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Andersson, R.; Musterd, S.

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WHAT SCALE MATTERS? EXPLORING THE RELATIONSHIPS BETWEEN INDIVIDUALS' SOCIAL POSITION, NEIGHBOURHOOD CONTEXT AND THE SCALE OF NEIGHBOURHOOD

by
Roger Andersson and Sako Musterd

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ABSTRACT. Over the past few years, neighbourhood effects research has received significant attention from the academic world, not only in the US, where that attention has a longer tradition, but also in Western Europe. There is also substantial interest among policy makers. Most policy makers intend to reduce concentrations of poverty by enhancing the social mix of neighbourhoods. Avoiding high immigrant concentrations in particular neighbourhoods is another issue that fuels political debate and policy intervention in many Western European countries, Scandinavian countries included. However, there are clear gaps in the understanding of the relationship between neighbourhood composition and social outcomes. One of these gaps regards the scale of the neighbourhood; if there would be neighbourhood effects, what scale is it relevant to consider? Is mix good or bad for the social prospects of individuals at a level that is very local, for example a few neighbouring streets, or could mix be helpful at a somewhat higher scale? This article will focus on this issue, applying individual longitudinal data in multi-level models for the entire active population of the three largest metropolitan areas in Sweden. We will explore the degree to which the social and ethnic composition of geographical districts, at a variety of scales (measured at time t), are statistically related to individual employment and earnings for adult metropolitan residents at time t+1, controlling for relevant personal and household characteristics.

Key words: social outcome, social mix, neighburhood effect, longitudinal, multi-level, scale

Introduction

Over the past couple of decades, studies on the impact of neighbourhood composition on the life chances of individuals have slowly gained interest and have provided new insights (for surveys and reviews of the literature, see, e.g. Jencks and Mayer 1990; Briggs 1997; Ellen and Turner 1997; Leventhal and Brooks-Gunn 2000; Galster 2002; Sampson *et al*. 2002; Friedrichs *et al*. 2003). In the USA the so called Gautreaux case and comparable lawsuits about 'the right to live in a neighbourhood that offers "equal" opportunities to all', substantially contributed to the rise of neighbourhood effects studies. Impacts of social and ethnic compositions of neighbourhoods were investigated. In Europe, neighbourhood effects research in the sphere of voting behaviour has a long tradition (see e.g. Johnston 1987) and technical innovations were discovered early as well (Jones 1991). However, over recent years neighbourhood effects research regained interest in the social sphere, partly driven by academic and political debates about the relationship between social mix, ethnic composition and integration in various countries in Western Europe (see e.g. Friedrichs 1998; Andersson 2001; Atkinson and Kintrea 2001; Buck 2001; Ostendorf *et al*. 2001; Farwick *et al*. 2002; Kearns and Parkes 2003; Musterd *et al*. 2003, 2008; Musterd and Andersson 2005, 2006; Andersson *et al*. 2007; Galster *et al*. forthcoming). However, results of these studies do not always point in the same direction.

In this article we intend to contribute to the understanding of neighbourhood effects on social outcomes. We will do that by focusing on the impact of the social and ethnic composition of neighbourhoods on individual social mobility outcomes for adults, controlling for a range of individual and household characteristics which are also considered to have an impact on social mobility and applying multi-level modelling. The neighbourhood effects literature addresses issues such as crime rates, health care, educational outcomes and socio-economic outcomes, and focuses on such target groups as children, adolescents and adults (see Ellen and Turner (1997) and Atkinson and Kintrea (2001) for overviews of the range of studies that have been carried out in various spheres). The most frequently mentioned neighbourhood effect mechanisms are in the

spheres of stigmatization, the functioning of social networks and socialization processes. These may play a role in opportunities for attaining a (better) job, and through that obtaining higher incomes and better employment positions.

