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Master's thesis

Has spatial segregation along ethnic lines increased in Helsinki metropolitan area?

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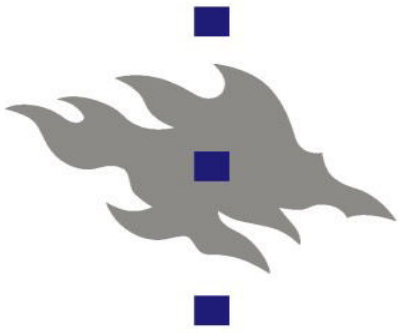

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Tiivistelmä – Referat – Abstract

Starting from the beginning of 1990s, Finland has experienced rapid growth rates in population fractions of non-native residents, with almost half of all immigrants eventually settling in Helsinki metropolitan area. This thesis studies immigrant settlement patterns in the capital region, with the purpose of reliably quantifying and documenting dynamics of ethnic residential segregation.

Formation of "ethnic enclaves" is a widely-debated issue which might have ambiguous impact on immigrants' economic and social outcomes. Robust inference on segregation dynamics is a prerequisite for furthering understanding of the issue. However, qualitative inference on segregation dynamics is often hindered by the fact that different spatial unit sizes and/or immigrant population fractions generate random segregation of varying magnitudes.

This thesis overcomes the problem by employing index of systematic segregation which is expressed as a fraction of maximum excess dissimilarity (net of random) that could possibly occur. Index of dissimilarity (Duncan index) is chosen as a baseline measure for calculating systematic index, ensuring comparability of my research to the existing body of knowledge on the phenomenon.

While index of dissimilarity reports only marginal growth in segregation, systematic measure reports almost two-fold increase in ethnic residential segregation. Employing systematic index allows reliable comparison of segregation across various immigrant groups and localities. Thus, I find that immigrants from Balkan and African countries are more segregated than other foreign-born individuals. Comparison of systematic indices across largest Finnish cities reveals that Turku has been substantially more segregated than its counterparts starting from year 1995.

Eventually, I isolate the measure of segregation along ethnic lines from sorting along other dimensions, such as income. I find no evidence that increase in residential segregation is driven by widening income gap between native and immigrant population.

Finally, all the findings are presented compactly in two web applications, allowing flexible controls over the choice of locality of interest, immigrant group, statistics and map-types.

Avainsanat – Nyckelord – Keywords
Helsinki – Housing – Ethnic Residential Segregation – Index of Dissimilarity – Systematic Index - Immigrant

Contents

I Introduction

This paper examines whether spatial segregation along ethnic lines has increased in Helsinki metropolitan area. I find that levels of ethnic residential segregation has grown in the course of the last two decades. The rate of increase is intensified when accounting for the fact that even random allocation of immigrants to residential areas would generally result in a positive measure of segregation. Moreover, unevenness in the distribution of individuals along ethnic dimension is not underlined by differences in income levels between immigrants and native population.

Figure 1 presents the main findings of my investigation. Duncan index (the top line) demonstrates that the share of a minority group which is to change a residential area to achieve evenness in the distribution across entities has moderately increased in the span of the last two decades. Indices of systematic dissimilarity (red and blue lines below) illustrate an extent to which observed segregation is different from dissimilarity under random allocation. They appear to be closely following the patterns of the traditional index. All the measures report that the first peak in dissimilarity falls on year 1995, with a subsequent quinquennium being characterized by slightly decreased segregation. Systematic indices are noted to experience much faster rates of increase and therefore achieve the predecline segregation levels more promptly than the traditional Duncan index. A narrow gap between the measures of systematic dissimilarity conditional on income (the bottom line) and unconditional systematic dissimilarity appears to be increasing over time.

I also find that immigrants from Balkan countries and Africa are more segregated than other foreign-born individuals. Moreover, comparison of dissimilarity indices across Finnish cities illustrates that starting from year 1994 Turku is steadily characterized by a higher degree of spatial dissimilarity than its counterparts. There are no significant differences in segregation levels between other municipalities.

All the findings are presented in web application (Zhukov, 2014a), providing flexible controls for comparing segregation dynamics of various minority groups within and across a number of localities.

These findings add to the previous literature on ethnic segregation in Helsinki (Dhalmann and Vilkama, 2009; Kauppinen, 2002; Mannila et al., 2010; Vaattovaara et al., 2010; Vilkama, 2011). While my estimates of traditional dissimilarity index are in line with prior research, this paper is the first to account for the possibility of randomly generated unevenness in distribution of immigrants, which enables its interpretation as documentation of systematic selection. Moreover, while some studies imply that segregation along ethnic lines might be confused by sorting mechanisms along other dimensions, they do not provide systematic measure for capturing such effects.

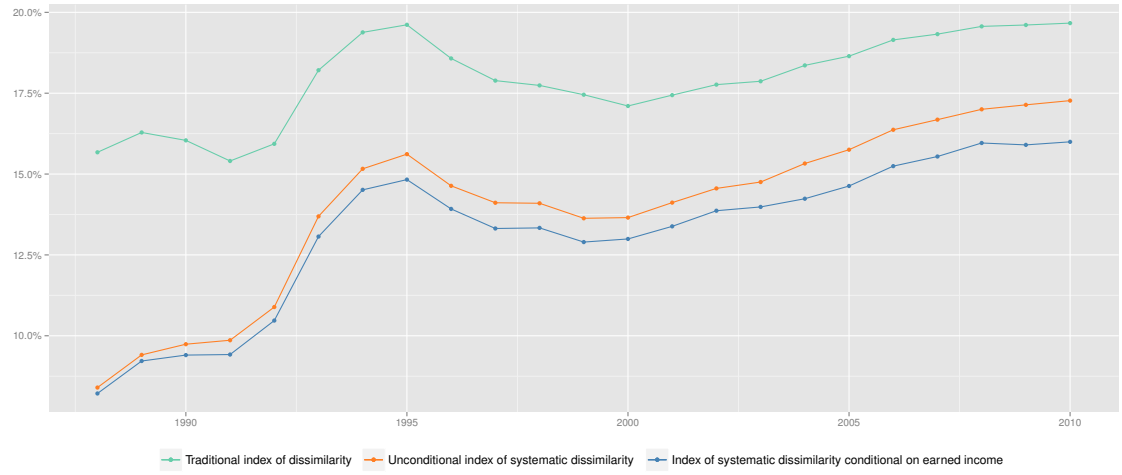

Figure 1: Segregation in the Capital Region

The outline of the paper is as follows. The next section reviews theoretical framework and existing evidence on economic consequences of living in areas characterized by high degree of immigrant concentration. Section III discusses issues related to measuring segregation, accounting for randomness and conditioning the measure on covariates. Section IV provides an overview of Finnish debate on immigrant settlement patterns. Section V describes data. Findings are examined in section VI. Section VII examines robustness of the results to various assumptions imposed on the early stages of calculations. The last section concludes.

II Segregation and outcomes

2.1 Theoretical framework

There exists a number of alternative hypotheses regarding how residential segregation affects economic and social outcomes of immigrants. Edin, Fredriksson and Åslund (2003) suggests at least four types of mechanisms through which segregation might impact individual outcomes:

1. Slower rates of acquisition of country-specific skills
2. Spatial mismatch
3. Ethnic networks
4. Human capital externalities

The hypothesis that ethnic residential segregation adversely affects individual outcomes through *slower rates of acquisition of country-specific capital* seems to have

been among the dominant motives for implementation of urban and housing policies of ethnic mixing in Finland (Dhalmann and Vilkama, 2009). The rationale for this hypothesis is that immigrants in spatially segregated locations are less exposed to native population, which reduces their motivation and bounds their possibilities for attaining, e.g., language proficiency and assimilating to cultural norms of the society (Lazear [1997]). This, in turn, limits a number of job opportunities and hampers moving to better positions, reducing earnings in long term.

Simple statement of *spatial mismatch hypothesis* (Kain [1968], Ihlanfeldt and Sjoquist [1998]) is that compared to predominantly "native" areas there are fewer jobs per worker in or near immigrant dense neighborhoods. To be more precise, the premises allegedly driving this mechanism are:

1. Factors restricting ethnic minorities in their ability to gain jobs spatially removed from their neighborhoods: limited public transportation for commuting, insufficient information about distant employment opportunities.

