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ABSTRACT

We examine the 'overlap' or to which degree tenure form patterns are similar to socio-economic segregation patterns. The issue has been discussed concerning mixing policies; does mixing of tenure hinder socio-economic segregation? If mixing tenure is to be an effective policy against segregation, the overlap has to be understood. Using Swedish register data, we cross tenure-type landscapes with patterns of high/mixed/low-income and with European/non-European/Swedish-born. To what degree is there overlap among tenure, income and country of birth? Is the overlap related to geographical scale and polarization? Is the overlap of tenure forms with socio-economic characteristics consistent across regions? We find strong overlap of large-scale cooperative tenure landscapes with very high incomes as well as with Swedish-born. Small-scale tenure-landscapes provide mixing opportunities for incomes wherever they are located; however, these landscapes have a small non-Swedish-born population nearby. Some tenure-type landscapes vary in characteristics depending on location; e.g. public rental concentrated areas are high-income in urban cores but low-income in urban peripheries.

Introduction

The idea of mixing housing types and tenure forms to create social cohesion in neighborhoods is a contested theme. In policy circles, there is a persistent belief that mixing of tenure forms in neighborhoods can be used to achieve a local mix of populations along socio-economic and ethnic characteristics. The logic is that increased tenure mix in this way can curb negative effects on individuals′ life courses caused by socio-economic and ethnic segregation. Accordingly, many neighborhoods in Europe have been planned with tenure mix in mind (Bergsten & Holmqvist, 2013; Bolt *et al.*, 2010; Kleinhans, 2004; Musterd & Ostendorf, 2008). The policy of mixing is, however, questioned, not only in certain political camps but also among researchers. The critics argue, one the one hand, that other aspects than tenure forms are more important in residential sorting, e.g. residential sorting based on individual preferences and characteristics

(c.f. Galster, 2012). One the other hand, they mean that spatial proximity of people alone will not lead to improved individual outcomes (c.f. Musterd & Andersson, 2005).

One of the main ways to discern the importance of tenure mixing has been to study the relationship between tenure mix and residential segregation along socioeconomic and ethnic lines. These studies have only been able to study the tenure form composition on a single neighborhood scale. Vital contributions from this string of research indicate that the relationship is weak; i.e. that an overlap is not clear cut (Blind, 2015; Livingston et al., 2013; Musterd & Andersson, 2005), but also that there is some evidence for that tenure mix can explain ethnic mix, at least in the capital regions in northern Europe (Skifter Andersen et al., 2016). Although, a clear connection between tenure mix and social and ethnic mix most likely never will be found since multiple sorting processes into neighborhoods occur, studies informing policy circles tend to only have been able to discuss the relationship on a single local neighborhood scale. This despite the fact that residential segregation on multiple scales has been proved to affect individuals' lives (e.g. see Clark et al., 2015). The everyday lives of individuals span well beyond the immediate administrative neighborhood. Thus, recent segregation studies tend to stress that residential segregation is best understood using a multiscalar approach that better capture the lives and neighborhoods of individuals.

In this study, we argue that tenure mix likewise needs to be considered a multiscalar phenomenon and we show how such an analysis can be conducted to inform the ongoing policy debate on how tenure forms contribute to the structuring of residential sorting by income and ethnicity. Our aim, thus, is not to analyze levels of segregation but instead to clarify the extent to which segregation is linked to tenure type mixing. In doing so, we use what recently has been denominated Tenure Type Landscapes (TTL) instead of neighborhoods (Wimark et al., 2020). The virtue of TTL lies in that they are created based on the composition of tenure forms that households live in on different scales. In TTL, neighborhood scale is operationalized as numbers of closest neighbors based on Euclidian distance between neighbors. This means that TTL span beyond the most immediate neighborhood and take into account also the tenure form composition of the surroundings. Using TTL, we analyze how tenure form configurations are related to income mixing and ethnic mixing and ask the following questions:

- To what degree is there overlap among tenure vis à vis income and vis à vis ethnicity?
- To what extent can we find that perfectly fitting overlap is related to geographical scale and polarization?

The results suggest that scale indeed is of importance when exploring the overlap of income variation and ethnic composition with tenure form composition. In TTL where the tenure form composition is consistent no matter what scale it is measured on, so called large scale, the overlap with income classes and ethnic composition is evident. Thus, such large scale TTL structure residential segregation. Concentrated TTLs, in which a specific tenure form strongly dominates at small scales and where

tenure mix only is reached on very high scales, show signs of overlap in polarized ways, where income and ethnic mix clearly depend on the tenure form. For example, the public rental and private rental tenure forms overlap with low-income classes, while the owner-occupied and cooperative tenure forms overlap with high-income classes. By contrast, TTLs that are dominated by a tenure type at very low scales but rapidly become tenure mixed as the measurement scale increases, tend to overlap with more income mixed clusters. This suggests that planners advocating tenure mix as a solution to alleviate residential segregation need to bear in mind the scale of the neighborhood and that building homogeneous areas on very small scales might not be an issue as long as the tenure forms in surrounding areas are different.

Geography of tenure forms and household access

This study fits in the field of housing studies in that we consider the housing market structure and mixing of tenure forms. It is likewise a part of segregation research in that it shows the segregation patterns of aspects such as income and ethnicity. Furthermore, the study departs from research that points to the intrinsic meaning of place of residence for life course outcomes. In this section, we describe theories about in what ways housing tenures can been found to regulate and structure households access to housing. Also other types of factors influence who will access different types of housing; preferences and discrimination. These factors are important for the outcome in terms of overlap between tenure forms and ethnicity and income but in this study we argue for the importance of tenure forms and study tenure forms as the basis.

Tenure types and how they are scattered in space forms a distinctive and lasting geography, which we name tenure type landscape. The housing stock in any country is only slowly changing, with some exceptions. Thus, we regard space and the tenure structure much according to Malpas discussion of space (Malpas, 2012). Malpas claims that relational ideas of space may obscure what space is about in a more simpler way since 'within much contemporary literature, in geography and beyond, space appears as a swirl of flows, networks and trajectories, as a chaotic ordering that locates and dislocates and as an effect of social process that is itself spatially dispersed and distributed' (Malpas, 2012, p. 228). We acknowledge that tenure forms are renegotiated, under constant debate and that tenure forms are sometimes conversed (Andersson & Turner, 2014) but in an historical perspective owning and renting have been fundamentally different in most national contexts. In the same way tenure types have always regulated access by different groups to different tenure type landscapes.

Thus, we consider tenure types to regulate how households can *access* housing, and to contribute to structuring the whole urban fabric. In traditional segregation and urban geography literature, models of cities were made to show patterns of the physical environment as the ground for socio-economic characteristics of people in sectors, ethnic clusters and demographic concentric zones (Murdie, 1969). In this study, we assume in a similar way the physical layout in the form of tenures to be structuring the income and ethnic residential patterns.