In this study we focus the attention on neighbourhood effects on social outcomes for the adult population. The main aim of this contribution is to shed special light on the impact of scale. The fact that contrasting results have been published so far may imply that different contexts create different effects, aside from the possibility that aspects of the effects studied are under-researched. It seems, however, that many studies carried out so far suffer from serious methodological problems or shortcomings. Some of these problems concern the so called modifiable areal unit problem (Openshaw and Taylor 1979; Openshaw 1984; Unwin 1996), that is, issues concerning zoning and aggregation of data. But many authors also point to a lack of adequate data, not only their handling. Neighbourhood effects studies require wide (rich), long and longitudinal datasets, which include detailed geography. These large-scale longitudinal datasets, which may help overcome a series of problems and enable tests of the assumptions that have been made, are seldom available. However, we have been in a special position to have access to such very rich longitudinal datasets. This has allowed us to start a series of research projects, aimed at understanding the impact of neighbourhood composition on individual outcomes. The issue of neighbourhood effects is not only of academic interest; it is a political and social policy issue. We think it is essential that countries and cities that pursue counter-segregation policies make better use of existing research in the design of such policies. Arguing for evidence-based policy making also requires that researchers take methodological challenges seriously (Kearns 2002; Andersson 2008).

The current article will address the issue of "what scale matters?". This relates directly to key aspects of theories dealing with neighbourhood effects. We link our empirical tests of the scale matter to Manski's concepts of endogenous, exogenous, and correlated effects. We suggest that these effects have different spatialities, where the first two relate to the geography of face-to-face contacts while the latter does not. Our article will thus not only provide an input to the political discourse on planning for neighbourhood social mix (at what level should households be mixed?) but also hopefully advance our understanding of the importance of different types of neighbourhood effects.

We elaborate on theoretical matters in the next section, where we investigate to what extent the scale issue is addressed in the neighbourhood effects literature. This section includes an attempt to formulate hypotheses regarding what type of effects might be expected at different geographical levels. The following section contains a description of the multi-level analyses, comments upon the modifiable areal unit problem and further aspects of the methodology applied. This section also presents the data used and contains a brief discussion of the Swedish urban context, the laboratory for testing our hypotheses. After the presentation of the empirical results in the penultimate section, we draw some conclusions in the final one.

Neighbourhood effects and geographical scale

There have been several comprehensive reviews of the potential theoretical links between neighbourhood processes and individual outcomes for various categories of the population (Jencks and Mayer 1990; Duncan *et al*. 1997; Gephart 1997; Friedrichs 1998; Haurin *et al*. 2002; Sampson *et al*. 2002; and Ioannides and Loury 2004). Galster (2005, p. 6) provides a very useful introduction to the matter, linking the issue of individual socioeconomic advancement to the notion of urban opportunity structures:

> This opportunity structure operates in dramatically varied ways across and within metropolitan areas, enhancing or eroding chances for socioeconomic advancement depending on one's place of residence. There are at least three spatial scales over which this variation occurs. Across neighborhoods, variations in peers groups, social organizations, and social networks occur. Across political jurisdictions, health, education, recreation, and safety programs vary. Across metropolitan areas, the locations of employment of various types and skill requirements vary.

In the wider literature on the relationship between man and environment some argue that the direct neighbourhood of individuals has lost significance, especially for the life chances and social opportunities of the adult population. Fischer (1982), for example, stated that people tend to become socially integrated through differentiated, looser networks at different scales. Increased affluence, but also wider access to the rest of society

or even the world through higher levels of individual mobility and the explosion of telecommunications and Internet connections in particular, would have resulted in a diminishing role of the local environment in the daily lives of most people (Castells 1989). Blokland (2003), who applied in-depth interviews, found that the local environment had only a minor impact on significant social interaction between different population categories. However, others state that the local environment still plays a significant role.

Neighbourhoods tie people both socially and spatially, if only on functional grounds. Janowitz (1952) and Suttles' (1973) "community of limited liability" clearly fits these ideas about the role of the local neighbourhood. They state that (middle-class) neighbours come together, work together and become active and influence each other when they regard that as necessary; otherwise, they live a preferably silent and peaceful local life. Bridge *et al*. (2004, p. 39), who summarized the research findings on neighbourhood ties, state that 'The evidence for the widely held perception that neighbourliness is declining is in fact mixed.' Buonfino and Hilder (2006) confirmed that view in a recent review on neighbourliness when, after reviewing part of the literature, they raised a large number of questions still to be answered in future research. However, some statements in their report seemed to be research-based already, such as that some groups will be more sensitive to potential effects of neighbourhood than others: 'good neighbours may be particularly more important for those who spend more time in their local area – flexible workers, young families, the young, the elderly, the unemployed and the disabled' (Buonfino and Hilder 2006, p. 5).