2. Factors restricting ethnic minorities in their ability to move to the areas where job growth exists: lack of availability of social housing, ethnic discrimination in housing market.

3. Factors shifting jobs away from immigrant neighborhoods.

Thus, according to this hypothesis, it is not high spatial concentration of immigrants per se that impedes their success in the labor market, but remoteness of employment opportunities.

Predictions of theories emphasizing *network effects* are more ambiguous. Montgomery (1991) reviews literature on importance of family and friends in providing job referrals. Munshi (2003) argues that since immigrants are newcomers to the local labor market, ethnic networks play even more important role in disseminating information about employment opportunities. Further, Munshi (2003) identifies job networks among Mexican immigrants in the U.S. and presents compelling evidence that an individual is more likely to be employed and receive higher earnings when the size of her network is exogenously larger. Thus, segregation improves labor market outcomes, removing physical distance between immigrants and encouraging formation of networks. However, Borjas and Hilton (1996) finds that there is correlation between the type of benefits received by successive immigrant waves, indicating that ethnic networks are also conducive of disseminating information hindering labor market advancement. Moreover, Bertrand, Luttmer and Mullainathan (2010) provides additional evidence on the importance of ethnic networks in welfare participation. In this view, effect of segregation on individual economic outcomes is a priori ambivalent.

Borjas (1995) argues that ethnic spatial segregation is the mechanism linking labor market outcomes of immigrants' children to the average characteristics of ethnic group in preceding generation. Along similar lines, Wilson (1987) presents evidence that exodus of well-to-do blacks adversely affects residents of inner-city ghettos. These findings are compatible with models based on *human capital externalities*. In this context, segregation is not necessarily bad: if an alternative to segregation along ethnic lines is segregation along income dimension, ethnic enclaves might have positive impact for less successful immigrants.[1] In other words, quality of the enclave is determinant of how segregation affects individual outcomes.

This line of thinking closely relates literature on ethnic residential segregation to the broader venue of research into neighborhood effects. Studies on neighborhood effects are numerous but estimation of the causal effects of neighborhood attributes on residents' outcomes is fraught with difficulties and therefore one should be heedful when interpreting results of such studies (Duncan, Connell and Klebanov [1997], Jenks and Mayer [1990]). Arguably the most credible evidence on the issue is presented by the studies exploiting natural experiment design provided by Moving to Opportunity (MTO) demonstration in Baltimore, Boston, Chicago, Los Angeles, and New York (Katz, Kling and Liebman [2001], Ludwig, Duncan and Hirschfield [2001]). Within MTO framework disadvantaged families were randomly assigned assistance in moving to more prosperous neighborhoods. The final impact report on MTO concluded that demonstration showed mixed results which could be briefly summarized as follows (Sanbonmatsu et al. [2011]) :

1. Lower poverty rates and safer neighborhoods
2. Better health outcomes
3. *No* better educational, employment, and income outcomes

2.2 Empirical evidence

Literature briefly reviewed in the previous section investigates workings of mechanisms through which segregation might impact labor market outcomes of immigrants. In addition to it, a branch of literature abstracted from the above hypotheses and looked to identify causal relationship between the chosen measure of segregation and individual outcomes. In such settings, hindrance for interpretation of this relationship as causal is presented by omitted variable bias and selection bias.

Omitted variable bias presumes existence of some unobserved variables - perhaps, political or economic attributes - which might lead to both negative individual out-

[1] Throughout the text "ethnic enclaves" refer to immigrant-dense neighborhoods resulting from spatial segregation along ethnic lines.

comes and higher segregation. Ananat (2011) refers to an example of Detroit, where political corruption and aftermath of manufacturing economy might be underlying both high degree of racial dissimilarity and poorer outcomes of city's residents.

Selection bias stems from the fact that individuals typically have some degree of freedom in choosing places where they live. In this instance, better outcomes in less-segregated localities might reveal selection of successful immigrants into less immigrant dense neighborhoods, biasing estimates in negative direction.

Thus, transparent estimation of impact of ethnic residential segregation on immigrants' outcomes is hard to accomplish without explicit placement policies (random assignment of individuals to neighborhoods or municipalities). Another solution might be to use instrumental variables to identify exogenous variation in spatial dissimilarity.

Edin, Fredriksson and Åslund (2003) exploits natural experiment design provided by exogenous assignment of refugee immigrants to municipalities in Sweden. They find that one standard deviation *increase* in ethnic concentration is associated with 13 percent earnings growth. Further, along the lines of models featuring human capital externalities they conclude that quality of an ethnic enclave matters: high-income enclaves drive positive effects of segregation while residing in ethnic enclave with less than average quality might actually hurt immigrant's labor market performance.

Cutler and Glaeser (1997) circumvents sorting issue by using variation in segregation across metropolitan areas and arguing that sorting poses less of a problem in this case. They employ a set of instruments (public finance structure, the number of municipal governments in the metropolitan statistical area and the share of local revenue that comes from intergovenmental sources) to identify exogenous variation in their measure of segregation. They find that one standard deviation *decrease* in segregation accounts for reduction of one-third of black-white differences in individual outcomes.

Ananat (2011) uses similar research design, employing a different set of instruments: arrangements of railroad tracks in the nineteenth century. Her findings are in line with those in Cutler and Glaeser (1997), verifying that racial residential segregation exacerbates black poverty, while decreasing rates of poverty and inequality among whites.

Card and Rothstein (2007) uses rigorous controls to identify that higher degree of spatial dissimilarity is associated with a wider black – white test score gap. They also demonstrate that the most probable mechanism driving this association is not racial composition of the locality, but neighbors' incomes.

Additionally, Massey and Denton (1993) and Wilson (1996) provide extensive evidence on adverse impact of racial residential segregation on minority's outcomes.

In conclusion, this brief review suggests that the causal effect of segregation on individual outcomes is ambiguous and remains on the agenda of future research. Moreover, evidence on neighborhood effects which pertains to the functioning of the models featuring *human capital externalities* is similarly inconclusive.

III Methodology

3.1 Index of dissimilarity

The starting point for all segregation studies is the choice of an index which addresses the question of an extent to which one group is segregated from the other (others). There is vast literature on the issue and a number of measures exists which tackle different aspects of it. The most natural commencement of the analysis would be to use an index of dissimilarity (known also as a Duncan Index), which, according to Simpson (2006), is commonly referred to as *"the"* segregation index. The main motivation for selecting dissimilarity index is its popularity, which ensures comparability of my research to the existing body of knowledge on the phenomenon.

The index measures *unevenness* in the distribution of two mutually exclusive groups (i.e., ethnicities) across entities (i.e., residential areas). In other words, an index attempts to summarize whether some particular group has larger than expected presence in any given unit. To be more precise, the following expression stands for an index of dissimilarity (Kuosmanen, 2014):

$$D = \frac{1}{2} \sum_{i=1}^{n} \left| \frac{a_i}{A} - \frac{b_i}{B} \right| \tag{1}$$

Where:

n: number of entities

A: number of individuals in group A

B: number of individuals in group B

a_i: number of individuals of group A in entity i

b_i: number of individuals of group B in entity i

This definition suggests an interpretation of an index as a proportion of people in either (minority or majority) group which is to change a residential area to achieve complete evenness in the distribution across entities.

The index ranges from 0 to 1 (equivalently from 0 to 100) with 0 representing complete evenness (each entity comprises the equal share of a minority group) and 1

standing for complete unevenness (two mutually exclusive groups do not share any residential area).