A somewhat later strand of urban geographical research, however, focused on housing, housing stock and housing submarkets instead of the households' demand side. The housing submarkets were characterized by tenure form, price and type (apartment, row/attached, single detached) paired with the demography, economic status and ethnic origin of its dwellers. Such studies also showed the complexity by which households were sorted in space to form segregation patterns (Murdie & Borgegard, 1998). In housing studies, housing submarkets characterized by many different aspects have also been analyzed in the form of different national housing systems. Sorting, access and segregation patterns partly depend on whether the housing system is the dualist rental system or the integrated rental market system (Kemeny, 2006). According to Kemeny, Sweden belongs to the integrated rental market system wherein non-profit municipal housing has been integrated with the open rental market.

Specifically housing *affordability* regulates households' access to tenure types. Studies of affordability include many financial accessibility aspects (Haffner & Heylen, 2011; Hulchanski, 1995), originally denoting the housing expenditure-to-income ratio. There is also a more recent global trend where especially rents, but also housing costs across tenures have increased more than incomes (Wetzstein, 2017) which have resulted in recent publications on affordability (Anacker, 2019), and publications on the production of affordable housing (Granath Hansson, 2019). This has also started movements which can be read about elsewhere (e.g. the film Push).

If considering housing affordability as a residential mobility mechanism, it regulates access to tenure forms, and thus forms the social and ethnic patterns on top of the tenure type landscape. (Residential mobility research is an important source for affordability and access discussions e.g. (Alm Fjellborg, 2018). Hulchanski mentions affordability in the form of getting a mortgage or not to access ownership as one access regulator (Hulchanski, 1995). The total expenditures for a tenure also differs and regulate entrance to some areas where a tenure form dominates (Alm Fjellborg, 2020). This is despite that fact that Swedish housing policy has been one of neutrality between housing tenure forms, where subsidies and support should not favor any tenure form. The expenditures in total will also be dependent on the status of the residential area.

Tenure mix, income mix and ethnic mix, empirical results

There are earlier studies on the relation between tenure form spatial patterns and the socioeconomic characteristics of populations as well as ethnic mixing (Livingston et al., 2013; Skifter Andersen et al., 2016; South et al., 2011). However, data restrictions often make the analysis difficult to perform and refrain researchers from carrying out national-level studies. Data that allow one to classify areas according to tenure forms and then classify the same areas according to population characteristics are needed. Some studies are conducted to analyze this so-called overlap between tenure forms and populations, but to our knowledge, studies that cover entire countries are few.

The studies that we have found mainly report that the relationship is weak; that is, the overlap is not clear cut (Blind, 2015; Livingston *et al.*, 2013). Using Swedish data from the mid/1990s, Musterd & Andersson (2005, p. 779) conclude, 'There is no clear relationship between housing mix and social mix'. Most likely, a clear connection between tenure form and socioeconomic characteristics in the population will never be found since we expect residential segregation and sorting into neighborhoods.

However, there is some evidence that tenure mix can explain ethnic mix in the Nordic capital regions (Skifter Andersen *et al.*, 2016). Concentrations of immigrants are found in public/social rental areas in the four Nordic capital regions. Skifter Andersen *et al.* state that ethnic divisions of housing tenures contribute to residential segregation, and they add that this means that the distribution of tenure forms is therefore very important in shaping geographical patterns. Importantly, they also state that '… a policy of neighborhood tenure mix in one of the cities [Helsinki] has resulted in a relatively low degree of segregation in spite of high concentrations of immigrants in social/public housing' (Skifter Andersen *et al.*, 2016, p. 1).

Livingston, Kearns and Baily used census data from 2001 on households to measure occupational mix and tenure mix across regions. They show that neighborhoods are generally more mixed in occupation than in tenure, so tenure does not prescribe inhabitants. They also found that tenure mix had a positive (moderate) relationship with occupational mix, and contrary to conventional wisdom, occupational mix and tenure mix increased with the level of area deprivation. They further concluded that if policy is concerned with increasing social mixing, then increasing mix in affluent neighborhoods must be the focus of mixing policies (Livingston *et al.*, 2013). However, the general debate on the benefits and drawbacks of mixing is not the focus of our paper; instead, see the special issue and the introduction by Bolt *et al.* (2010).

Housing market policies and tenures in Sweden

Although, many states are known to have active housing policies, Sweden stands out regarding a long history of an efficient housing policy, known as the *Folkhem* model (Grundström & Molina, 2016). From the 1930s and onwards regulations were decided upon aiming at raising housing standards and financial instruments were introduced to increase housing production and erase the housing deficit. *Allmännyttiga* public municipal rental housing companies producing housing for the benefit of everyone became key players in the housing market. An integrated rental market system dominated, in which rent levels were set by the public housing sector, the private rental sector had to adjust and rents were negotiated with the Swedish Union of Tenants (Bengtsson, 2006). A goal of neutrality between tenure forms was set so that dwellers´ housing needs would be financially indifferent between housing tenures, enforced through, e.g. housing allowances. Housing production increased and culminated with the housing program *Miljonprogrammet* between 1965 and 1974 in which approximately 1 million new homes were built.

The million housing program is important in regard to tenure mix and scale of housing areas. As Grundström & Molina (2016) explains, the state subsidies were created in such a way that in order for developers to take part of them they needed to

construct a single tenure form in larger housing estates. In many cases, this resulted in a differentiation between housing areas along tenure forms: large scale housing estates consisting of rental housing in high rise buildings, areas consisting smaller apartment buildings with tenant cooperatives and carpets of single detached houses in ownership tenure. The differentiation also aligned with socio-economic segregation where the poorest dwellers moved in to the housing estates. This 'new' form of socio-economic segregation spurred a political debate on how to best create social cohesion in the society and in the mid-1970s the goals of the national housing policy changed – the goal became to create social mix in areas according to age, household types and income (Holmqvist & Bergsten, 2009).

Since the 1990s the tools to achieve mixing has changed as the housing policy has become more liberalized. Due to EU regulations, public housing companies had to become profit oriented. Changes in national politics reduced the rent subsidies for multifamily housing, and the housing sector was to fulfil the role of being a contributor to public revenues, not a receiver of funding in the national Swedish economy (Turner, 1997; Turner & Whitehead, 2002). These changes in housing politics have entailed changes in the housing system, such as proportions of different tenure forms, composition of residents, affordability and status of the tenure forms.

Although, deregulations have decreased the possibilities of building rentals, and therefore, also tenure mixed areas (Bergsten & Holmqvist, 2013), municipalities have always been responsible for implementing the national social mix policy (Holmqvist & Bergsten, 2009). Municipalities also have the main responsibility of providing housing for its inhabitants (Magnusson & Turner, 2008). This means that planners have continued to aim for tenure mix in planning new areas and counteracting residential segregation in existing areas (Andersson & Turner, 2014; Holmqvist & Bergsten, 2009).