Wilson (1987), who has had perhaps the most influence on the neighbourhood effects debate, believes firmly in a neighbourhood impact. He, and others, refer to various interrelated mechanisms through which neighbourhood characteristics might affect social opportunities, and especially opportunities in the educational sphere: collective socialization (role models), social control, and social capital that is available, occupational opportunities and institutional conditions (such as schools). However, it certainly makes sense to ask the question whether all of these effects occur at the same spatial level. It is more likely that different spatial scales provide different opportunities, because different mechanisms may be operating at these varying scales, and different outcomes of these mechanisms may be the result. In a study by Ainsworth (2002, p. 145) in which the effects of the just-mentioned dimensions were tested, one of the conclusions was that

> despite the ways the current research moves the urban and educational literatures forward, it is limited with respect to how well neighbourhood characteristics and theoretical mediators are measured. Areas defined by ZIP codes are somewhat larger than what most people think of as a neighbourhood. Census tracts are most likely preferable to ZIP codes, but they too are apt to correspond imperfectly to residents' self-defined neighbourhoods.

Dietz (2002, p. 541) observes that 'neighbourhood definitions have typically not been formed by thoughtful theoretical considerations. Rather neighbourhood delineation has been defined by the limitations of an available data set' (see also Burgess *et al*. 2001). There clearly is a need for more in-depth qualitative studies, which can tell us more about the mechanisms behind the neighbourhood effects, and subsequently about the scales at which effects develop. However, more quantitative studies may also contribute to this debate, when they focus explicitly on the question: at what scale may effects of an individual's environment be felt most? This is what we intend to do.

The "what scale matters?" question is highly relevant to the more general "does neighbourhood matter?" question. That is, the scale that is used in neighbourhood effects studies has impacts on the conclusions about neighbourhood effects. The question should be asked whether the conclusion holds when other scales are applied. To illustrate this point we refer to a detailed and excellent Swedish neighbourhood effects study by Brännström (2005). He analysed neighbourhood effects on income and receipt of social assistance. The empirical material (register data derived from the Stockholm Birth Cohort Study) provided a unique opportunity to analyse repeated information on both outcomes and place of residence for the cohort of Stockholmers born in 1953 during a 50-year period. With the use of longitudinal multi-level modelling, this study explored the interdependence of the observations by partitioning the total variance into different components of variation due to various hierarchical levels in the data. In the extensive longitudinal multi-level analyses the author worked simultaneously with two spatial levels (census areas and parishes).

These areas have different territorial scope. Brännström (2005, p. 170) concluded that

> the major message of this study is that it is people and time point of measurement, rather than place of residence, that matter. Put simply, it matters more who you are than where you are. At least where the outcomes addressed in this study are concerned, this may indicate that it is primarily people and their households that should be the focus of policy efforts to alleviate disproportions in social and economic opportunities.

However, we should consider that both the census tracts and the parishes are socially very heterogeneous and also large areas. These areas may indeed hardly show any effects, but we should not rule out the possibility that social processes and relevant interactions between people actually occur at more fine-grained levels. Ideally, the impact of these smaller levels should also be taken into account.

This argument is in a way supported by a study among Australian teenagers, where the focus was on neighbourhood effects on school dropout rates and where explicit attention was given to the socio-economic composition of the immediate and of the larger locality (Overman 2002). The larger area indicated the socio-economic character of the school catchment area, while the small area would indicate the socio-economic characteristics of the immediate neighbourhood where the teenager lived. Overman found contrasting effects at both levels; a high proportion of vocationally trained adults at the larger scale lead to higher dropout rates (perhaps due to larger labour market demands), whereas a high proportion of vocationally trained adults at the smaller scale neighbourhood lead to a reduction of dropout probability (perhaps due to informational networks that support staying on at school). Lower socio-economic scores in these neighbourhoods, however, encouraged school dropouts.

Ruth Lupton (2003) has reviewed part of the British and American studies on neighbourhood effects and discusses scale issues and the possibility of bringing qualitative and quantitative neighbourhood research closer together. Concerning the quantitative studies, she states that 'The geographical units of analysis used are often acknowledged to be too large to have any explanatory power' (Lupton 2003, p. 9). Somewhat later in her paper (p. 14), she recommends that

> While some reductionism is, of course, inevitable for quantitative work, it should not be accepted uncritically, especially if the result is that policy is founded on weak results. It is incumbent on quantitative researchers, therefore, to work with their qualitative colleagues in a collaborative but critical way, to aid the development of more sophisticated operational models of neighbourhood, rather than simply letting them get on with it. Findings of quantitative research based on arbitrary boundaries or failing to control for different relationships between individuals and their neighbourhoods should not be accepted uncritically as a useful 'beefing up' of the evidence.

