neighbourhood types. Given the richness of the data on neighbourhood composition (four years, three migrant groups,
five different scale levels and more than 200,000 different locations) it is a challenge to analyse spatial patterns. The solution we have opted for is to rely on cluster analysis to classify locations into distinct types based on the composition of the neighbourhood population in 1990, 1997, 2005, and 2012. A cluster analysis could have been applied to the complete data (60 different variables for each location) but given the high correlation between the variables we have instead used factor analysis to capture the most important dimensions in our data and then used factor scores on these dimensions in the cluster analysis. There is a risk that a cluster analysis based on factor scores may fail to build interesting groups. But in our case, the aim is to capture general spatial patterns and, therefore, basing the classification on factor scores is helpful in establishing a relatively easy-to-interpret classification.

The factor analysis of the neighbourhood data suggests that three factors can account for most of the variation. The loadings for these factors are presented in Figure 5, bottom right table. Two of these factors represent the presence of European migrants (factor 1) and non-European migrants (factor 3) respectively. Factor 1 and factor 3 have the highest loadings for scales that correspond to the size of local neighbourhoods, k=6400 and k=800. Factor 2, on the other hand has low loadings for scale levels that correspond to the local neighbourhood (k=100, k=800, k=6400) and high loadings for scale levels that correspond to the size of urban areas (k=51200 and k=409600).

The classification into different types was done with hierarchical cluster analysis using Ward’s method. Initially, 20 different clusters were considered but it was found that 12 clusters sufficed to capture the most important patterns. The more parsimonious approach was preferred in order to make the classification easier to grasp. The resulting clusters fall into three categories. First, a class of clusters characterised by rising proportions of non-European migrants at the scale of local neighbourhoods but not necessarily at the scale of urban areas. Second, we have a class of clusters characterised by low proportions of non-European migrants at the scale of local neighbourhoods and high proportions of non-European migrants at the scale of urban areas. And, third, clusters characterised by low proportions of non-European migrants both at the scale of local neighbourhoods and at the scale of urban areas. A more detailed account of the clusters is provided in the Results section.
5. Results

The percentile plots are presented in Figure 2 and Figure 3. Each figure contains 15 different graphs, one for every combination of migrant group and neighbourhood scale level. In addition, every graph contains separate, coloured lines that represent the variation in neighbourhood context for the different study years, 1990, 1997, 2005, and 2013. Figure 2 presents the results for all individualized neighbourhoods, while Figure 3 presents the results for the neighbourhoods of European migrants, non-European migrants, and the total migrant population. Then, in each graph the percentile values for 1990, 1997, 2005, and 2013 are presented in separate, coloured lines. Below, we separately analyse the segregation patterns of all migrants, non-European migrants, and European migrants based on Figure 2 and Figure 3.

Segregation patterns of the total migrant population

The percentile values for the proportion of all migrants are in the right-most column of Figure 2. Reading from the top to the bottom of Figure 2 it is evident that, across all neighbourhood sizes and across all percentiles, there has been an increase in the proportion of migrants. In terms of percentage points, the increase is larger for higher percentiles compared to lower percentiles, but in relative terms the increase is at least as strong for the lower percentiles. The proportion of migrants in the most immigrant-dense neighbourhoods is higher in smaller egocentric neighbourhoods compared to larger neighbourhoods. This is to be expected as small neighbourhoods can more easily include a homogenous population while larger neighbourhoods, for example with k=409,600, become more mixed due to their sheer size.

In Figure 2, the results for the k=800 level are given in the second row. Looking in the right-most column of that row the increasing proportion of migrants over the years can be clearly seen. In 1990 (blue line), the 10 percent (the 90-100th percentile) most migrant-dense neighbourhoods had at least 18 percent immigrants among their 800 nearest neighbours. This proportion had increased to 23% in 1997, to 27% in 2005 and to 34% in 2012. If the focus is shifted to migrant proportions for lower percentiles, the graphs show that immigrants are not evenly distributed across populated locations in Sweden. Despite a high overall proportion of migrants in the
Figure 2: Percentile plots based on the total Swedish population showing neighbourhoods’ proportions of three groups of migrants (columns), for five scale levels (rows) and four years.

Source data: Swedish register data, authors’ calculations.
Figure 3. Percentile plots based on the European, Non-European and general/total migrant populations showing the proportion of respective migrant groups in egocentric neighbourhoods, for five scale levels and four years.

Source data: Swedish register data, authors’ calculations.
Swedish population in the year 2012, almost half (45%) of the Swedish population had less than 10% immigrants among their 800 closest neighbours.