However, an assumption of evenness being a baseline for the indices exhibits certain limitations. Thus Carrington and Troske (1997) demonstrates via simulations that small unit sizes and/or minority shares generate substantial random segregation. Hence, it would be impossible to make inference on whether segregation in Turku is systematically higher than in Helsinki, as different minority shares and unit sizes generate random dissimilarity of different magnitudes. To overcome this shortcoming, Carrington and Troske (1997) introduces a measure of *systematic* segregation which is expressed as a fraction of the maximum excess dissimilarity (net of random) that could possibly occur (*equation* (2)).

$$\hat{D} = \begin{cases} \frac{D-D^\star}{1-D^\star}, D \geq D^\star, \\ \\ \frac{D-D^\star}{D^\star}, D \leq D^\star \end{cases} \tag{2}$$

Where:

$D^\star$: mean of dissimilarity indices calculated under repeated random allocations of immigrants to residential areas

$\hat{D}$: index of systematic dissimilarity

This index ranges between [-1, 1] with negative values indicating excess evenness; 0 implying that the current allocation is equivalent to a random one; and 1 standing for an attained maximum of excess dissimilarity.

3.2 Controlling for income differences

The other issue is isolating the measure of segregation along ethnic lines from sorting along other dimensions, such as, for instance, income. Åslund and Skans (2007) extend the procedure outlined above by calculating expected segregation under random allocation ($D^\star$) conditional on distribution of covariates. I employ this idea following presentation at Söderström and Uusitalo (2010) and calculate $D^\star$ conditional on the distribution of immigrants with given income levels across residential areas by means of straight-forward extension of simulation procedure described in the following paragraph.

The set of all observation for a given year is divided into 10 equal groups based on earned income. Eleventh group constitutes all the observation with missing value of an income variable. A fraction of immigrants in each income interval is then calculated and immigrant status is randomly assigned to individuals so that

the fraction of "random" immigrants in each group is equivalent to a respective observed fraction. Mean of dissimilarity indices repeatedly calculated from thusly simulated data represents an expected value of dissimilarity index when immigrants and natives are randomly assigned to neighborhoods conditional on their earned income. To avoid confusion, henceforth this measure would be referred to as $D_c^\star$.

Substituting $D^\star$ with $D_c^\star$ in *equation 2* yields an index of systematic dissimilarity, $\hat{D}_c$, capturing sorting along ethnic lines which is not confounded by income differences between natives and immigrants.

Eventually, to make an inference on whether any fraction of systematic dissimilarity along ethnic lines can be *reliably* attributed to income differences, bootstrapped confidence intervals of $\hat{D}$ are calculated. 500 replication of size N are drawn with replacement from the original sample and segregation index is calculated for each drawing. Obtained empirical bootstrap distribution provides means for deriving confidence intervals.

3.3 Dimensions of segregation and checkerboard problem

Massey and Denton (1988) carried out a factor analysis of segregation indices and documented five dimensions of residential segregation:

Evenness

Measures unevenness in distribution of minority groups across spatial units.

Exposure

Attempts to quantify interactions between immigrants and natives.

Concentration

Refers to the relative amount of the physical space occupied by a minority group

Centralization

Captures an extent to which a group is located near the center of the urban area.

Clustering

Refers to the relative positions of immigrant-dense neighborhoods: high if ethnic enclaves are adjacent to each other, low if scattered across the locality.

Concentration and centralization are dimensions specific almost exclusively to metropolitan areas in the United States. Clustering indices are widely unpopular in empirical literature, which renders their interpretation unfeasible. Indices capturing evenness and exposure are similar along the lines of not accounting for

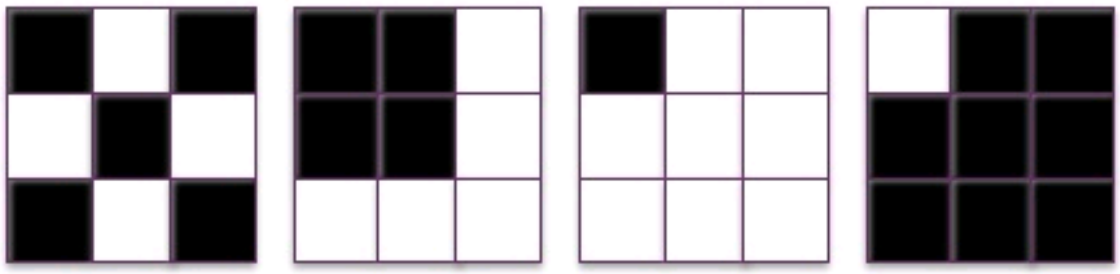

Figure 2: Checkerboard Problem (Harris, 2013)

locational pattern of immigrant dense neighborhoods. It makes them susceptible to the "checkerboard problem" (White, 1983).

Figure 2 illustrates the essence of the checkerboard problem: index of dissimilarity corresponding to each of the facets equals unity, representing the maximum attainable level of segregation. However actual experience of segregation for different facets might not be equivalent and therefore bear different consequences for economic and social outcomes of ethnic minorities (Goodhart, 2013). As none of the "traditional" indices overcome this problem, various measures of segregation based on spatial optimization were introduced (Jakubs, 1981; Morgan, 1983; Harris, 2014). If underlying data exhibit checkerboard problem, it might arguably be sensible to use these types of indices.[2]

IV Review of Finnish debate

This section overviews Finnish debate on immigrant settlement patterns. While social and economic polarization of the capital area received considerable attention in the literature, studies of *immigrant* residential segregation are not numerous.

One of the earliest contributions to the debate is due to Kauppinen (2002), who, among other things, studies dynamics of index of dissimilarity in Helsinki metropolitan area in the final quinquennium of the 20th century. Immigrant status is defined by foreign nationality and the number of spatial units used for index calculation is 210 with average population size of 4158. He concludes that the measure of ethnic residential segregation buoyed at around 25%, and undertakes comparison of dissimilarity levels of different immigrant groups. Along these lines, he finds that immigrants from "prosperous" countries demonstrate the lowest levels of spatial dissimilarity, while natives of Somali constitute the most segregated minority group.

[2]some of which could be roughly interpreted as normalized distance an average immigrant is to travel for distribution to be even across spatial units.

Vaattovaara et al (2010), Vilkama (2011) report development of index of dissimilarity between native Finnish and foreign-language-speaking-residents in the capital region for years 2000 to 2009. The spatial units used for analysis are "pienialuet", which are substantially smaller than postal code areas with average population size of 2400. They find that index of dissimilarity stayed at around 27%, decreasing by 2.8% over the study period. Similarly, they confirm that residents speaking western European languages are the least segregated while immigrants for whom sub-Saharan languages are native - the most spatially dissimilar minority group. Eventually, they conclude that current levels of ethnic residential segregation are rather modest in international standards.

Vilkama (2010) also calculates index of dissimilarity for Helsinki metropolitan area for years 2000 to 2009 using spatial units of different size. She finds that the segregation index increased slightly from around 21% to about 23%. Her conclusions regarding the most and the least spatially segregated immigrant groups are in line with Vaattovaara et al (2010) and Vilkama (2011).

In addition, there exists a number of qualitative and descriptive studies such as Dhalmann and Vilkama (2009), Dhalmann (2011) and Vilkama (2012), some of which employ in-depth interviews to further understanding of ethnic residential segregation in the capital area. Thus, Vilkama (2012) finds that immigrant-dense neighborhoods are characterized by lower education attainment levels and higher unemployment rates.[3] Similarly, Dhalmann and Vilkama (2009) reports that Somali immigrants voice a concern that they are increasingly assigned to economically and socially under-privileged areas.

Thus, a number of studies attempted to investigate and compare segregation levels across years and minority groups. However, as population fractions are not constant, they generate random dissimilarity of varying magnitudes, thereby hindering qualitative inference.

V Data

My analysis is based on the FLEED (Finnish Longitudinal Employer-Employee Data) sample data created by Statistic Finland for research use. The data represent $\frac{1}{3}$ random sample of persons of working age (15 to 70) residing in Finland in years 1988-2010. Conforming to its name, the sample can be used as a panel, in a sense that individuals have been followed over the years they have been alive and aged properly (Tilastokeskus, 2010). Among other things, the sample data contain vari-

[3]However, it is due to note that immigrants' education attainment levels are not precise in Finnish administrative data, and immigrants are, on average, more likely to experience unemployment (Sarvimäki, 2011). Therefore, this evidence does not necessarily indicate that typical ethnic enclaves are hosting exclusively economically challenged residents.