The largest tenure form category in Sweden is *owner-occupied housing*, (38%), these are privately owned and consist mostly of detached housing. *Public rental* has declined in recent decades, and in 2012, it represented 17% of the dwellings. Traditionally, Swedish public rental has been the housing option for different income groups, but in recent years, the proportion of low-income groups has increased (Borg, 2019). Public rentals consist of apartments in municipality-owned multifamily housing that are rent-regulated. The market share of *private rental* has increased to 17% (in 2012). Also privately owned, rented apartments are rent regulated. Another increasing tenure form is *cooperative housing* where the tenants lease their individual apartments, and leases can be sold at market prices. In 2012, 22% of dwellings were in cooperative housing. (∼9% of dwellings are in *other forms of tenure*, farm dwellings, apartments owned by private or non-profit organizations).

There are few studies that compare residential segregation between countries and that give an overview of the residential segregation levels in Sweden. In one study comparing the levels of socio-economic segregation in the capital regions of Europe it was found that Stockholm laid in the middle of the stratum (Musterd *et al.*, 2017). In another study comparing the levels of ethnic segregation in five northern European countries it was shown that Sweden had comparable levels to the levels in Denmark and Netherlands but lower than Belgium (Andersson *et al.*, 2018). The levels of ethnic

Table 1. Classifications used in the analyses: Tenure type landscapes, country of birth context and income composition context.

	Tenure type landscapes	Country of birth context	Income group context
Indicator variables	*Five different tenure forms*: Tenant cooperatives, Owner-occupied, Public rental, Private rental, Other	*Three different migrant types*: European migrants, non-European migrants, total migrants	*Ten different income groups:* Deciles based on equalized disposable income deciles
Population	Households	Total population	Population aged 15 years and older
Spatial scales	50, 100, 200, 400, 800, 1600, 3200, 6400, 12,800, 25,600, 51,200, 102,400 and 204,800 nearest households	100, 800, 6400, 51,200 and 409,600 nearest neighbors.	1600 nearest neighbors
Years	1990, 1997, 2005 and 2012	1990, 1997, 2005 and 2012	1990–2015, all years
Clusters based on	Pooled data for all years	Observed contexts for the grid cell in 1990, 1997, 2005 and 2012 summarized by factor scores (3 factors)	Pooled data for 26 years
Number of grid cells classified in 2012	211,901	213,520	214,644
Resulting clusters	Twelve: Coop large-scale, Owner-occupied concentrated, Owner-occupied small-scale, Coop concentrated, Mixed even, Coop small-scale, Other small-scale, Mixed private rental, Owner-occupied large-scale, Public rental small-scale, Private rental concentrated, Public rental concentrated	Twelve: A-L, whereof nine clusters are used.	Twelve: Very high income 1-2, High income 1-2, Mixed 1-4, Low income 1-2, Very low income 1-2

segregation have not increased in any substantial manner since the 2000s despite housing policy deregulations and a (from a European perspective) high immigration (Malmberg *et al.*, 2018; Nielsen & Hennerdal, 2017).

Data and method

To explore the overlap between tenure form composition and household composition we will rely on a classification of individual locations based on (a) tenure form composition, (b) composition of income groups and (c) ethnic composition (country of birth). As described below and in Table 1, the classifications have been done in different ways, but the classifications used all refer to the same year, 2012. This is the last year for which we have classifications for all three dimensions. The degree of overlap will be explored by cross-tabulating ethnic classifications and income structure classifications with the tenure form classification. Our motive for using separate classifications instead of a composite classification (Singleton & Longley, 2009) is that this allows to explore to what extent income sorting and country-of-birth sorting is linked to the underlying tenure type composition of areas.
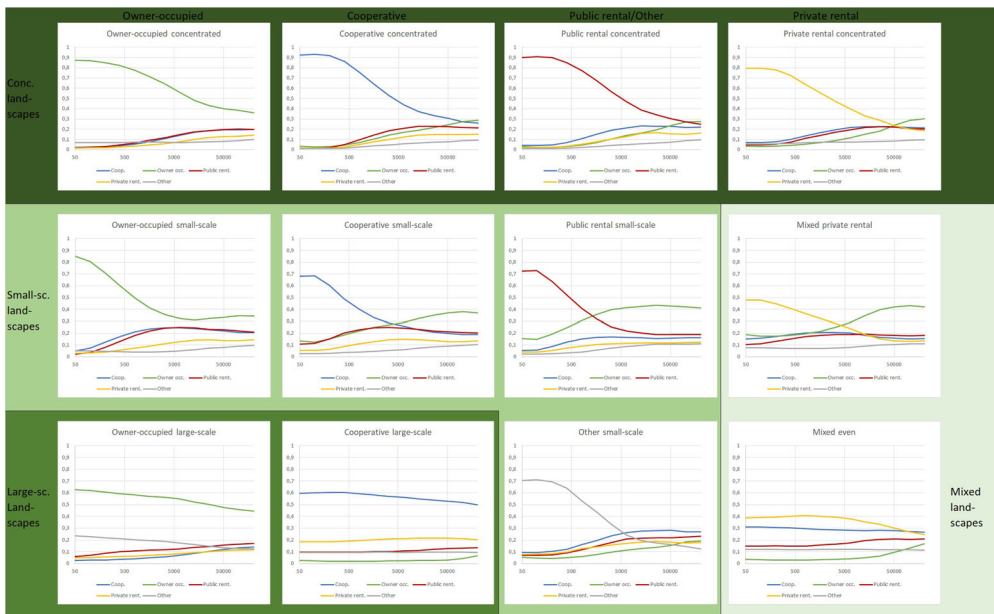
Figure 1. Tenure type clusters with share of tenure form at different scales (*k* number of closest neighbors). Tenure forms in columns and scales in rows.

Tenure type landscapes

A novelty in our approach is that we measure tenure form composition across multiple scales. This is made possible by the existence of geo-gridded register data (Statistics Sweden, 2015). This grid consists of 250-m squares in built-up areas and 1000-m squares outside dense settlements, visible in the maps as small and larger squares. The residential context of individual locations is identified by extending a buffer around each grid cell until the buffer population reaches a pre-defined population threshold, after which the composition of the buffer population is computed using Equipop software (Östh *et al.*, 2014). Details on the different tenure forms we have used, and the different scales for which the tenure form distribution have been computed are provided in Table 1. Based on the data on tenure form composition across different scale levels, typical Tenure Type Landscapes (TTL) have been identified using *k*-means cluster analysis. Different number of clusters were considered, and we decided that using 12 clusters was sufficient for capturing most of the variation. The resulting clusters are presented in Figure 1.

The first row in Figure 1 contains the TTL that are clearly dominated by a single tenure form. That is, 50% or more of the 50 to 3200 nearest dwellings are in a single tenure form. Based on the dominating tenure form these clusters have been named: *Owner-occupied concentrated*, *Cooperative concentrated*, *Public rental concentrated* and *Private rental concentrated*.