In Figure 3 the right-most column also shows the proportion of all migrants, but here the percentiles are based on the migrant population itself. It shows quite dramatic changes in the population composition of neighbourhoods where migrants live. For example, in 1990, only 10% of the migrant population lived in neighbourhoods with more than 40% migrants among their nearest 100 neighbours; in 2012 the proportion of migrants living in neighbourhoods with more than 40% migrants had increased to almost 30%. A similar trend applies to neighbourhoods consisting of 6,400 neighbours. Here, about 5% of migrants lived in neighbourhoods with more than 40% migrants among their nearest neighbours, but this proportion has increased to 20% in 2012. Moreover, for both k=800 and k=6400 neighbourhoods in 2012, half of the migrant population lived in egocentric neighbourhoods with more than 20% migrants. In 1990, half of the migrant population lived in k=800 and k=6400 neighbourhoods with more than 12% migrants.

Overall, Figure 2 and Figure 3 show that migrants living in Sweden in 2012 lived in neighbourhoods with much higher proportions of migrants than migrants living in Sweden in 1990. In the general debate, the increasing proportion of migrants living in migrant-dominated neighbourhoods is often seen as a reason for concern.

*Segregation patterns of non-European migrants*

The percentile values for the proportion of non-European migrants in different sized egocentric neighbourhoods for the whole Swedish population are shown in the middle column of Figure 2. The percentile plots in Figure 2 clearly reflect the strong increase in the non-European migrant population between 1990 and 2012, and show a highly segregated pattern overall. Across different scale levels and across all years, 50% of the Swedish population lived in neighbourhood where the proportion of non-European-born could be considered low. This is true also in the last year of observation in spite of a strong increase in the non-European population. Especially notable is the total absence of non-European migrants for all years at the k-100 level in the 10 percent most native-dominated neighbourhoods of the Swedish population. In 1990, over 30% of the Swedish population had no non-European migrants among their nearest 100 neighbours. The low
proportion of non-European migrants in non-migrant-dominated neighbourhoods is in sharp contrast to the rapidly rising proportions of non-European migrants in the most migrant-dense neighbourhoods.

A comparison across years shows that for k=100 and k=800 neighbourhoods, the relative increase between 1990 and 2012 of non-European migrants in the lower percentiles was faster than the relative increase of non-Europeans in the highest percentiles. This means that over time, non-Europeans are to a larger extent moving into neighbourhoods dominated by a low proportion of migrants. Last but not least, the increase of non-Europeans in areas with low proportions of migrants was faster than the overall increase of non-European immigrants at all k-levels for the period 1997 to 2012. This can be interpreted to show tendency for more mixing and less reinforcement of non-European residential segregation patterns over this period.

However, that there has been some increase in the proportion of non-Europeans living in areas with few such migrants does not counteract the effect of a rising non-European population in increasing the slope of the percentile-plot curve. Consider for example, the k=800 neighbourhood level in Figure 2. In 1990, the proportion of non-European migrants in the 90th population percentile was 5%, implying that 90 % of the Swedish population lived in areas with less than 5% non-European migrants among their 800 closest neighbours. In 2012, the 90th percentile value had increased to 18%, meaning that 10% of the Swedish population, those belonging to the 90th to 100th percentiles, lived in neighbourhoods in which 18% or more of their 800 closest neighbours were non-European migrants.

The dramatic changes in neighbourhood composition that are associated with increases in the non-European population are also clearly shown in the percentile plots of Figure 3 (middle column) where the population composition for percentiles based on the non-European migrant population is presented. For example, in 1990 only about 5% of the non-European migrants lived in areas with more than 20% non-Europeans among their closest 6400 neighbours. This could be interpreted to mean that in 1990, relatively large-scale neighbourhoods with a dense non-European migrant population were close to non-existent, and that living in such areas was not a common experience for non-European migrants. In contrast, in 2012, 34% of the non-European migrants lived in neighbourhoods with 20% or more non-Europeans among their closest 6400 neighbours.
Thus in 2012, an experience that in 1990 was the exception had become, if not a norm, at least a relatively common experience for non-European migrants living in Sweden.

**Segregation patterns of European migrants**

Lastly, segregation patterns for European migrants based on the total Swedish population, found in the left column in Figure 2, show the fewest differences in proportions between the years of measurement. This is because the increase in European migrants is relatively small and is relatively evenly distributed over the different percentiles, compared to non-European migrants in the central column. For example, 3% of the Swedish population had no European migrants among their 100 nearest neighbours in 1990, compared to 32% living in areas with no non-European migrants. In 2012, only 1% percent of the Swedish population had no European migrants among their 100 nearest neighbours, compared to 12% with no non-European migrants. One possible explanation for this is that many of the European migrants entered Sweden in the 1960s and 1970s and thus had longer to establish themselves in the housing and labour markets (Magnusson Turner and Hedman 2014).