Table 1: Descriptive statistics[I]

Year	1988	1990	1995	2000	2005	2010
Number of observations	200136	203017	217834	232589	243879	257655
Fraction of immigrants[II]	1.7	2.1	4.4	6.0	8.3	11.6
Population of the postal code area	1251 (1051)	1277 (1051)	1361 (1119)	1454 (1168)	1478 (1150)	1571 (1175)
Size of a minority group[III]	21 (20)	27 (26)	59 (68)	85 (97)	119 (140)	173 (197)
Income	15579 (11999)	18809 (14290)	18382 (14676)	22526 (17925)	25771 (21349)	30267 (24707)
Income of a minority group	14351 (13036)	16033 (14372)	11542 (12563)	14672 (15161)	16522 (17322)	20263 (19443)

[I]means (standard deviations in parentheses)
[II]% of total population
[III]within the postal code area

ables required for my investigation: country of origin, native language (classified as Finnish, Swedish or the other), postal code of the registered address, municipality of residence and earned income.

Postal code area is the basic "entity" of analysis as outlined in description of *equation 1.* Immigrant is defined as an individual born outside of Finland. The number of postal code areas increased from 160 in 1988 to 164 in 2010. Descriptive statistics for selective years is reported in *Table 1.* It is restricted to the capital region, comprising municipalities of Helsinki, Espoo, Kauniainen and Vantaa, which host almost half of all immigrants in the country. Henceforth, all the presented findings and statistics refer to Helsinki metropolitan area, unless otherwise is explicitly specified.[4]

It can be noted from *Table 1* that the population share of immigrants demonstrates tremendous growth rates throughout the study period. Sizes of postal code areas and numbers of immigrants they accommodate also appear to be growing rapidly over time. The gap between an average immigrant income and an average income in population is largely widened, on the background of an an overall increase in earnings.

[4]Terms "capital region" and "Helsinki metropolitan area" are used interchangeably throughout the text, and should be understood to represent the same entity.

Providing a general idea on segregation evolution, *Figures 3 and 4* present spatial distribution of immigrants across postal code areas along with endemic income statistics for the first and the last years of the study period.[5] The top panels of *Figures 3 and 4* show immigrant distributions and the bottom panels report average income for each postal code area. In accordance with *Table 1*, it was natural to expect that immigrant-dense neighborhoods are characterized by lower average earnings. However, it should not be taken as indication that segregation along ethnic lines is driven by income dissimilarities. To get insight into that issue, similar maps with income statistics of *native* residents are presented in section VI. Thus, the foremost purpose of lower panels of *Figures 3 and 4* is to give at least some idea about the quality of ethnic enclaves. The choice of income for this purpose does not appear unreasonable and is dictated by the data.

Figures 3 and 4 suggest that spatial dissimilarity in Helsinki metropolitan area rose sharply. Year 1988 was distinguished by relatively even distribution of immigrants, while year 2010 witnessed stark differences in fractions of non-native residents across postal code areas. It also appears that there are no particular "rich" immigrant neighborhood, in a sense that data do not reveal that more affluent immigrants tend to organize their own communities. This evidence pertains to the models based on human capital externalities functioning via mechanisms presented in Wilson (1987). Eventually, it can be noted that immigrant-dense neighborhoods are increasingly located in north-eastern Helsinki, and to some extent in central and southern Vantaa. As described in section III, such clustering is not captured by index of dissimilarity and might present a case for introducing indices based on spatial optimization. Unfortunately, data for this type of analysis are not currently available and thus the issue stays on the venue of future research.

Web application (Zhukov, 2014b) provides flexible controls over the choice of location, statistics of interest, type of the base-map and possibility to view the slide show with evolution of immigrant concentration over the sample period.

Maps are based on the postal code area data for year 2004.[6] A small number of postal codes emerged between the first year of the study period and year 2004, explaining some of the missing data (sky-blue polygons) in *Figures 3 and 4*. The rest of the missing statistics is accounted for by FLEED being $\frac{1}{3}$ random sample of the data, with postal code areas hosting less than some threshold number of residents not making it into the sample.

Finally, *Figure 5* plots histograms of postal code areas' sizes (in terms of the

[5] A similar map based on more refined geographical data for year 2013 was published in Helsingin Sanomat (2014) and indicates that there has been little changes to the distribution of immigrants in the years following the final year of the study period.

[6] Postal code area data for year 1988 that would be more suited for the analysis are unfortunately unavailable.