For the present article, the studies Johnston *et al*. (2004, 2005) have carried out are very interesting as well. They focused on scale and neighbourhood effects on voting behaviour and applied the British Household Panel Study. Apart from paying attention to effects of multiple spatial levels they also paid attention to the exact calculation of context. They created so called bespoke neighbourhoods, local areas defined for each individual separately; these environments were built up with enumeration district data. Two different types of bespoke neighbourhoods were created: by different numbers of nearest population around the respondent's home (neighbourhoods with nearest 500 around the individual; neighbourhoods with nearest 1000 around the individual, etc.); and by different distances from the respondent's home (population within 250m, population within 500m, etc.; see also Musterd *et al*. 2003 and Musterd and Andersson 2006 in which similar types of bespoke neighbourhoods are used). Their arguments to do so were based on the idea that separate mechanisms and processes may operate at different scales. Among other things they found that there were simultaneous wide-area and highly local neighbourhood effects; voting for Labour was more common in deprived areas, but especially so in pockets of extreme deprivation. Johnston *et al*. (2004, p. 367) conclude that

> there are many hypotheses regarding neighbourhood effects in geographical and related literatures, but their successful testing has been hampered by the absence of relevant data. In particular, analysts have lacked data on both individuals and their neighbourhood milieus, which allow the interactions of different types of people in different kinds of local con-

> text to be explored. Furthermore, most analyses of neighbourhood effects have been significantly constrained by the nature of the areas for which data are available. In many cases these are relatively large and in almost all cases no data are available to explore variations in the nature and strength of the sought-for effects at different scales.

These statements are clearly also the drivers behind the current article in which two questions are raised:

- To what extent is individual social mobility of adults influenced by individual and neighbourhood characteristics?
- To what extent are neighbourhood effects affected by various levels of scale and various definitions of area composition?

The modifiable areal unit problem (MAUP) is sometimes regarded to be associated with studies of this kind. The MAUP states that when the attributes of spatially heterogenous phenomena (e.g. people) are aggregated into districts, the resulting summary values (e.g. rates, proportions) are influenced by the choice of district boundaries. This statistical and geographical problem concerns both scale and aggregation. The scale effect is the tendency for different statistical results to be obtained from the same set of data when information is grouped at different levels of spatial resolution (such as neighbourhoods, municipalities, regions). The aggregation effect rather concerns how a given number of areas could be grouped together at a given scale.

As Openshaw (1996, p. 65) notes, however, 'The MAUP will disappear once geographers know what the areal objects they wish to study are'. In the context of neighbourhood effects, finding these areal objects calls for a theoretical approach. Hypotheses about the mechanisms producing neighbourhood effects should relate to the spatiality of these mechanisms. This is in line with the argument put forward by Nakaya (2000), who constructs areas according to explanatory variables. Although our basic problem is not about aggregation but about comparing scales, we have chosen a similar strategy in this article, that is, deriving the units theoretically (see the next section).

In organizing our hypotheses we employ the distinction introduced by Manski (1995, 2000) – and elaborated on by Galster (2005) – among endogenous, contextual (exogenous) and correlated neighbourhood effects. If we face endogenous interactions, the propensity of an agent to behave in some way varies with the behaviour of the group. In contextual interactions, the propensity of an agent to behave in some way varies with exogenous characteristics of the group members. Correlated effects concern situations when agents in the same group tend to behave similarly because they have similar individual characteristics or face similar institutional environments. As concluded by Manski (2000, p. 127), 'Endogenous and contextual interactions express distinct ways that agents might be influenced by their social environments, while correlated effects express a non-social phenomenon.'

Numerous versions of endogenous effects have been forwarded, including effects related to socialization, social networks, local competition over finite resources, and relative deprivation. Exogenous neighbourhood effects occur if the behaviours or attitudes of one neighbour depend on the exogenous (or predetermined, fixed) characteristics of the individual's neighbours, such as ethnicity, religion, or race. For our purpose the distinction between endogenous and exogenous effects are not of immediate importance. Both sets of effects relate to the population composition of a neighbourhood and both relate to the fact that people interact locally and potentially have influence on each other. One should however note that endogenous and exogenous effects are not so called compositional effects. If for instance political participation or educational achievements in a certain area only reflect the composition of people ("the sum of individual attributes"), we do not view this as a contextual effect. If, however, people's behaviour or performances are affected by their neighbours ("more or less than the sum of individual attributes"), we regard this to be a contextual (endogenous or exogenous) effect.