Figure 2 shows the proportion of European migrants among the closest 800 neighbours in the left column, second row. Proportions of European migrants are not particularly high below the 90th population percentile (highest in 2012). For example, the proportions of European migrants at the k=100 is less than 6% for up to 50% of the total population (Figure 2).

The left column of Figure 3 presents the neighbourhood proportions of European migrants for percentiles based on European migrants. Here one can see, for example, that in 1990 for k=6400 neighbourhoods, 10% of European migrants lived in neighbourhoods with at least 20% European migrants. As described above, in 1990 only about 5% of non-European migrants lived in neighbourhoods with at least 20% non-European migrants. That implies that in 1990, for a European migrant to live in a relatively large-scale neighbourhood with a substantial proportion of European migrants was a more common experience than for a non-European to live in a corresponding neighbourhood with a substantial proportion of non-European migrants. By 2012, however, the proportion of European migrants living in European migrant-dense neighbourhoods
had not increased as much as the six-fold increase for the proportion of non-European migrants living in non-European migrant dense neighbourhoods.

Variation in geographical context

The percentile plots show a great variation in the proportion of migrants across neighbourhoods, and increasing variation over time. In order to summarize the information contained in the percentile plots we have computed the standard deviation of the proportion of migrants across neighbourhoods for migrant groups and different k-levels over the years that we study. The results are presented in Figure 4 below.

A comparison between percentile graphs and Figure 4 shows that the standard deviation of the migrant proportion across neighbourhoods is closely related to the slope of the percentile plots. That is, a steep slope indicates high variation in the migrant proportion and this is reflected in high standard deviations. Thus, the standard deviation graphs neatly summarize the percentile plots. First, they show that the variation in neighbourhood context is larger for small k than for large k neighbourhoods (blue line, Figure 4). Second, they also show that the variation in neighbourhood context has not been increasing over the period with respect to the proportion of European migrants. This is in sharp contrast to the pattern for the proportion of non-European migrants. For this indicator, there has been a large increase in variation with a doubling of the standard deviation from 1990 to 2012. There has also been an increase in the standard deviation of the proportion of total migrants, and this increase largely reflects the increasing variance in the proportion of non-European migrants.

Figure 4. Standard deviation of migrant proportions in differently sized neighbourhoods 1990-2012, European migrants, Non-European migrants, and migrants, total.
Source data: Swedish register data, authors’ calculations.

*Has segregation increased in Sweden? A test using aggregate indexes*

The overall trend in percentile plots of Figure 2 and Figure 3 is an increase in the proportion of non-European migrants and migrants overall in a majority of Swedish neighbourhoods between 1990 and 2012. An important question is whether there also has been an increase in segregation. To answer this question we have used the most commonly used measure of segregation in the literature, the dissimilarity index.

Table 1. Dissimilarity index for European migrants, non-European migrants and all migrants for different k-levels and years.

| Immigrant group | k-level | 1990  | 1997  | 2005  | 2012  | Change          |
|-----------------|---------|-------|-------|-------|-------|-----------------|
| Europeans       | 100     | 34.5% | 34.5% | 32.4% | 30.9% | Decline from 1997 |
| Non-Europeans   | 100     | 54.3% | 54.6% | 52.6% | 50.8% | Decline from 1997 |
| All migrants    | 100     | 36.8% | 39.1% | 38.9% | 39.5% | Decline from 1997 |
| Europeans       | 800     | 31.1% | 30.5% | 28.8% | 27.3% | Decline from 1990 |
| Non-Europeans   | 800     | 46.3% | 49.5% | 48.6% | 46.4% | Decline from 1997 |
| All migrants    | 800     | 33.4% | 35.8% | 36.3% | 36.8% | Increase         |
| Europeans       | 6,400   | 28.1% | 25.7% | 24.6% | 23.7% | Decline from 1990 |
| Non-Europeans   | 6,400   | 35.7% | 41.5% | 41.3% | 39.0% | Decline from 1997 |
| All migrants    | 6,400   | 29.2% | 30.3% | 31.1% | 31.5% | Increase         |
| Europeans       | 51,200  | 24.1% | 21.1% | 19.5% | 18.9% | Decline from 1990 |
| Non-Europeans   | 51,200  | 26.8% | 32.1% | 32.3% | 29.9% | Decline from 1997 |
| All migrants    | 51,200  | 24.5% | 24.6% | 24.7% | 24.6% | Stable           |
| Europeans       | 409,600 | 22.7% | 18.5% | 17.2% | 16.8% | Decline from 1990 |
| Non-Europeans   | 409,600 | 19.8% | 24.9% | 24.6% | 21.6% | Decline from 1997 |
| All migrants    | 409,600 | 20.4% | 20.2% | 19.8% | 18.7% | Decline from 1990 |