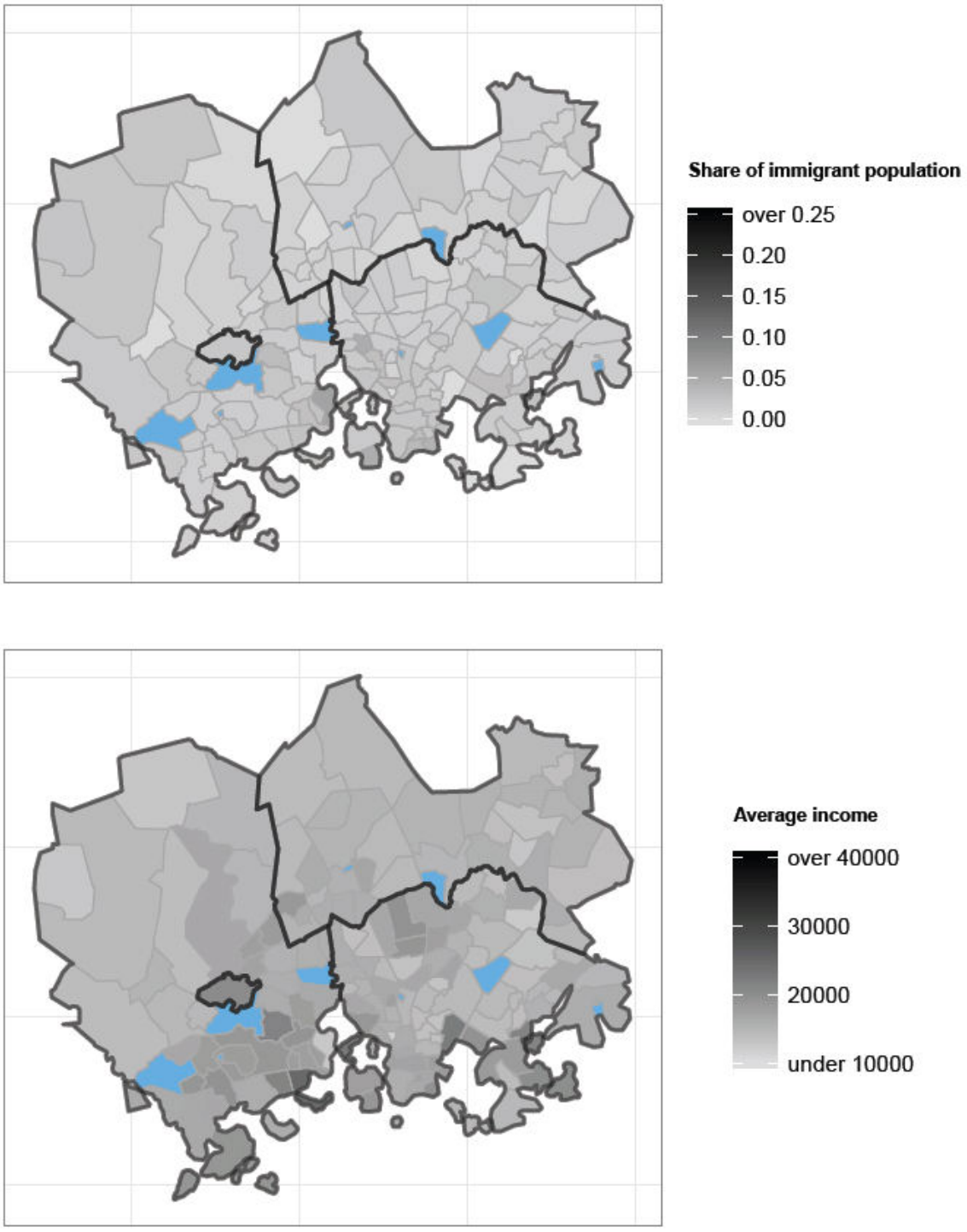

Figure 3: Spatial Distribution of Immigrants across Postal Code Areas, 1988

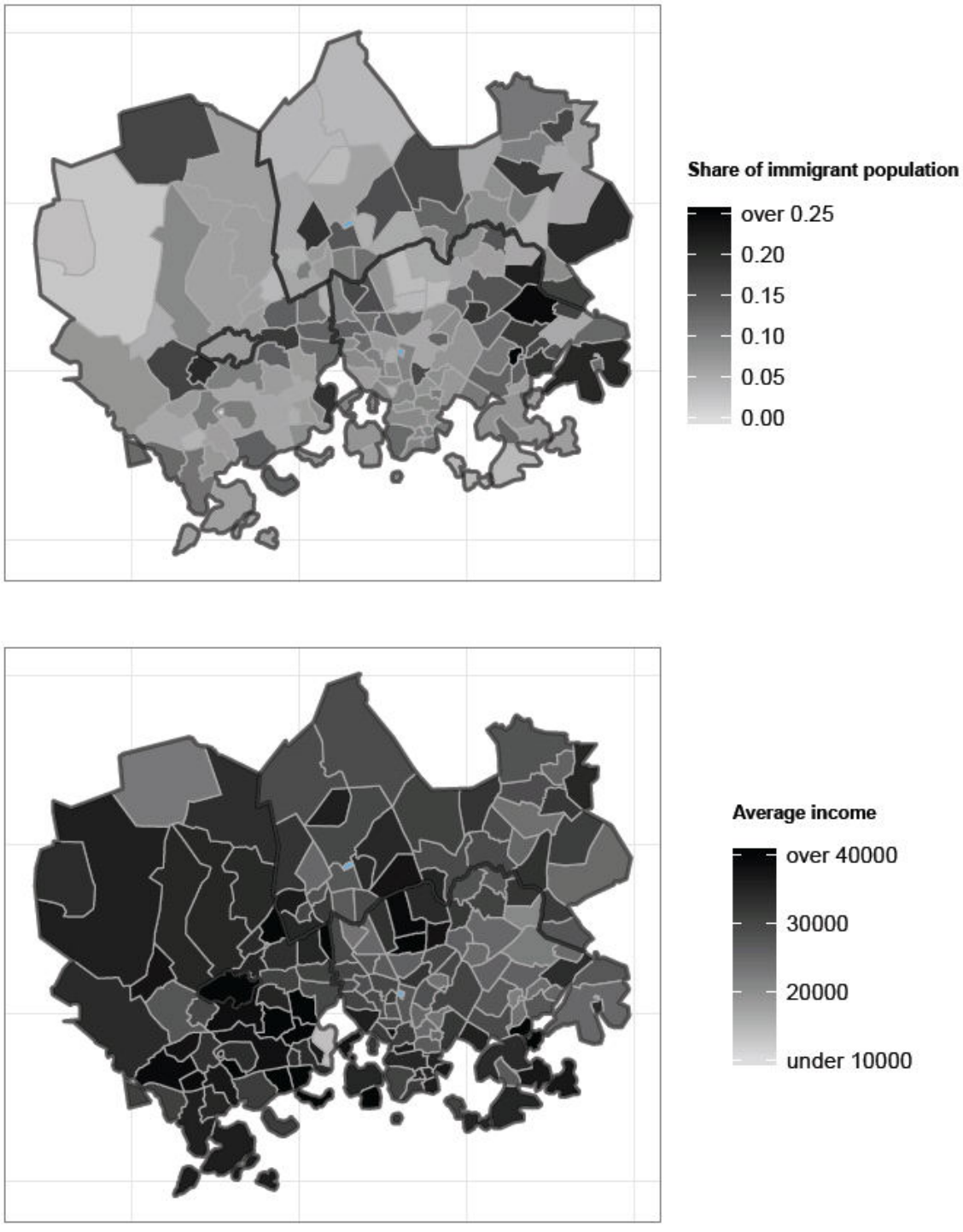

Figure 4: Spatial Distribution of Immigrants across Postal Code Areas, 2010

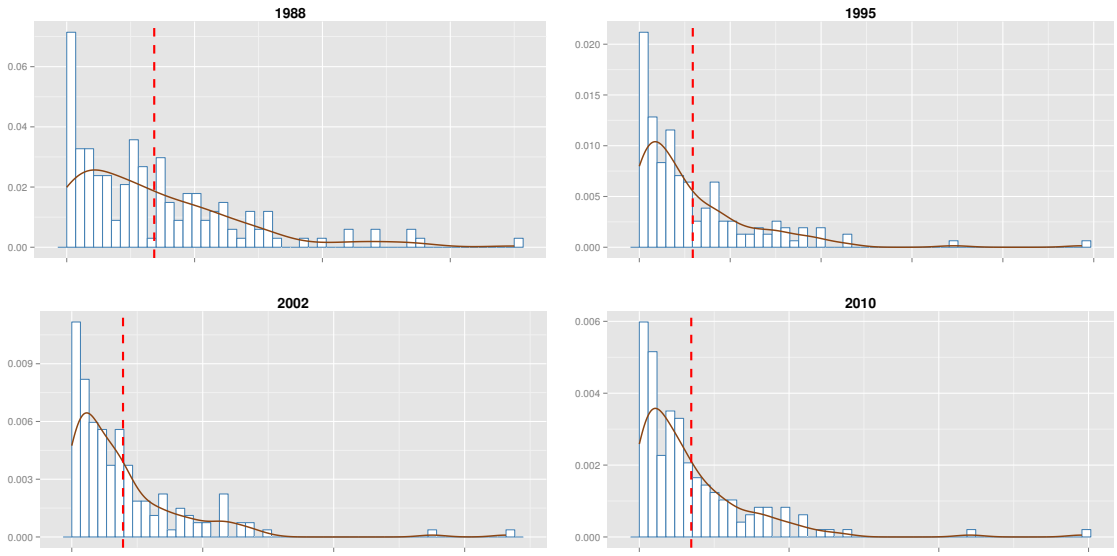

Figure 5: Distribution of a Number of Immigrants

number of immigrant residents) overlayed with kernel density estimates for different years. It indicates that there is a larger number of neighborhoods which host extreme (either low or high) numbers of immigrants, suggesting that segregation in fact increased within the study period.

VI Results

The growing population fraction of immigrants naturally raises interest in their settlement patterns. *Figure 1* presents results of my investigation into the question of whether individuals born outside of Finland systematically tend to share residential areas.

Traditional index of dissimilarity (*equation 1*) suggests rather modest increase in segregation. Thus, in year 1988, 15.5% of a minority (majority) group would have needed to change a residential area to achieve complete evenness in the distribution across entities, while the corresponding number stands at around 19.5% in a final year of the study period. As it was mentioned in the previous sections, the problem with this comparison stems from the fact that different sizes of postal code areas and minority population (both are reported in *Table 1*) generate random dissimilarity of different magnitudes, thus disallowing reliable qualitative inference on segregation dynamics.

Index of systematic dissimilarity (*equation 2*) employed to overcome the above problem reports that while only 8% of the maximum excess (net of random) segregation was attained in the first year of the study period, it more than doubled

Figure 6: Index of Systematic Dissimilarity by Area of Origin

and peaked at 17.5% in the final year. Whereas both indices report increase in dissimilarity, the dynamics and entailed conclusions they suggest are different.

6.1 Segregation across minority groups

Figure 6, top panel illustrates evolution of an index of systematic dissimilarity by an area of origin, enabling reliable comparisons of segregation across minority groups of different sizes. *Figure 6, bottom panel* suggests insights into immigrant population composition in the capital area. Each facet of the bottom panel reports population shares of the minority groups originating in the following regions, from left to right: Africa, Balkan countries, Baltic countries, Eastern Europe (excl. Balkans), Latin America and the Carribean, and Nordic countries. Country grouping is largely based on classification suggested by Statistics Finland and, to a lesser extent, in Dahlberg, Edmark and Lundqvist (2011). A list of countries in each category is available in Appendix A.

First of all, *Figure 6, top panel* asserts that there is substantial variation in segregation levels and dynamics across minority groups.

Second, African and Balkan countries contribute the most spatially concentrated

communities among immigrant population of Helsinki metropolitan area, attaining around 30% of maximum excess dissimilarity.