Manski's third type of possible effects, the correlated neighbourhood effect, is however interesting as it does not presuppose ideas about "contagion effects" or mechanisms related directly to the composition of households. Correlated neighbourhood effects do not vary by alterations in neighbourhood household composition, but rather are determined by larger structural forces in the metropolitan area, like locations of jobs and geographic dis-amenities and the structures of local government. These external forces may impinge differentially on different neighbourhoods, but within any given neighbourhood they affect all residents

roughly equally, producing thereby correlations in neighbours' outcomes (Galster 2005). Such aspects of peoples' environment are not "non-social" – and certainly not non-political – but they do not stem from local human to human interaction. Of course, the real effect of the external forces on individuals is dependent on individual resources and dispositions.

In the same article, Manski touches upon the basic problem facing researchers trying to empirically study the relation between individual and group behaviour, namely how to identify "the group": 'Often, however, it is not obvious what the relevant groups should be. Consider, for example, the definition of "neighbourhood". Should the neighbourhood be an apartment house, a block, a census track, or a city? Or might the relevant geography be that of schools, workplaces, or church parishes? What of advances in telecommunications that may diminish the importance of physical geography substantially?' (Manski 2000, p. 129). It is this particular question that this article focuses on.

It is reasonable to assume *that if endogenous neighbourhood effects are in operation, such effects would be greater in the immediate surroundings of an individual and they would decrease as the size of the unit increases*. However, for correlated effects it is more difficult to hypothesize which level would be the most important and the spatiality can also be expected to vary according to which outcome we decide to study. In our case, focusing on labour market-related outcomes, both the existence of spatial mismatch (no jobs available nearby, uneven public transportation services etc.) and uneven support provided to people who are unemployed or in need of job information services *can be expected to be more influential at the municipal and urban district levels than at the level of the immediate surrounding of individuals*. Or put the other way around: at higher levels of geographical scale we expect endogenous effects to be weaker than they are at the scale of peoples' closest environment. If correlated effects exist at higher geographical levels (municipality, urban district) they would also exist at lower levels, adding up to stronger neighbourhood effects at the lowest geographical scale.

There is, however, one particular aspect of correlated effects that might operate primarily at lower geographical scales, namely spatial stigmatization. Galster (2005, p. 11) identifies stigmatization both as a type of endogenous effect and as a correlated effect:

> Endogenous stigmatization of a place transpires when important institutional, governmental or market actors negatively stereotype all residents of a place and/or reduce the flows of resources into the place because of its household composition. This might occur as the percentage of households in some disadvantaged ethnic group in the neighborhood exceeds the threshold of where they are perceived by these external actors as 'dominant.' … External stigma: certain neighborhoods may be stigmatized regardless of their current population because of their history, environmental or topographical disamenities, style, scale and type of dwellings, or condition of their commercial districts and public spaces.

It is highly plausible that both types of stigmatization occur at a relatively low geographical scale, such as neighbourhoods and maybe urban districts.

Data, Swedish context and methodology

We selected the metropolitan areas of Stockholm, Gothenburg and Malmö as our empirical test locations. We investigate the impact of different compositions of areas in which individuals live on individual's income positions; we apply several measures for the composition of the area (key group level variables), such as the level of unemployment, the share of immigrants from non-western countries, the share of low-income households, and the share of high-income households, since these compositions are – through various mechanisms – assumed to have potential impact on individual outcomes. We also differentiate between several spatial scales and between types of area in geographical terms: bespoke neighbourhoods and statistical units at various scales. We investigate neighbourhood effects for each of the possible combinations, controlling for individual and household information.

Most of the variables we employ are constructed from data of the Statistics Sweden *Louise* files, which are produced annually. These files contain a large amount of information on all individuals age 15 and above and represent compilations of data assembled from a range of individual registers (income, education, labour market and population). We have merged selected information about individuals from annual *Louise* files to create a longitudinal database 1995–2002 for all individuals who were living (during the entire period) in one of the three largest metropolitan areas of Sweden (Stock-

holm, Gothenburg and Malmö), and who were 20–57 years old in 1995 and thus still in the labour force in 2002. Only those individuals are included who lived in 100 × 100 meter squares with at least 10 people (so, also larger areas had more than 10 people). We emphasize that our dataset includes observations of virtually the *entire population* of the three metropolitan areas within the desired age range, not a sample. Thus, the t-statistics we present below should not be interpreted as guides for prospective errors involving inferences from a sample to the larger population.