Source data: Swedish register data, authors’ calculations
Looking at the trends in the dissimilarity index in Table 2 it is clear that there is very little evidence for increasing segregation. To the contrary, for Europeans (from 1990) and for non-Europeans (from 1997) segregation as measured by the dissimilarity index is declining. This is the effect of decreasing spatial segregation patterns due to the mixing in all parts of the population, i.e. areas with low proportions of immigrants are attracting more immigrants over time. The reason why the downward trends in segregation of European and non-European migrants do not translate into a similar clear downward trend in the segregation of all migrants is the shift in the composition of the migrant population from European to non-European migrants. Since the latter population is more segregated than the former, the increasing weight of the non-European population counteracts the tendency toward lower segregation when the two groups are considered separately. In other words, on some k-levels the general migrant group is becoming more segregated over time, but this is because the proportion of non-European migrants, who are much more segregated, is increasing over time.

It can be noted that the standard deviations in Figure 4 and dissimilarity indices in Table 2 give very different answers about how segregation has developed in Sweden. According to the most generally used measure there has not really been any increase in segregation. But as shown in Figure 4 there has been a considerable increase in the between-neighbourhood variation in population composition. But does this amount to an increase in segregation? The answer is no if segregation is understood simply as the difference in the distribution of groups across sub-units. In the Swedish case the distribution of migrants across neighbourhoods has not become increasingly skewed. However, with an increase in the migrant population, large differences in the across-neighbourhood distribution of migrants have translated into an increasing variation in migration proportions, and in this way the unevenness in the spatial sorting has become more salient.

Thus, it could be argued that indices that measure unevenness are so sensitive that they detect segregation before segregation patterns are observed by urban dwellers in their everyday lives. That is, the dissimilarity index can detect segregation even if the group studied is very small, at a level where the unevenness in the residential distribution of the group would in reality go unnoticed by most people. However, the underlying unevenness in the distribution will become
much easier to see when, with increasing group size, it translates into a higher variance of group shares. If this is the case, high variation in population composition should be acknowledged as an important dimension of segregation because of its importance for how segregation is experienced by, and affects urban dwellers.

Geographical patterns

Figure 5 presents the results of the classification of populated grids cells based on the composition of the neighbourhood population in 1990, 1997, 2005, and 2012. For details see the method section. The 12 different types have been labelled with the letters A to L. These different types will be described in more detail below but it is also possible to understand the classification by looking at the small inset diagrams in each map which show the mean factor scores for the three factors used in the classification. The loadings for these factors are displayed in the bottom, right corner of Figure 5.

As can be seen from the inset diagrams, types A to D (first column) are characterised by increasing values on factor 3 (blue line) over time, and this corresponds to increasing proportions of non-European migrants at local neighbourhood scales, in particular at k=800 and k=6400. Types E to H are characterised by increasing values for factor 2 (green line) which corresponds to increasing proportions of non-European migrants and migrant total at the scale of urban areas, in a particular at k=51,200 but also k=409,600. Type I-L finally, are characterised by low values for factor 2 and factor 3, and with the exception of type L, by relatively high scores for factor 2 corresponding to high proportions of European migrants at local neighbourhood scales.

It can also be seen in Figure 5 that the clusters in the first column (A-D) are in descending order with respect to factor 3 (non-European, local neighbourhood). Clusters E-H are in descending order with respect to factor 2 (non-European and all migrants for the urban area). And clusters I to L are in descending order with respect to factor 1 (European migrants, local). Maps A-D, presented in the first column, show that the location of clusters characterised by increasing proportions of non-European migrants at the scale of local neighbourhoods, are linked to different levels of the urban hierarchy. Clusters of type A, with the highest proportion of non-European migrants, are found only in the four major metropolitan areas: Stockholm, Gothenburg,
Malmö and Uppsala. Clusters of type B, with somewhat lower proportions of non-European migrants are found in the major metropolitan areas and a selection of the major cities. Clusters of type C are in a broader range of the larger cities whereas clusters of type D, with relatively low but increasing proportions of non-European migrants, are relatively well-represented also in smaller urban centres.