The second row of Figure 1 contains clusters that are dominated by a single tenure form at smaller spatial scales but are more mixed at larger spatial scales. Typically, in these small-scale clusters, at scales beyond than 400 dwellings, the dominating tenure form has less than 50%. As an indication of this scalar characteristic these TTL have
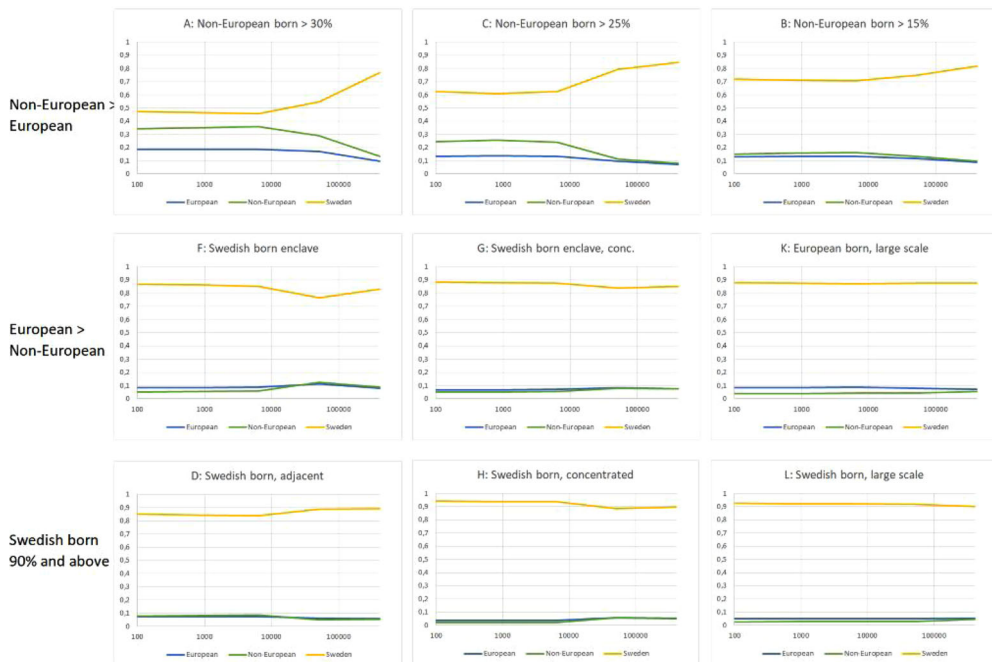
Figure 2. Country of birth clusters, shares of non-European born (green line), European born (blue line) and Swedish born (yellow line).

been named: *Owner-occupied small-scale*, *Cooperative small-scale*, *Public rental small-scale* and *Mixed private rental*. Small-scale cluster diagrams are presented in a lighter shade of green. For individuals living in these clusters, this means that in their closest vicinity, they are exposed to households living in a specific tenure form, but as they move further away from their homes, they quickly become exposed to other tenure forms.

The third row contains two large-scale clusters that is cluster with little variation in tenure composition across scales: *Owner-occupied large-scale* and *Cooperative large-scale*, both diagrams in darker green. For individuals living in these clusters, it does not matter how far away from their homes they travel – they are still exposed to the same tenure form composition. The third row also contains the cluster *Mixed even*, a diagram in the lightest shade of green, which is also a large-scale cluster but with the difference that there is virtually no tenure form domination. This means that individuals living in this cluster are exposed to all tenure forms regardless of how far away they travel from their homes. To simplify, we name all these clusters 'landscapes' throughout the text. For more details, see Wimark *et al.* (2020).

Country of birth clusters

The country of birth clusters are presented in Figure 2, arranged in three rows. These clusters are also based on multiscalar measures of geographical context, for details see (Malmberg *et al.*, 2018).

The first row in Figure 2 shows neighborhoods that have the highest share of non-European born. Cluster A has the highest concentrations of non-European-born individuals. Clusters C and B have progressively lower migrant shares.

The second row presents clusters where the concentration of European-born individuals is higher than the concentration of non-European-born individuals. For Cluster F and Cluster G, the concentration of Swedish-born individuals is lower at larger scales than at smaller scales, while Cluster K has similar concentrations across the scale level.

In the last row, finally, clusters have, with rather small differences, high proportions of Swedish-born individuals, at large-scales for Cluster D, at small-scales for Cluster H and across scales for Cluster L. That is, Cluster L maintains a high proportion of Swedish born across close by and further away neighbors.

Income group clusters

In contrast to the tenure form clusters and the country-of-birth clusters, the income clusters are based on only one scale level: the nearest 1600 neighbors, computed using Hennerdal's *geocontext* script (Hennerdal, 2019). Again, *k*-means cluster analysis has been used for the classification into 12 different categories based on the proportion of individuals in different income deciles. Using deciles makes it possible to characterize neighborhood not only based on a rich to poor scale but also capture degrees of homogeneity and mixing. The categories used reflect neighborhood composition during the 1990–2012 period, but for the analysis in this article, the locations have been assigned to these categories based on the composition in 2012.

Table 2 presents the composition of the income-based clusters in terms of population share across income deciles. The Very high income 1 cluster has a high concentration of individuals in the highest income decile. The Very low income 2 cluster, conversely, has a high concentration of individuals in the lowest decile. In between these extremes, the Very high income 2 cluster to Very low income 1 cluster have progressively fewer individuals in the highest income deciles and progressively more individuals in the lowest income deciles. The most even distribution is found in the Mixed 2 cluster, where each decile is represented by close to 10% of the population. That is, Mixed 2 has a distribution across income deciles that is very close to the income distribution of the entire Swedish adult population.

Entropy index and dissimilarity index

Below, in addition to presenting cross-tabulations of TTL in relation to country-of-birth clusters and income decile cluster we will also use two statistics to evaluate overlap. The first of this is the entropy index as implemented by Hårsman (2006). To compute the entropy index the product:

$$p_{ij} * \ln(p_{ij})$$

Is computed for each cell, where p_{ij} is the proportion of households living in TTL *i* that belong to income decile cluster (or country of birth cluster) *j*. Then, the sum of

Table 2. Income decile clusters and their shares of income deciles for year 1990–2015.