Third, immigrants from the other Nordic countries and Latin America and the Caribbean are found to be substantially less segregated than their counterparts from elsewhere, even more so during the last decade. In case of the latter group, it should be noted that low levels of systematic dissimilarity are likely to stem from random dissimilarity of high magnitude generated by a minority of a marginal size (*Figure 6, bottom panel*).

Fourth, taking into account certain similarity in the profiles of the largest immigrant waves, an interesting case can be made of comparing segregation dynamics of minority groups from Baltic countries and Eastern Europe. Measure of systematic dissimilarity of both groups grew at rapid pace in the first half of the 1990s. Reaching their respective maxima, the index of the former group started decreasing intensively, while the measure of systematic dissimilarity of immigrants from Eastern Europe buoyed up until 2010. Not unexpectedly, after initial period of adjustment indices appear to fluctuate around the same value.

Finally, it should be also noted that immigrants from non-OECD[7] countries are more segregated than other foreign-born individuals.

6.2 Segregation across localities

Figure 7 compares evolution of systematic index of dissimilarity in Helsinki metropolitan area to the same measure of segregation in the largest Finnish cities. It suggests that segregation dynamics and levels do not substantially differ by locality. The notable exception is the city of Turku, which has been more ethnically segregated than its counterparts for over 15 years. A gap between Turku and the other localities appears to be slowly widening over time. Appendix Figure B.1 reports that population fraction of foreigners in Turku has been growing at the pace similar to that of the capital region. However, unlike the capital region, Turku experienced an influx of immigrants from Western Asia who (as of year 2010) constituted the second largest minority group of the city (Appendix C) and at the same time demonstrated high degree of spatial dissimilarity (Zhukov, 2014a). Moreover, immigrants from Balkan countries (who constitute one of the most segregated minority groups across municipalities) account for a larger fraction of non-native population in Turku than anywhere else in Finland.

Dissimilarity dynamics in Tampere was rather closely following general trends characteristic of the largest Finnish cities throughout the most of the study period, but staring from year 2005 Tampere experienced the sharpest increase in ethnic

[7]based on OECD membership status before 1994 (available in Appendix A)

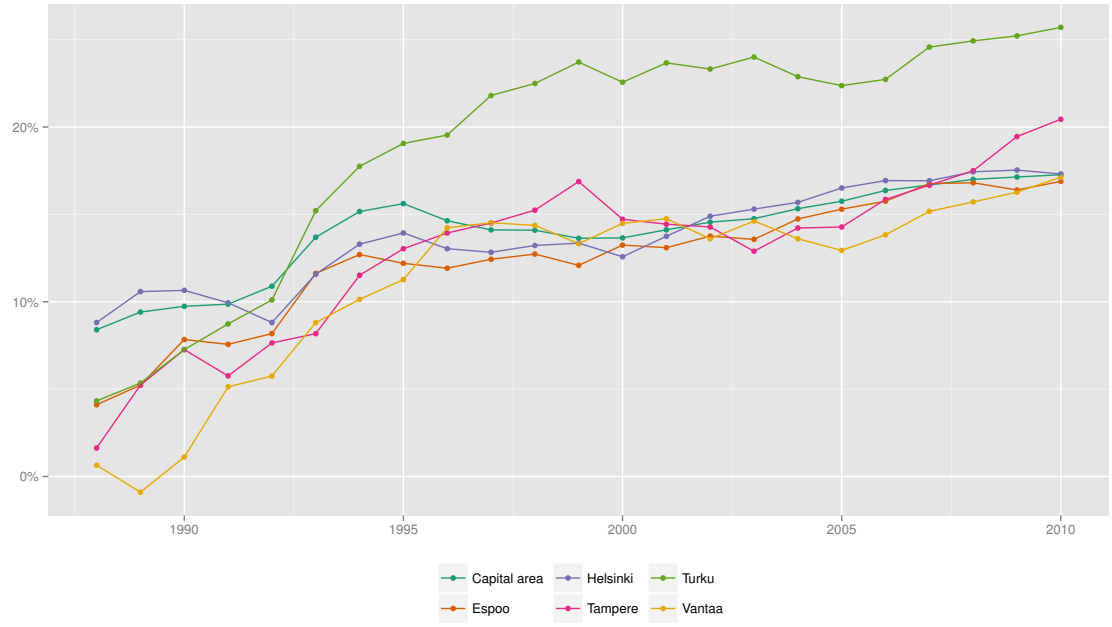

Figure 7: Index of Systematic Dissimilarity across Localities

segregation. Similarly to Turku, the reason might arguably lie in ethnically different composition of immigrant population (Appendix C).

6.3 Accounting for income differences between native and immigrant population

Some of the recent studies on Helsinki metropolitan area imply that ethnic residential segregation might be underlined by growing dissimilarities along income dimension (as documented in *Table 1*). Juxtaposition of *Figures 3, 4 and 8* additionally reveals that on average immigrant-dense neighborhoods are less prosperous. Conforming to this evidence, certain ethnic minorities voiced a concern that they are assigned to social housing in neighborhoods largely hosting economically challenged population (Dhalmann and Vilkama, 2009).

Figure 9 quantifies an extent to which income factors contribute to ethnic segregation. It should be interpreted as follows: merely small fraction of ethnic segregation might be explained[8] by income differences between natives and immigrants. However, a narrow gap between the measure of systematic dissimilarity conditional on income (the bottom line) and unconditional systematic dissimilarity is slowly increasing in capital region. While the dynamics itself might appear alarming, the contribution of income differences to ethnic segregation is still infinitesimal.

It should be noted that dissimilarity along income dimension accounts for a

[8]in the context of this paper, the verb 'explain' does not bear casual connotation