The more detailed locations of clusters A-D are also presented in the map for Stockholm and the map for Western Sweden in the right-most panel of Figure 5. As shown in the legend, clusters A to D are represented by the colour blue. These two maps again show that clusters with increasing proportion of non-Europeans are found in the urban areas of Sweden, with Western and South Stockholm having the largest concentrations of clusters having high proportions of non-European migrants at the scale of local neighbourhoods.
Figure 5. Maps of classified factor loadings. Maps in three columns, A-D, E-H, I-L showing 12 clusters of factor scores. Three factors with loadings in table and maps of Stockholm and the south-western part of Sweden.

Source data: Swedish register data, authors’ calculations
The second column of maps presents the location of clusters that have high proportions of non-European migrants and all migrants at the scale of urban areas, but relatively low proportions of these migrant groups at the scale of local neighbourhoods. As can be seen in maps E-H the location of these clusters is closely associated with the location of clusters A to D. Thus, clusters of type E are found close to clusters of type A, clusters of type F are found close to clusters of type B and so on. This is, of course, not surprising since having a high proportion of migrants at the scale of urban areas is only possible if concentrations of migrants exist nearby.

The third column of maps in Figure 5 presents the location of clusters that have low proportions of non-European migrants both at the scale of local neighbourhoods and at the scale of urban areas, with maps I, J, and K showing clusters that have relatively high proportions of European migrants. As shown in maps I-K, clusters with high proportions of European migrants are mainly found in two regions: first, in regions bordering or close to Finland, Norway, and Denmark, and, second, in traditional manufacturing regions in Sweden. Thus, the locations of these clusters reflect cross-border migration and the substantial flows of European labour migrants to Sweden in the post-World-War-II period. Map L, finally, shows locations that have low migrant proportions overall. These are locations that have been relatively untouched by international migration flows during the last three decades and they are mostly found in locations at some distance from the major metropolitan areas, and remote from the border regions.

It is interesting to note that in 2012, only about 20% of the Swedish population lived in neighbourhoods with a population largely unaffected by international migration (cluster L). About 15% of the population lived in locations mostly affected by European migration (cluster I, J, and K). Close to 30% lived in locations that have experienced increasing proportions of non-European migrants in their local neighbourhood (clusters A-D) and about 35% live in locations with low proportions of non-Europeans in their local neighbourhood but with increasing proportions of non-European migrants at neighbourhood scales that correspond to the size of urban areas (cluster E-H). These figures testify to the fact that Sweden has become an immigration country and that the inflow of migrants has transformed almost the entire country from being relatively homogenous into a country where most inhabitants live in neighbourhoods with not insignificant country-of-birth diversity.
6. **Concluding discussion**

In times when migration is high, a recurrent question is how cohesion, integration and inclusion can take place in societies. These questions are now on the agenda in Sweden due to the entry of about 100,000 immigrants yearly, and recently a rising numbers of migrants adding to the total Swedish population of now close to 10 million. As is described in this study, an increasing proportion of the migrant population originates from non-European countries. Following this development, the aim of this paper is to analyse how a migrant population that is both expanding and changing in composition has affected the composition of Swedish neighbourhoods in different parts of the country and at different scales.

The analysis is based on Swedish geo-coded individual level register data for the years 1990, 1997, 2005 and 2012 for all migrants, and for European and non-European migrants respectively. In the analysis of the demographic composition we use a range of neighbourhood scales, from those encompassing the nearest 100 individuals to those encompassing the nearest 409,600 individuals.

To address the aim we used percentile plots, standard deviations, dissimilarity index (DI) and maps. First, we found segregation levels to be higher at small-scale levels, for instance the 100 closest neighbours, for all migrant populations. Small-scale segregation is especially severe for non-European migrants, while at the same time the decrease in segregation has been strongest for small-scale neighbourhoods for non-Europeans, as shown by the DI. At the same time, variation in population composition has increased between neighbourhoods over time. That is, contrasts between neighbourhoods with few migrants and neighbourhoods with many migrants have become more marked. Consequently, although there has been no major shift in the proportions of the migrant population living in different neighbourhoods, the expanding migrant population has led to increasing gaps in the proportion of the population that is foreign-born in each neighbourhood. This will have implications for the possibility of contact between migrants and natives.

The diverging results - decreasing segregation measured as unevenness (DI) and increasing segregation when it comes to disparities between areas - point to the need for a discussion of how to assess segregation trends. From a policy point of view, there is interest in segregation because
high levels of segregation imply reduced contact between different populations, and this could have negative effects on social cohesion, democracy and equality in a society. Another, potentially negative effect of segregation could be that reduced contact between populations can make it more difficult for some individuals to take advantage of the positive opportunities that are associated with being socially and economically integrated into a society.