With regard to the Swedish context, and particularly the situation in the three largest metropolitan areas, we must say that the country, and the three areas chosen, are still highly characterized by a strong welfare state. That implies firm state (and municipal) intervention in situations of inequality and many efforts to realize full employment in order to be able to sustain the welfare state. Over the past decades, however, the welfare state has tended to withdraw from a number of spheres, which has resulted in greater differences in Swedish society. Nevertheless, inequality is moderate according to international standards, state interventions are still quite frequent, and public services are rather uniformly distributed. Social problems and issues related to immigrants are most clearly associated with the three largest metropolitan areas. Immigrant-dense areas in these regions have been targeted by State-funded area-based interventions since the mid-1990s (SOU 2005; Urban 2005; Andersson 2006; Palander 2006).

The methodology we apply is aimed at constructing multi-level models for the income level of individuals, for each of the three metropolitan regions separately. These models are recommended in situations in which the structure of the data is hierarchical. Here we have data for individuals who share similar residential environments. Since we include separate variables for these environments, and even will focus attention on their effects, and also since we cannot expect the variables at these two levels to be entirely independent from each other, OLS regression would yield smaller standard errors (and thus "easier" significance) than would be the case if the multi-level character of the data would be explicitly taken into account (see for example Snijders and Bosker 1999). We use the mixed models procedure available in recent versions of SPSS. That procedure allows us to calculate estimates while also determining separately the impact of individual level and group level predictor variables on income through partitioning of the variance into these two levels. Therefore we specify the group structure (the scales *j*) in the mixed model (municipality, Small Area Market Statistics (SAMS) or coordinate) per model. The dependent variable is, more precisely, the natural logarithm of the average annual income from work in 1999 and 2002.[1] We control for a range of individual and household variables which are regarded to be important for the explanation of the dependent variables as well, such as the household situation, children in the household, whether the person involved was studying, or sick or pre-retired; the age of individuals, educational level, progress in educational level in different time periods, changes in the household situation and country of origin.

Furthermore we have constructed four types of contextual variables (group level variables *i*): the percentage unemployed in 1999, the percentage non-western migrants[2] in 1999 (only those who belonged to the most significant categories from Chile, Turkey, Somalia, Iran, Iraq, Ethiopia and Bosnia), the percentage with incomes in the three lowest income deciles in 1999 and the percentage with incomes in the three highest income deciles in 1999. The group level variables are derived from the same individual data set, that is, they are an aggregation of the individual data. Each of these contextual variables are applied in models at three different spatial scales *j* (the group levels), for each of the three metropolitan areas (contexts *k*).

We are able to apply bespoke neighbourhoods for each individual when we construct the coordinate value, the 100m × 100m grid in which the individual resides. In the calculation of the values we exclude the individual under consideration. The second level regards the SAMS level; this is an existing statistical unit with an average size of approximately 20 hectares, but SAMS are constructed on the basis of local logical considerations, mostly related to age of construction and social homogeneity. Finally, the third level we investigated was the municipal level.

We argue that the three spatial levels of resolution chosen for this study are theoretically sound. As much of the theory on endogenous and exogenous effects assume social interaction, we argue that a relevant neighbourhood scale is the immediate surrounding of one's residential location. The 100m by 100m squares that we use comprise on average 30–40 people.

From a political point of view, municipalities are

Table 1. Population dynamics per labour market region and geographical level, 1995–2002.