Neighborhood type	Income decile (share)									
	Lowest incomes									Highest incomes
	Decile 1 (%)	Decile 2(%)	Decile 3(%)	Decile 4(%)	Decile 5(%)	Decile 6(%)	Decile 7(%)	Decile 8(%)	Decile 9(%)	Decile 10(%)
Very high income 1	7	4	4	4	5	6	8	10	15	37
Very high income 2	6	5	5	6	7	8	10	12	15	25
High income 1	8	6	7	8	8	9	11	12	14	18
High income 2	5	7	8	9	11	11	12	12	13	12
Mixed 1	6	9	10	11	12	11	11	11	10	8
Mixed 2	11	10	10	10	10	10	10	10	10	10
Mixed 3	9	12	12	12	11	11	10	10	8	6
Mixed 4	11	15	14	12	11	10	9	8	7	4
Low income 1	17	14	12	11	10	9	9	8	7	5
Low income 2	24	16	13	10	9	8	7	6	5	3
Very low income 1	33	19	12	9	7	6	5	4	3	2
Very low income 2	46	20	11	7	5	4	3	2	2	1

these products for across income decile cluster (or country of birth cluster) for each TTL is computed:

$$\sum_{i=1}^{n} p_{ij} * \ln(p_{ij})$$

This is the entropy value for TTL, and can be denoted H_j. To normalize this value one computes $\overline{H}$, which is the value that H_j would have if the distribution across income clusters (country-of-birth clusters) would be the same as the distribution for the total population. The normalization is obtained by computing:

$$\frac{\overline{H} - H_j}{\overline{H}}$$

This index will be zero if the distribution is the same as for the population and increase the more households are concentrated to a single category. That is, as strong overlap will be reflected in a large entropy index.

The dissimilarity index will be used to measure the differences in distribution across income decile clusters (or country-of-birth clusters) between tenure type clusters 1 and 2:

$$\frac{1}{2} \sum_{i=1}^{n} \text{abs}(p_{i1} - p_{i2})$$

where p_{ij} is defined as stated above. Values close to 1 indicate the distributions are very different. Values close to zero, that they are very similar. These differences will be computed for every pair of tenure type landscapes. The median value of the dissimilarity index will be used as an overall indicator of the extent to which one tenure type landscapes is different from others with respect

Note that the different types of context have different base populations: households, individuals 15 years and older and total population. However, when overlap between contexts is analyzed, the total population is used to designate the grid cell population. In total, we have 211,897 grid cells that are classified in all three dimensions. The total population number in these grid cells is 9,509,876. The official population in Sweden in 2012 was 9,555,893, yielding a discrepancy of 46,017. Of these, 16,583 have not been assigned a grid cell coordinate by Statistics Sweden. The rest are in grid cells that do not have all three classifications.

Results

In Figure 3, the distribution of tenure type landscapes and income decile clusters across Sweden are shown in a set of maps (Supporting Information: Twelve maps, one for each tenure type landscape, illustrate the overlap between tenure type landscapes and income level). These maps allow a visual analysis but do not allow a quantitative evaluation of to what extent there is an overlap. Data for a quantitative
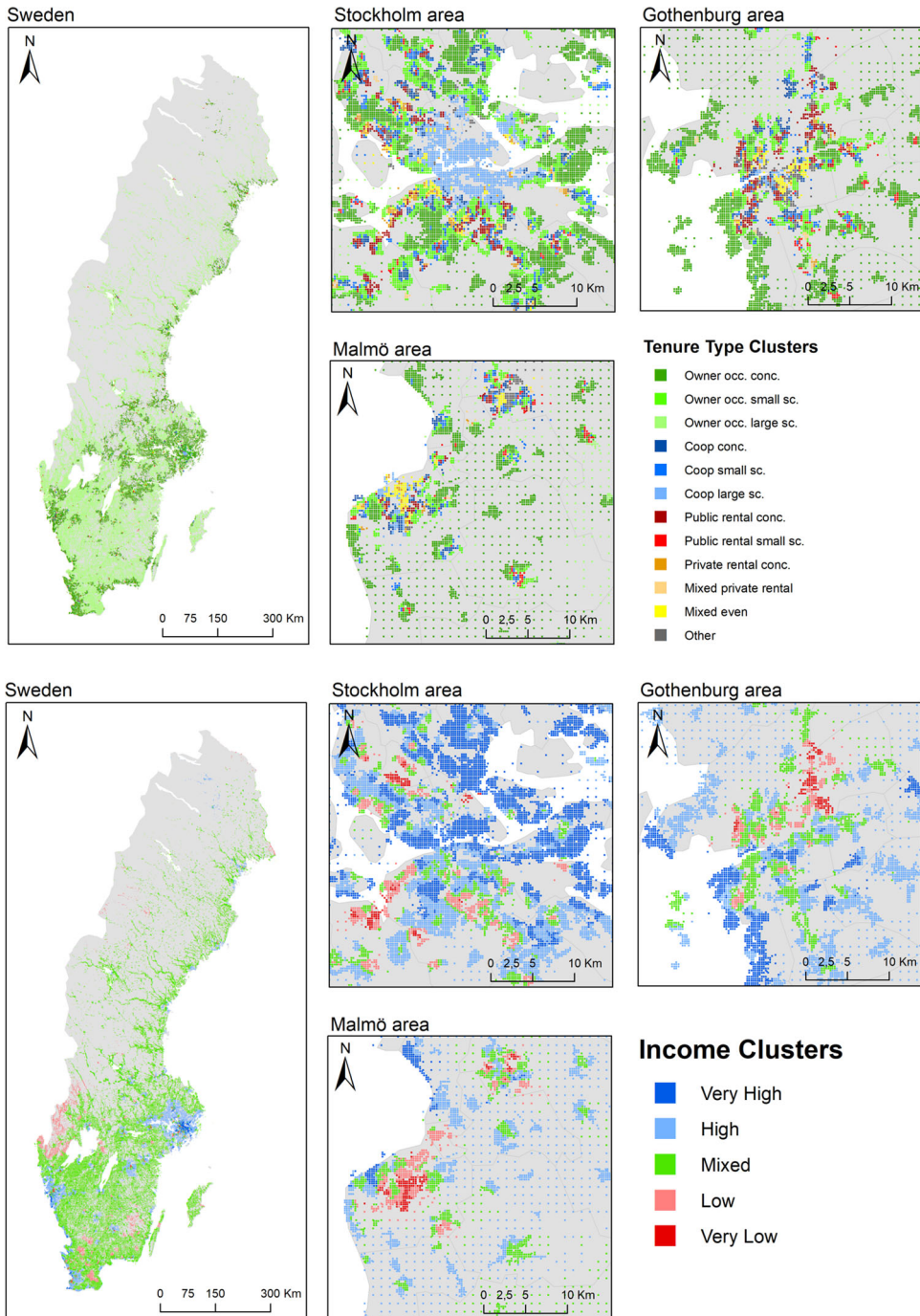
Figure 3. Tenure type clusters and income clusters with enlargements for the three metropolitan regions.

evaluation is instead provided in Table 3, showing how neighborhoods classified into the different tenure type landscape classes are distributed across different income decile clusters. Table 4, in the same way, shows the distribution across different

Table 3. Tenure type cluster and income decile clusters. Entropy and Dissimilarity (DI) indexes showing distribution across income clusters, and aggregated clusters, low income clusters versus not low income clusters.