In addition, we argue that residential segregation measures should be based on individualized neighbourhoods. In many cases, the characteristics of individual neighbourhoods are of importance for an individual’s opportunities concerning matters such as work and education. With a view of segregation as differences in geographical situations, the result of this study is different and more important than the results concerning an uneven definition of segregation. *While the unevenness (DI) is decreasing, variation in neighbourhood characteristics is increasing.* The risk of neighbourhood effects being substantially different is higher when areas in which people live are worlds apart as regards population composition (Andersson & Malmberg 2016 on line version). This, we would claim, is an important argument for not using only DI to measure segregation.

With respect to the DI results it is interesting to note that our findings are not contradicted by the trends that are presented in the tables and figures of earlier studies of ethnic segregation in Sweden. In fact, all the scientific reports we have referred to above do present some results that indicate declining or at least stabilizing levels of residential segregation as defined here by DI, even if these results are not fully reflected in the summary sections of the reports and papers. One reason for researchers’ reluctance to base their conclusions on the DI results might be the observation that neighbourhoods are becoming increasingly different and thus potentially contributing to unequal living conditions. But it should also be acknowledged that the time-period, geographical coverage, migrant group use, and neighbourhood definitions are different from those used in earlier studies and this could have contributed to our finding of stable or declining dissimilarity index segregation. For example, our finding of decreasing segregation for the European migrants may be related to that particular group’s long stay in Sweden in combination with adaptive residential mobility (Magnusson Turner and Hedman 2014).
On the basis of these findings, can it be concluded that measurements based on individualized neighbourhoods can contribute to a better understanding of how large migration flows influence patterns of segregation? Our answer is yes. Apart from addressing the modifiable areal unit problem, the use of individual neighbourhoods also contributes to an understanding of segregation that more closely links processes of residential sorting to its effects on how individuals experience their geographical surroundings, and in doing so it has been helpful in exposing potential shortcomings in the ability of the dissimilarity index to capture important segregation trends.

The individualized neighbourhood approach is also helpful in highlighting the fact that large migration flows influence neighbourhood composition on different geographical scales and this contributes to variation in how the geographical context of different individuals is changing. Whereas some individuals experience change in their close neighbourhood, others experience little change nearby but more substantial change at larger geographical scales. Clearly, this diversity of experiences is important to consider when the effects of large migration flows on host societies is analysed.

References
Andersson, Eva K. and Malmberg, Bo (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*, doi:10.1177/0042098016643915.
Andersson, Roger, Bråmå, Åsa and Hogdal, Jon (2007). Segregationens dynamik och planeringens möjligheter: en studie av bostadsmarknad och flyttningar i Malmöregionen [The dynamics of segregation and the possibilities of planning: A study of the housing market and mobility in the Malmö region]. Malmö: Stadskontoret Malmö city.
Andersson, Roger, Bråmå, Åsa and Hogdal, Jon (2009). Fattiga och rika-segregerad stad Flyttningar och segregationens dynamik i Göteborg 1990-2006 [Poor and rich – Segregated city. Mobility and the dynamic of segregation in Gothenburg 1990-2006]. Gothenburg: Gothenburg City.
Andersson, Roger, Hedman, Jan, Hogdal, Jon and Johansson, Sara (2007). Planering för minskad boendesegregation [Planning for decreasing residential segregation]. Stockholm: Regionplane- och Trafikkontoret.

Andersson, Roger and Kährik, Anneli (2015). Widening gaps: Segregation dynamics during two decades of economic and institutional change in Stockholm. In: T. Tammaru, S. Marcińczak, M. van Ham and S. Musterd (Eds.), *Socio-Economic Segregation in European Capital Cities. East Meets West* (pp. 110-131). New York: Routledge.

Biterman, Danuta (2006). Boendesegregation [Residential segregation]. In: Social Rapport 2006 (pp. 185-219). Stockholm: The National Board of Health and Welfare.

Biterman, Danuta (2010). Boendesegregation [Residential segregation]. In: Social Rapport 2010 (pp. 176-226). Stockholm: The National Board of Health and Welfare.

Biterman, Danuta and Franzén, Eva (2007). Residential segregation (chapter 6). *International Journal of Social Welfare* 16, 127-162.

Böhlmark, Anders, Holmlund, Helene and Lindahl, Mikael (2015). School choice and segregation: Evidence from Sweden. Working Paper 2015: 8. Uppsala: Institute for Evaluation of Labour Market and Education Policy (IFAU).