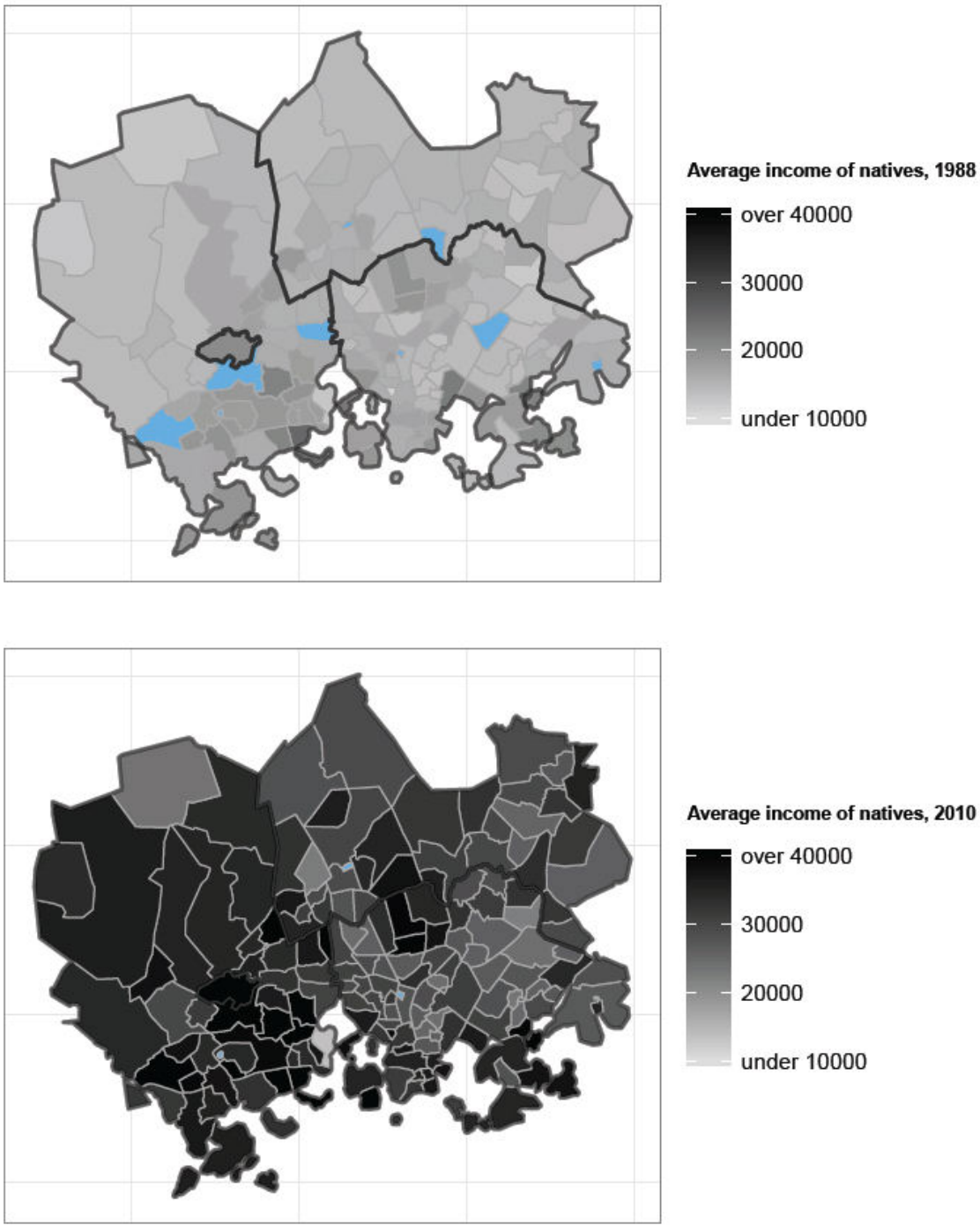

Figure 8: Endemic Income Statistics of Native Population

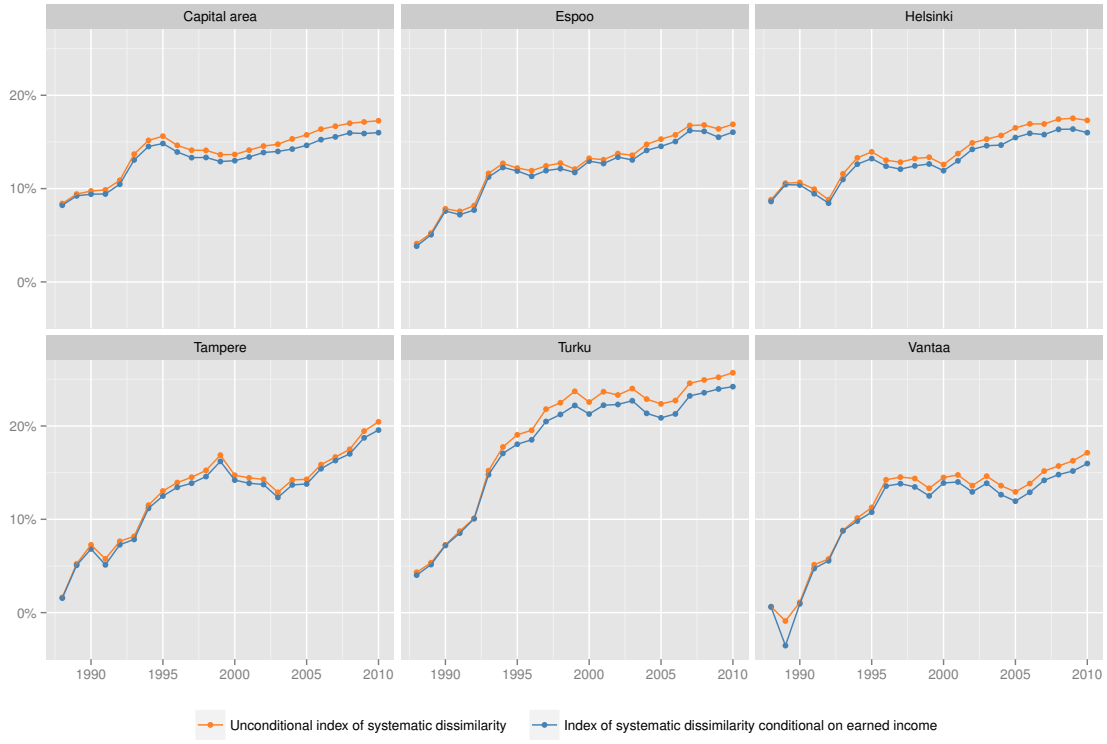

Figure 9: Index of Systematic Dissimilarity Conditional on Earned Income

higher fraction of ethnic segregation in Helsinki metropolitan area, than in any other locality.

Differences between unconditional and conditional indices are never statistically significant, fortifying a conclusion that segregation along ethnic lines is not driven by income dissimilarities.

A potential problem of the current setup arises from a relatively large size of an average postal code area (*Table 1*). Kortteinen and Vaattovaara (1999) establishes that the use of smaller area units (250m $\times$ 250m) empowers appearance of fine-scaled local income variations, so called "pockets of poverty". It also finds that the pockets of poverty are substantially diffused across the city. In this case, the use of the postal code areas as the basic unit of analysis is likely to understate the role of income differences in ethnic residential segregation.

However, small unit sizes generally *overstate* an extent of spatial dissimilarity. To illustrate this statement, think of two neighboring apartment buildings, with each building hosting one of two mutually exclusive population groups. In this case, using a building as a fundamental entity of segregation analysis would result in a maximum attainable level of dissimilarity, even though their residents are highly likely to interact with each other on regular basis and send their children to the same school or kindergarten. In this light, the use of postal code areas dictated by

Table 2: Sensitivity of the estimates

	Baseline specification	Native Language	Missing postal codes
Year	$\hat{D}, \%$	$\hat{D}, \%$	$\hat{D}, \%$
1990	9.4	11.2	10
1995	15.6	17.6	16.1
2000	13.7	15.8	14.7
2005	15.8	17.8	17.3
2010	17.3	19.3	19.5

the data, does not appear to be unreasonable.

VII Robustness

Table 2 offers summary of the sensitivity analysis performed. Following short paragraphs outline the essence of the robustness tests.

Definition of ethnicity

The current section explores robustness of the findings to classifying ethnicities on the basis of country of origin. Instead, ethnicities are assumed to be determined by linguistic group affiliation. Precisely, an immigrant is defined as an individual who does not speak any of the official country languages as her mother-tongue.

Table 2 reports that new treatment slightly increases the estimates of dissimilarity without changing qualitative conclusions on segregation dynamics.

Treatment of observations with unspecified postal code areas

While the baseline specification omits all the observations with missing values of a postal code variable, this section allocates them to one fictitious residential area. According to *Table 2*, this treatment causes the measure of systematic dissimilarity to increase indicating a greater number of non-native speakers in the residential area in question. Similarly, it does not have decisive impact on results interpretation.

VIII Concluding Remarks

Regardless of the assumptions imposed, index of dissimilarity experienced a tremendous boost throughout the study period with the most significant growth

falling on the first half of the nineties. I find no evidence that this increase in ethnic residential segregation is driven by a widening income gap between native and immigrant population.

An upward trend of ethnic residential segregation is the most general insight of the paper. However, it also establishes that there is substantial variation in dissimilarity dynamics and levels across minority groups and localities.

Therefore, one of the potential questions for future research concerns the extent to which differences in dissimilarity levels across cities are underlined by immigrant population composition. More coherent definition of a neighborhood (and respectively finer-scaled data) could also provide valuable insights into the issue. Eventually, data analysis exposes that index of dissimilarity suffers from "checkerboard problem". Consequently, employing spatial optimization to account for clustering might advance understanding of segregation dynamics.

While increasing segregation might appear alarming, it is still ambiguous what its consequences for immigrants' outcomes are. However, reliably documented here variation in spatial dissimilarity across localities could be further used to estimate causal effects of segregation.[9]

Finally, whereas the dynamics of the index is rather informative, there is one more aspect to it. Even when peaking, its value did not exceed 20%, which would be considered as indicating an extremely low level of segregation by international standards.[10]

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[9]Of course, issues of reverse causality and sorting are to be dealt with, perhaps in the fashion similar to that in Cutler and Glaeser (1997).