	Stockholm	Gothenburg	Malmö	Total
Total population in selected agegroups 1995	862681	308666	232633	1403980
Remaining in same municipality 95–99	749395	278521	208151	1236067
Perc. Remaining in same munic. 95–99	86.9	90.2	89.5	88.0
Thereof remaining in same munic. 99–02	694517	262045	195364	1151926
Perc remaining in same munic 1995–2002	80.5	84.9	84.0	82.0
Remaining in same SAMS 1995–1999	580417	197803	153040	931260
Perc remaining in same SAMS 95–99	67.3	64.1	65.8	66.3
Thereof remaining in same SAMS 99–02	485946	165930	130035	781911
Perc remaining in same SAMS 1995–2002	56.3	53.8	55.9	55.7
Remaining in same 100m coordinate 1995–1999	524878	184691	142632	852201
Perc remaining in same 100m coordinate 95–99	60.8	59.8	61.3	60.7
Thereof remaining in same 100m coordinate 99–02	420515	148557	118319	687391
Perc remaining in same 100m coordinate 1995–2002	48.7	48.1	50.9	49.0

the most important administrative entity. They exercise power over local taxes, infrastructural and housing construction decisions, organization of public services such as schools, care for the elderly and social services. Each metropolitan area comprises 15 to 35 municipalities, a fact that not only makes anti-segregation policies problematic but also raises issues concerning the importance of municipal residence for metropolitan residents. It is therefore theoretically relevant to study whether the social composition of municipalities affects the socio-economic trajectories of people.

Finally, our choice of SAMS relates both to the fact that it is an intermediate scale and to the fact that SAMS are used for identifying urban districts in need of state interventions in order to combat segregation. Furthermore, SAMS corresponds well with the scale used for segregation-related research in other countries. An average SAMS in metropolitan Sweden comprises some 400 to 800 people depending on the region under consideration.

Since we assume that individuals should have been exposed to their environment long enough to allow for impacts from these environments, we require their stay in the neighbourhood under consideration to be over the period of 1995–1999. If we produce models for the 100m × 100m grid, that implies that we only take into account those who lived in the same 100m by 100m grid in 1995 and 1999; when modelling at the SAMS level, the requirement was that those taken into account would be living in these small areas in 1995 and 1999; the analyses in which the municipal context was used as "contextual" variable, only included individuals who stayed in the municipality in 1995 and 1999. Table 1 illustrates the reductions of population numbers when these requirements are imposed. As can be seen, the criterion "staying in same context 1995–1999" decreases the number of people less at the municipal level than at the SAMS and 100m by 100m level. In total, 88.0 per cent of the metropolitan adult population aged 20–57 in 1995 meets the criterion of having stayed put in a municipality 1995–99, while 66.3 per cent meets the stability criterion at the SAMS level and 60.7 per cent are non-migrants at the 100m by 100m level. Whether a person migrates or not after 1999 has not been taken into account but Table 1 provides information on this issue as well.

Modelling income

We model income as a context and scale-specific, log-linear multi-level function of personal varying (1995, 1999, 2002) and unvarying characteristics and characteristics of the spatial units in which they reside at the beginning of the period (1999). Symbolically:

$$\ln(I_{99-02jk}) = \alpha + \beta\,[P_{95jk}] + \gamma[P_{99jk}] + \delta [P_{02jk}] + \zeta\,[P_{95-99jk}] + \varphi[P_{99-02jk}] + \theta N_{99ijk} + \varepsilon \quad (1)$$

where:

I_{99-02} = average income from work over 1999 and 2002 observed for individual.[3]
$[P_{95-99}]$ = personal characteristics that can vary over time (e.g. marital or fertility status, educational attainment)
$[P_{95}]$, $[P_{99}]$, $[P_{02}]$ = personal characteristics

Table 2. Number of units and average population age 24–61 in 1999 per metropolitan region.

	Metro area					
	Stockholm		Gothenburg		Malmö	
	No of units	Aver. pop.	No of units	Aver. pop.	No of units	Aver. pop.
100m*	20899	39	8761	32	7170	30
SAMS**	1311	844	1199	357	765	408
Municipality	35	31599	15	29559	15	20829

*100m are the fixed 100m by 100m grids. All grids having less than 10 persons aged 24-61 in 1999 are excluded. **Small Market Statistics defined by Statistics Sweden in cooperation with each municipality.

that may or may not vary (e.g. age in 1995, no. of children under 7 yrs in 1999 and in 2002, parental leave in 1999 and 2002, etc.)
$[P_{95–99}]$, $[P_{99–02}]$ = personal characteristics that change between years (such as marital or fertility status improved educational level, change in household composition)
N_{99} = characteristics at group level (spatial units where the individual resides) in 1999 (a variety of i characteristics will be modelled)
ε = a random error term with the usual assumed statistical properties
j = one of the three scales applied
k = one of the three metropolitan areas

All Greek letters represent parameters to be estimated through Multi-level Mixed Model techniques, with each model stratified for a particular place/scale stratum.