Dagens Nyheter (newspaper) (2015, March 10). Rika områden blir rikare – invandrartäta får fler invandrare [Rich areas become richer – immigrant dense areas get more immigrants], http://www.dn.se/nyheter/sverige/rika-omraden-blir-rikare-invandrartata-far-fler-invandrare/.

Duncan, Otis Dudley and Duncan, Beverly (1955). A methodological analysis of segregation indexes. In C. Peach (Ed.), *Urban Social Segregation* (pp. 35-51). London: Longman.

Frankenberg, Ruth (1993). White Women, Race Matters: The Social Construction of Whiteness. London: Routledge.

Glitz, Albrecht (2014). Ethnic segregation in Germany. *Labour Economics* 29, 28-40.

Grbic, Douglas, Ishizawa, Hiromi and Crothers, Charles (2010). Ethnic residential segregation in New Zealand, 1991-2006. *Social Science Research* 39(1), 25-38.

Holmlund, Helene, Häggbloom, Josefín, Lindahl, Erica, Martinson, Sara, Sjögren, Anna, Vikman, Ulrika and Öckert, Björn (2014). Decentralisation, skolval och fristående skolor: Resultat och likvärdighet i svensk skola [Decentralisation, school choice and independent schools: Results
and equity in Swedish schools]. Working Paper 2014: 25. Uppsala: Institute for Evaluation of Labour Market and Education Policy (IFAU).

Hall, Matthew (2013). Residential integration on the new frontier: Immigrant segregation in established and new destinations. *Demography* 50(5), 1873-1896.

Iceland, John and Scopilliti, Melissa (2008). Immigrant residential segregation in U.S. metropolitan areas, 1990-2000. *Demography* 45(1), 79-94.

Iceland, John, Weinberg, Daniel and Hughes, Lauren (2014). The residential segregation of detailed Hispanic and Asian groups in the United States: 1980-2010. *Demographic Research* 31(20), 593-624.

Lichter, Daniel T., Parisi, Domenico, Taquino, Michael C. and Grice, Steven M. (2010). Residential segregation in new Hispanic destinations: Cities, suburbs, and rural communities compared. *Social Science Research* 39(2), 215-230.

Lichter, Daniel T., Parisi, Domenico and Taquino, Michael C. (2015). Spatial assimilation in U.S. cities and communities? Emerging patterns of Hispanic segregation from blacks and whites. *The Annals of the American Academy of Political and Social Science* 660(1), 36-56.

Lindbom, Anders (2010). School choice in Sweden: Effects on student performance, school costs, and segregation. *Scandinavian Journal of Educational Research* 54(6), 615-630.

Lindbom, Anders and Almgren, Ellen (2007). Valfrihetens effekter på skolornas elevsammansättning: Skolsegregationen i Sverige. In Lindbom, A. (Ed.), *Friskolorna och Framtiden - Segregation, Kostnader och Effektivitet* (pp. 89-119). Stockholm: Institute for Future Studies.

Magnusson Turner, Lena and Hedman, Lina (2014). Linking integration and housing career: A longitudinal analysis of immigrant groups in Sweden. *Housing Studies* 29(2), 270-290.

Manley, David, Johnston, Ron, Jones, Kelvyn and Owen, Dewi (2015). Macro-, meso- and microscale segregation: Modeling changing ethnic residential patterns in Auckland, New Zealand, 2001-2013. *Annals of the Association of American Geographers* 105(5), 951-967.

Marcińczak, Szymon, Musterd, Sako, Tammaru, Tiit and Van Ham, Maarten (2015). Socio-Economic Segregation in European Capital Cities: East Meets West. Abingdon, Oxon: Routledge.
Martori, Joan Carles and Apparicio, Philippe (2011). Changes in spatial patterns of the immigrant population of a southern European metropolis: the case of the Barcelona metropolitan area (2001–2008). *Tijdschrift voor Economische en Sociale Geografie* 102(5), 562-581.

Massey, Douglas S. and Denton, Nancy A. (1988). The dimensions of residential segregation. *Social Forces* 67(2), 281-315.

Mattsson, Katarina (2005). Klonad skönhet – Fröken Sverige och andra ‘missar’ i kritisk belysning. In G. Forsberg and C. Grenholm (Eds.), Och Likväl Rör det Sig: Genusrelationer i Förändring (pp. 191-202). Karlstad: Karlstad University Press.

Molina, Irene (1997). Stadens Rasifiering: Etnisk Boendesegregation i Folkhemmet [Ethnic Residential Segregation in the Swedish Folkhem]. PhD dissertation, Uppsala University.