[10]By way of comparison, the estimates of unadjusted dissimilarity for various Metropolitan Statistical Areas of the USA from the paper "Are Ghettos Good or Bad" (Cutler and Glaeser, 1997) are between 20.6% and 87.3% with the mean value of 58.6%

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A List of Countries

OECD Countries:
Austria
Belgium
Canada
Denmark
Finland
France
West Germany
Greece
Iceland
Ireland
Italy
Luxembourg
New Zealand
The Netherlands
Norway
Portugal
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

Nordic Countries:
Sweden
Norway
Denmark
Iceland
Faroe Islands
Svalbard and Jan Mayen
Åland Islands

Baltic Countries:
Latvia
Lithuania
Estonia

Balkan Countries:
Albania
Bosnia and Herzegovina
Macedonia
Croatia
Montenegro
Slovenia
Serbia
Former Yugoslavia

Rest of Eastern Europe:
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Poland
Romania
Slovakia
Czech Republic
Ukraine
Hungary
Belarus
Russian Federation
Former Soviet Union

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Monaco
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Switzerland
United Kingdom

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Ireland
Jersey
Isle of Man
Andorra
Spain
Gibraltar
Italy
Greece
Malta
Portugal
San Marino
Slovenia
Holy See

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Armenia
Azerbaijan
Bahrain
Georgia
Iraq
Israel
Yemen
Jordan
Kuwait
Cyprus
Lebanon
Oman
Palestinian Territory, Occupied
Qatar
Saudi Arabia
Syrian Arab Republic
Turkey
Kazakhstan
Kyrgyzstan
Tajikistan
Uzbekistan

Eastern Asia:
Hong Kong
Japan
China
Korea,
Democratic People's Republic of
Korea, Republic of
Macao
Mongolia
Taiwan, Province of China

Southern Asia:
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Bangladesh
Bhutan
India
Iran, Islamic Republic of
Maldives
Nepal
Pakistan
Sri Lanka
Turkmenistan

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Ivory Coast
Saint Helena
Senegal
Sierra Leone
Togo
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Cameroon
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Congo (Congo-Kinshasa)
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Zambia
Seychelles
Somalia
Tanzania, United Republic of
Uganda
Zimbabwe
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Botswana
South Africa
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Namibia
Swaziland

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Greenland
Canada
Saint Pierre and Miquelon
United States
Australia
Christmas Island
Cocos (Keeling) Islands
Norfolk Island
New Zealand
Fiji
Papua New Guinea
Solomon Islands
New Caledonia
Vanuatu
Guam
Kiribati
Marshall Islands

Micronesia, Federated States of
Nauru
Palau
Northern Mariana Islands
United States Minor Outlying Islands
American Samoa
Cook Islands
Niue
Pitcairn
French Polynesia
Samoa
Tokelau
Tonga
Tuvalu
Wallis and Futuna

Latin America and the Carribean:
Netherlands Antilles
Anguilla
Antigua and Barbuda
Aruba
Bahamas
Barbados
Virgin Islands, British
Cayman Islands
Dominica
Dominican Republic
Grenada
Guadeloupe
Haiti
Jamaica
Cuba
Martinique
Montserrat
Puerto Rico
Saint Barthélemy
Saint Kitts and Nevis
Saint Lucia
Saint Martin
Saint Vincent and the Grenadines
Trinidad and Tobago
Turks and Caicos Islands
Virgin Islands, U.S.
Belize
Costa Rica
El Salvador
Guatemala
Honduras
Mexico
Nicaragua
Panama
Argentina
Bolivia
Brazil
Chile
Ecuador
Falkland Islands (Malvinas)
Guyana
Colombia
Paraguay
Peru
French Guiana
Suriname
Uruguay
Venezuela

B Immigrant population across localities

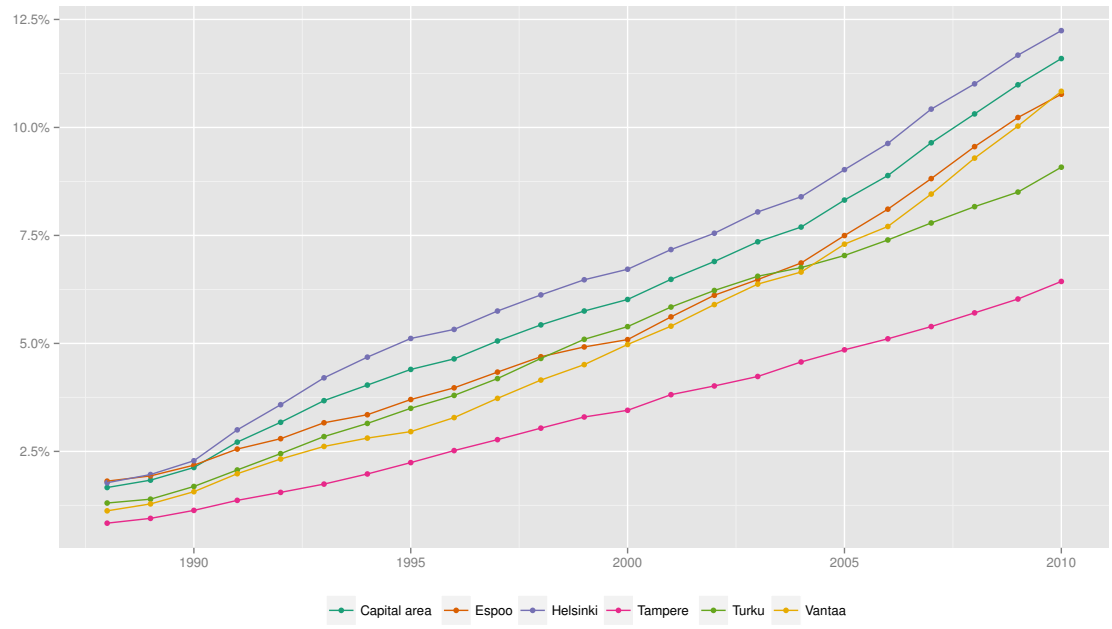

Figure B.1: Population Share of Immigrants across Localities

C Composition of immigrant population

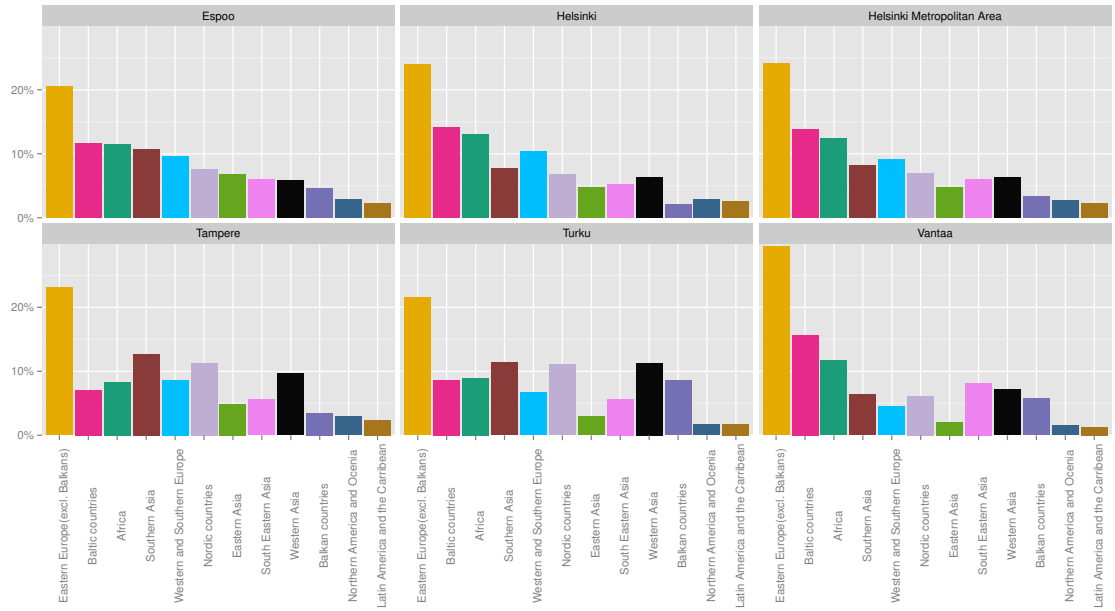

Figure C.1: Immigrant Population Composition across Localities, 2010