Tenure type landscape	Income clusters														Distribution across income clusters		
	Very high income 1	Very high income 2	High income 1	High income 2	Mixed 1	Mixed 2	Mixed 3	Mixed 4	Low income 1	Low income 2	Very low income 1	Very low income 2	Total	Entropy (%)	DI, median value		
															All clusters	Agg., low vs. not low
Coop large-scale	23%	25%	34%	44%	1%	9%	1%	0%	2%	1%	0%	0%	542,814	27	**70.4**	11.4
Owner-occupied concentrated	3%	10%	10%	32%	30%	2%	11%	2%	1%	0%	0%	0%	1443,949	24	**59.9**	15.3
Owner-occupied small-scale	3%	6%	10%	21%	23%	8%	13%	7%	7%	2%	1%	0%	758,632	6	41.7	7.7
Coop concentrated	1%	5%	9%	13%	15%	12%	17%	11%	12%	5%	2%	0%	440,414	2	31.2	11.8
Mixed even	1%	5%	16%	6%	6%	24%	11%	5%	12%	11%	4%	1%	283,133	4	44.5	18.2
Coop small-scale	1%	2%	5%	14%	18%	10%	18%	19%	9%	5%	1%	0%	633,469	7	32.0	9.2
Owner-occupied large-scale	0%	0%	1%	4%	21%	5%	39%	24%	6%	1%	0%	0%	1192,398	**32**	47.2	9.5
Mixed private rental	0%	0%	2%	8%	14%	7%	25%	30%	9%	4%	1%	0%	547,022	16	38.1	10.3
Public rental small-scale	0%	0%	1%	7%	16%	4%	23%	34%	8%	6%	1%	0%	532,029	19	40.7	10.5
Other small-scale	0%	5%	10%	3%	4%	18%	11%	4%	10%	16%	15%	4%	136,331	1	46.9	31.0
Private rental concentrated	0%	1%	4%	6%	6%	11%	14%	13%	11%	17%	13%	3%	360,559	3	34.4	30.4
Public rental concentrated	0%	0%	1%	1%	2%	7%	9%	13%	17%	23%	20%	7%	579,676	12	**53.5**	**52.9**
	201,333	384,925	581,311	955,230	1245,098	537,287	1316,135	1025,928	525,310	389,815	228,673	59,381	7450,426			

Table 4. Distribution of individuals in tenure type clusters across country of birth clusters. Entropy and Dissimilarity (DI) indexes showing distribution across income clusters, and aggregated clusters, low income clusters vs. not low income clusters.

	Tenure type landscape	A: Non-European born > 30 %	C: Non-European born > 25 %	B: Non-European born > 15 %	F: Swedish born enclave	G: Swedish born enclave conc.	D: Swedish born, adjacent	K: European born large scale	H: Swedish born conc.	L: Swedish born large scale	Total	Entropy (%)	DI, median value — All clusters vs. all others	DI, median value — Aggregate, A, B, C clusters vs. all others
1	Owner-occupied large-scale	0%	0%	0%	1%	3%	5%	13%	16%	58%	1521,978	43	64.6	15.3
2	Owner-occupied concentrated	0%	0%	1%	13%	21%	4%	11%	22%	23%	2025,594	17	41.5	13.8
3	Public rental small-scale	0%	3%	2%	3%	12%	21%	14%	8%	30%	631,646	12	40.2	8.6
4	Mixed private rental	1%	3%	3%	4%	16%	17%	11%	11%	29%	644,798	15	43.0	10.6
5	Coop small-scale	2%	5%	8%	8%	22%	15%	10%	8%	17%	776,163	4	27.9	14.2
6	Owner-occupied small-scale	2%	4%	9%	10%	23%	15%	8%	9%	13%	1055,867	3	30.4	14.2
7	Coop large-scale	0%	2%	9%	6%	21%	7%	54%	0%	0%	658,746	40	50.7	10.6
8	Mixed even	1%	5%	23%	9%	40%	6%	6%	5%	0%	336,219	22	36.6	16.7
9	Coop concentrated	3%	6%	20%	15%	24%	11%	8%	2%	3%	521,329	8	31.2	17.0
10	Other small-scale	11%	18%	15%	4%	30%	12%	5%	0%	3%	168,645	14	35.9	28.1
11	Private rental concentrated	7%	18%	13%	7%	21%	8%	4%	7%	6%	442,655	3	31.0	23.9
12	Public rental concentrated	13%	23%	26%	4%	15%	11%	2%	2%	1%	726,236	14	46.9	46.3
	Total	208,763	462,579	736,895	702,716	1718,742	942,027	1198,878	1033,314	2047,010	9509,876			

country of birth clusters. In Table 3, the tenure type landscapes are ordered based on their distribution across the income clusters: the first row has the largest overlap with high income clusters, and the bottom has the largest overlap with very low income clusters. Similarly, in Table 4, the tenure type landscapes are ordered in relation to their distribution across foreign-born clusters: the top has a large overlap with Swedish-born clusters, and the bottom row has a large overlap with the non-European-born clusters.

In addition, the scale of the tenure form classes is visible through green coloring and is indicated in the name. Small-scale tenure type landscapes indicate that tenure is dominant only at small-scales, and more tenure mixing is present at large-scales. These landscapes are colored with a light shade of green. In large-scale tenure type landscapes, the specific tenure form is dominant across scales. These landscapes are colored with a darker shade of green. Concentrated tenure type landscapes tend to have the strongest domination of a tenure form and remain so until reaching quite high scales. These landscapes are colored with the darkest shade of green.

As is clear from the tables, one cannot find a one-to-one fit between the tenure form classification and either the income classification or the foreign-born cluster classification. There are, however, cells that contain zeros, indicating that, for that tenure form class, some income clusters or foreign-born clusters are entirely missing. These empty or close to empty cells are marked in blue in Tables 3 and 4. There are also cells showing a high degree of overlap. These cells are marked in red. Based on the idea that scalar structure matters, we can summarize the results in three major points.

Large-scale tenure type landscapes display clear overlap

The first point is that examples of strong overlap are found for large-scale TTL. Thus, Table 3 shows a strong overlap between the *Cooperative large-scale* tenure type landscape and income clusters with a large share of high-income earners (top row, first three columns). Moreover, mixed income neighborhoods and low-income neighborhoods almost never fall in *Cooperative large-scale* areas. Another example of strong overlap in Table 3 is found for the *Owner-occupied large-scale* tenure type landscape. Neighborhoods in this category are strongly concentrated in income clusters with a good mixture of high income earners, middle income earners and low income earners (all incomes). Conversely, neighborhoods in the *Owner-occupied large-scale* category very seldom are characterized by a high concentration of high-income earners or a high concentration of low-income earners. An entropy index computed across the income clusters captures this strong overlap well. High values of the entropy index imply that households are strongly concentrated to specific income clusters, whereas low values (close to zero) result when households are evenly distributed across income clusters. And, as can be seen in Table 3, *Cooperative large-scale* areas and *Owner-occupied large-scale* areas have the highest values, 27% and 32%, respectively, compared to a median of 9.5%.