Murdie, Robert and Borgegård, Lars-Erik (1998). Immigration, spatial segregation and housing segmentation of immigrants in metropolitan Stockholm, 1960-95. *Urban Studies* 35(10), 1869-1888.

Musterd, Sako (2005). Social and ethnic segregation in Europe: Levels, causes and effects. *Journal of Urban Affairs* 27(3), 331-348.

Musterd, Sako and Ostendorf, Wim (2009). Residential segregation and integration in the Netherlands. *Journal of Ethnic and Migration Studies* 35(9), 1515-1532.

Nordström Skans, Oskar and Åslund, Olof (2010). Etnisk segregation i storstäder–bostadsområden, arbetsplatser, skolor och familjebildning 1985-2006 [Ethnic segregation in the metropolitan cities – residential areas, work places, schools and family formation 1985-2006]. Rapport 2010: 4. Uppsala: Institute for Evaluation of Labour Market and Education Policy (IFAU).

Niedomysl, Thomas, Östh, John and Amcoff, Jan (2015). Boendesegregationen i Skåne [Residential segregation in Skåne]. Kristianstad: Region Skåne.

Osanami Törngren, Sayaka (2011). Love ain’t got no color? Attitude toward interracial marriage in Sweden. PhD dissertation. Malmö: REMESO, ISV, Linköpings universitet.

Östh, John, (2014). Introducing the EquiPop software: An application for the calculation of k-nearest neighbour contexts/neighbourhoods. [http://equipop.kultgeog.uu.se/Tutorial/Introducing%20EquiPop.pdf](http://equipop.kultgeog.uu.se/Tutorial/Introducing%20EquiPop.pdf)
Östh, John, Andersson, Eva and Malmberg, Bo (2013). School choice and increasing performance difference: A counterfactual approach. *Urban Studies* 50(2), 407-425.

Östh, John, Malmberg, Bo and Andersson, Eva (2014). Analysing segregation with individualized neighbourhoods defined by population size. In C.D. Lloyd, I.G. Shuttleworth and D.W. Wong (Eds.), *Social-Spatial Segregation: Concepts, Processes and Outcomes* (pp. 135-161). Bristol: Policy Press.

Sabater, Albert (2010). Ethnic residential segregation change in England and Wales. In J. Stillwell and M. van Ham (Eds.), *Ethnicity and Integration* (pp. 47-62). Dordrecht etc: Springer.

Shon, Jean-Louis P.K. and Verdugo, Gregory. (2015). Forty years of immigrant segregation in France, 1968–2007. How different is the new immigration? *Urban Studies* 52(5), 823-840.

Simpson, Ludi (2007). Ghettos of the mind: The empirical behaviour of indices of segregation and diversity. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 170(2), 405-424.

Simpson, Ludi, Gavalas, Vasilis and Finney, Nissa (2008). Population dynamics in ethnically diverse towns: The long-term implications of immigration. *Urban Studies* 45(1), 163-183.

Statistics Sweden (2002). Statistics on persons with foreign background. Guidelines and recommendations. Reports on Statistical Co-ordination for the Official Statistics of Sweden 2002:3. Örebro: SCB-tryck.

Statistics Sweden (2015). Geografidatabas [Geography database]. Retrieved from http://www.scb.se/sv_/Vara-tjanster/Bestalla-mikrodata/Vilka-mikrodata-finns/Geografidatabas/.

Stockholms Läns Landsting (2014). Segregation i Stockholms regionen. Kartläggning med EquiPop [Segregation in the Stockholm region. Mapping with EquiPop]. Demografisk rapport 2014: 09. Stockholm: Growth and Regional Planning Administration, http://www.tmr.sll.se/Statistik/Demografi-och-prognoser/Befolkningsprognoser/.

Sveriges Radio (Swedish radio) (2012). Nya siffror visar på dubblad bostadssegregation [New calculations show doubled residential segregation], http://sverigesradio.se/sida/artikel.aspx?programid=83&artikel=53611.

Wong, David W. (2016). From aspatial to spatial, from global to local and individual: Are we on the right track to spatialize segregation measures? In F.M. Howell, J.R. Porter and S.A.
Matthews (Eds.), *Recapturing Space: New Middle-Range Theory in Spatial Demography* (pp. 77-98). Spatial Demography Book Series. Dordrecht etc: Springer.

Wright, Richard, Ellis, Mark, Holloway, Steven R. and Wong, Sandy (2014). Patterns of racial diversity and segregation in the United States: 1990–2010. *The Professional Geographer* 66(2), 173-182, doi:10.1080/00330124.2012.735924.