A similar relation is found in Table 4 between large-scale TTL and different country-of-origin clusters. Thus, not only do *Owner-occupied large-scale* landscapes have
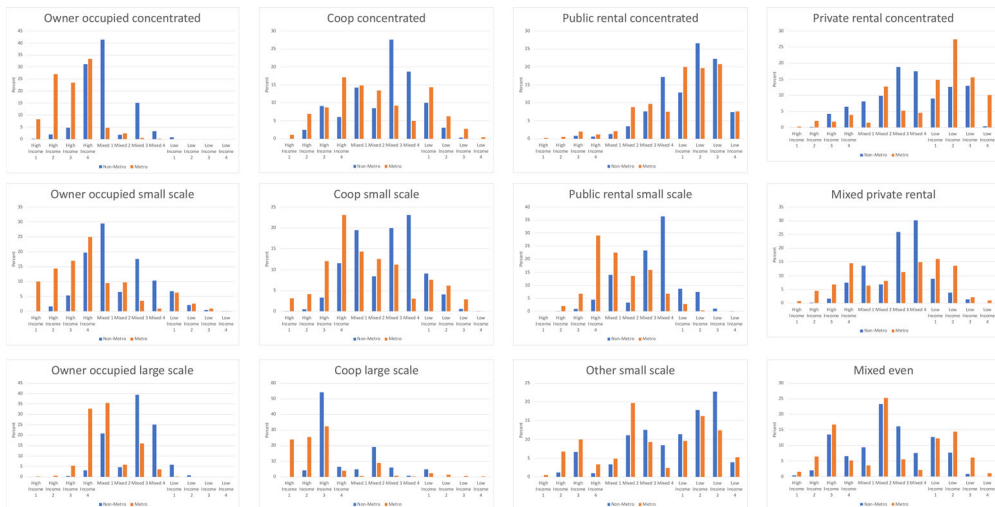
Figure 4. Overlap between tenure type landscapes and income clusters in metropolitan and non-metropolitan areas.

mixed income populations, they also to a very large extent are characterized by having few foreign-born residents (Cluster L: Swedish-born large-scale and Cluster H: Swedish-born concentrated) or mainly migrants of European decent (Cluster K: European-born large-scale). With very few exceptions, they lack neighborhoods with a significant presence of non-European-born residents (Cluster A: Swedish-born individuals <50%, Cluster C: Swedish-born individuals <65% and Cluster B: Swedish-born individuals <75%). In addition, the *Cooperative large-scale* landscape more or less lacks neighborhoods with a significant presence of non-European-born residents (Cluster A, Cluster C, Cluster B), as does Cluster F, a Swedish-born enclave. Instead, neighborhoods classified as *Cooperative large-scale* have a very strong overlap with Cluster K, European-born large-scale. There is some overlap with Cluster G, Swedish-born enclave weak. Both of these large-scale TTL, thus, have a tendency to be associated with a relative absence of non-European migrants. This tendency is stronger for *Owner-occupied large-scale* landscape but still significant for *Cooperative large-scale*. Again, this is reflected in the entropy index, now computed across country-of-origin clusters. For *Owner-occupied large-scale* landscapes the index is 42.5% and for the *Cooperative large-scale* landscapes 40.0%, compared to a median of 14%, Table 4.

The analysis presented above shows that for a large-scale tenure landscape where one tenure form dominates across scales, we find a clear overlap both with income clustering and with country of birth clusters. Moreover, these large-scale tenure type landscapes are dominated by dwellings that are individually owned. The processes that lie behind these patterns cannot be pinpointed with certainty but the patterns found suggest a need for considering more closely both how TTLs evolve (planning processes) and how they influence processes of income and ethnic sorting.

Concentrated tenure landscapes are associated with a polarized income cluster distribution and with patterns of ethnic segregation and mixing

Table 5. Dissimilarities in distributions across income clusters for small scale and large scale (concentrated) tenure type landscapes.

Contrast (Small scale)			DI	Contrast (Large scale or concentrated)			DI
Coop small scale	vs.	Public rental small scale	22.7	Coop large scale	vs.	Public rental concen-trated	85.0
Coop small scale	vs.	Owner occupied small scale	22.3	Coop large scale	vs.	Owner occupied large scale	86.1
Public rental small scale	vs.	Owner occupied small scale	42.4	Public rental concen-trated	vs.	Owner occupied concen-trated	82.2

The second major point is that concentrated TTL, strongly dominated by one tenure form, in a clear way overlap with specific parts of the income cluster hierarchy as well as with the different country-of-origin clusters.

For the *Owner-occupied concentrated* category, the second row in Table 3, the overlap is with income cluster High income 2 and Mixed 1, that is, the income clusters that are just below the most affluent clusters. This is the largest TTL representing 1.44 million individuals in Sweden, and it is the TTL that had the largest increase between 1990 and 2012 (Wimark *et al*., 2020). The distinctive distribution of *Owner-occupied concentrated* neighborhoods across income clusters is well captured if a dissimilarity index is used to measure the distance to the distribution across income clusters for other TTLs. The median value here is 59.9, confirming that *Owner-occupied concentrated* neighborhoods have household income compositions that differ from those found in other tenure type landscapes. Geographically, there is a tendency for *Owner-occupied concentrated* neighborhoods to overlap with more affluent neighborhoods in metropolitan areas compared to non-metropolitan areas, see Figure 4.

For the *Public rental concentrated*, the last row of Table 3, the overlap is instead with the opposite part of the income cluster hierarchy: here, most of the neighborhoods are found in income clusters Low income 1, Low income 2 and Very Low Income 1. Public rental concentrated has zero overlap with income clusters High income 1 and 2. The *Concentrated public rental* areas are very homogenous at scales from the 50th to the 5000th closest households, with 90% public housing diminishing progressively to 50% public housing at the scale of the 5000 closest households. Here, the scale of the homogenous area is a concern. There are smaller chances of changing tenure form in the area and, for instance, mixing income groups in local schools. The areas in many regards are self-sufficient and, thus, are characterized by public housing and low incomes. Thus, in this case, a fairly perfect overlap between tenure form and income is a concern because it is concentrated. Had it been small-scale, the chances of social mix in services, schools and daily life would have been greater, which would satisfy the goal of the mixing policy. The distinctiveness of *Public rental concentrated* is also possible to capture with a low-income dissimilarity index, that contrasts the overlap with any of the Low income clusters, versus High income and Mixed income cluster. For *Public rental concentrated,* the median for the low-income dissimilarity index is 52.9%, compared to the next highest median value which is 30.4% (*Private rental concentrated*). Moreover, the overlap between *Public rental concentrated* neighborhoods and low income neighborhoods looks very similar in metropolitan and non-metropolitan areas see Figure 4. This implies that the contrast in

social composition between *Public rental concentrated* neighborhoods and *Owner-occupied concentrated* neighborhoods will be more pronounced in metropolitan areas where *Owner-occupied concentrated* neighborhoods have higher concentrations of the affluent.

Earlier research (Wimark *et al.*, 2020) mapped *Public rental concentrated* areas to be multifamily, large housing estates at the outskirts of metropolitan and city areas. A change has been observed over the period 1990–2012 in that municipal public housing companies sold estates to private rental companies. This conversion made the landscape of concentrated public rental less homogenous (and large-scale) and common, but the tenure landscape *Private rental concentrated* had approximately the same concentration of low-income clusters, as shown in Table 3. The conversion of municipal public housing into private rental housing is a much-discussed issue with concerns that the physical buildings are left to decay or that the low-income residents are forced to move when companies' renovation strategies raise the rents (Gustafsson, 2019).

The same contrasts can be seen in Table 4 with respect to the country-of-origin clusters. *Owner-occupied concentrated* landscapes basically have zero overlap with the dense non-European foreign-born clusters A, B and C. More than 50% of the individuals in the *Owner-occupied concentrated* landscape overlap with the Swedish-born clusters K, L and H. Conversely, the neighborhoods in the *Public rental concentrated* landscape overlap with the dense non-European-born clusters A, B and C. Furthermore, there is almost zero overlap between the *Public rental concentrated* landscape and the Swedish-born clusters K, L and H. These differences clearly show up in dissimilarity indexes contrasting household shares in the A, B, C clusters with the other clusters. These indexes are as high as 60% for the comparison of *Public rental concentrated* with *Owner occupied concentrated* (and also *Owner occupied large scale*).

Additionally, with respect to the country-of-origin clusters, *Coop concentrated* and *Private rental concentrated* have a more diffuse overlap in the sense that it is possible to find examples of all country-of-origin clusters in these two tenure type landscapes. Nonetheless, few of the *Private rental concentrated* neighborhoods are found in the Swedish-born clusters K, L and H. Moreover, a large part of the *Coop concentrated* neighborhoods are in fact in country-of-origin clusters that have medium levels of Swedish-born individuals, Clusters B, F and G.

The distinctiveness of small-scale tenure landscapes

The third major point is that small-scale TTLs tend to overlap with mixed income clusters to a much higher degree than large-scale and concentrated TTLs, especially in non-metropolitan areas, see Figure 4. For example, while *Public rental concentrated* neighborhoods tend to belong to income clusters with a high proportion of low income earners, for *Public rental small-scale* neighborhoods, the bulk of overlap is with mixed income deciles (see Table 2). Similar patterns are found for the owner-occupied, cooperative and private rental TTLs: neighborhoods in small-scale TTLs (and mixed rental) are more income mixed than neighborhoods classified into

concentrated TTLs. The left hand column of Table 5 presents values for the dissimilarity index when small-scale tenure type landscapes are compared. And in the same way, the right-hand column presents values for the dissimilarity index when large-scale or concentrated TTLs are contrasted. From the Table 5, it is clear that small-scale TTLs are more similar to each other than the corresponding large-scale or concentrated TTLs.

Additionally, with respect to the distribution of neighborhoods across the country-of-birth clusters, small-scale TTLs are distinct. As shown in Table 4, only the *Owner-occupied small-scale* is more ethnically mixed than the *Owner-occupied concentrated* tenure type landscape. For the remaining TTLs, however, the opposite seems to be the case – smaller-scale tenure types shift towards overlapping with Swedish-born clusters.

Conclusion and discussion

To politically advocate tenure mixed neighborhoods seems common sense. The idea that tenure mixed neighborhoods also overlap with socioeconomic and ethnic mix tends to prevail in policy circles. As discussed in the introduction, studies scrutinizing the potential overlap between tenure mix and socioeconomic and/or ethnic mix find that there is generally only a moderate overlap (e.g. see Górczyńska, 2017; Livingston et al., 2013; Musterd & Andersson, 2005), with the exception of Skifter Andersen et al. (2016). In this study, however, we argue that these studies need to be broadened to include geographical scale and geographical variations to understand the overlapping dimensions of tenure and segregation.

Exploring the overlap of income variation and ethnic composition with tenure type landscapes that capture variation in tenure composition with geographical scales, we find that the scale of neighborhoods is of importance for how tenure type landscapes overlap with income and country-of-birth neighborhood types.

First, large-scale neighborhoods, comprised of a high degree of households in a specific tenure form regardless of the measurement scale, overlap in very clear ways with both income classes and ethnic composition. Second, concentrated neighborhoods, dominated by a specific tenure form at large ranges, also tend to overlap well with income and ethnic composition. Additionally, these neighborhoods show signs of overlap in polarized ways, where income and ethnic mix clearly depend on the tenure form. For example, the public rental and private rental tenure forms overlap with low-income classes, while the owner-occupied and cooperative tenure forms overlap with high-income classes. Third, small-scale neighborhoods, dominated by a tenure type only at low ranges, tend to overlap more with income clusters that contain individuals from all income deciles, i.e. that are more income mixed. In this study, the scale of tenure forms in neighborhoods is based on the tenure forms that the closest households live in; i.e. the scale of buildings or population density is disregarded. This means that, in theory, small-scale neighborhoods could be located anywhere. In reality, however, we know from our previous study that the bulk of small-scale neighborhoods are located in smaller cities and towns (Wimark et al., 2020).

Again, looking back at earlier studies that did not show clear-cut results of overlap concerning housing tenure and socio-demographic mix, we find that our approach offers an advantage. Using both scale and geography is an improvement. First, the scale is built into the so-called tenure landscapes. We can identify whether tenure forms are present on a large-scale, that is, whether the same form of tenure is present across a large area. We are also able to identify whether concentrations are high at closer ranges as well as in very close environments. This makes our tenure type landscapes more flexible in both scale and tenure mix than single tenure measures in fixed geographical areas. Second, the number of tenure type landscapes (twelve) provides room for multiple overlaps, more than do the four strict tenure forms (Wimark *et al.,* 2020). A limitation of our study, though, is that it only looks at aggregate patterns and at outcomes at a specific point in time. As demonstrated by (Clark, 2019), multiscalar neighborhood classifications can be used to explore individual residential mobility. Moreover, it would be interesting to analyze to what extent shifts in tenure type composition have consequences for subsequent change in the neighborhood composition. Third, we analyze the whole of Sweden and therefore are able to find that some tenure type landscapes hold different forms of overlap in different geographical locations. This is a more nuanced result than the usual finding that poor and foreign-born people live in public housing.

Our results suggest that there is support for politically advocating tenure mix at smaller scales in neighborhoods, especially if the intention is to create an income mix in neighborhoods. However, an important conclusion is the confirmed need to consider scale and geographical variation in discussions about how tenure form structure translates into patterns of segregation. Public rental dwellings do not need to be a concern per se, but if they are located in the urban periphery and in large concentrations at wide ranges, they could be a concern. There is support for putting this issue on the political agenda. This suggests that political calls for tenure conversions in such neighborhoods are not dubious but make sense (this was also the original idea). However, disregarding scale and geography in converting rental dwellings and creating large-scale neighborhoods in attractive locations is questionable if the objective is income-mixed and ethnically mixed neighborhoods.

Disclosure statement

Funding

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