We compare various estimates and coefficients to evaluate the magnitudes of the group level variables (characteristics of the spatial units at various scales), including (standardized) coefficients θ and their statistical significance across various specifications of N within each of nine strata (three metropolitan areas, three scales) as our empirical test. All other control variables in (1) shall remain the same in these trials.

A note on spatial scale

In this study we operationalize neighbourhood at three spatial scales. The 100m grids are comparable in each metropolitan area. Sweden is furthermore divided into 21 counties, 289 municipalities, about 2500 parishes and 9200 SAMS units. The SAMS division was constructed in 1993 but older information can be located to the existing division by use of the more precise coordinates that all real estate property have in Sweden. Local authorities in cooperation with Statistics Sweden delimit the SAMS units. The delimitation praxis is to construct fairly homogenous neighbourhoods in terms of housing types, date of construction and tenure form. However, the praxis varies somewhat between municipalities and it does not mean that areas comprising more than one tenure form are necessarily divided into two or several units. The average population size of a SAMS unit is about 1000 for the country as a whole. The SAMS units have been used frequently in recent Swedish residential segregation studies (Andersson 2000; Andersson and Bråmå 2004; Bråmå 2006) with the argument that they constitute the most relevant formal division available. While the 100m grids are based on arithmetic calculations based on geographical coordinates, SAMS units are constructed for planning and statistical purposes. However, they do not normally play any formal role in the institutional system. Table 2 has the data for the regions in our study.

Returning briefly to our hypotheses and relating them to our operationalizations, we expect the magnitudes of the (standardized) coefficients to be stronger for the 100m by 100m contexts than for the larger geographical units. It is reasonable to expect stronger effects for the SAMS units compared to municipal contexts, partly due to scale but also to the fact that SAMS units can be expected to better encapsulate social networks as they normally do not cut across very different types of residential areas. We expect to find rather weak effects for the municipality level, the reason being that the Swedish state is quite effective in distributing resources and opportunities across urban space: public transportation is of good quality and it is reasonably priced; state labour market re-training and guidance programmes may vary in accessibility and quality but not in a dramatic way; resources are normally allocated according to needs due to the overall political targets of having 80 per cent of the workforce in employment and maximum 4 per cent unemployed.

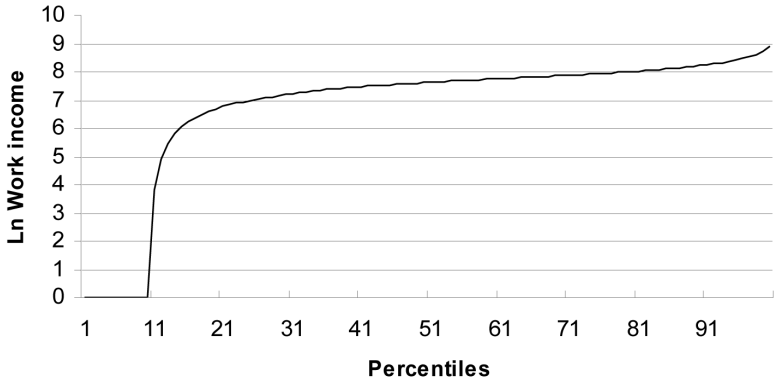

Fig. 1. The percentile distribution of the natural logarithm of Average income from work 1999 and 2002.*
* Work income = 0 has been put to 1 SEK to avoid negative values. Ln 1=0.

Descriptive overview –dependent and contextual variables

Descriptive statistics for the dependent variable income from work are presented per metropolitan region in Table 3 and in Fig. 1. Descriptive statistics for the four group level variables are presented per metropolitan context in Table 4. The percentage of people born in non-western countries varies less between the three regions (from 10.4 per cent for Stockholm to 7.8 per cent for Malmö). Income statistics show that Stockholm compared to the national average has an overrepresentation of people with high income and an average representation of low-income residents. Gothenburg, but especially Malmö, has an over representation of low income residents and an under representation of residents in the higher income brackets.

Figure 2 displays the decreasing variation in demographic and socioeconomic contexts that characterizes a movement from small to larger geographical units. For the 100m, SAMS, and municipality level we have computed the percentile cut points (.10, .25, .50, .75, .90) for two of our contextual variables, percentage of people in the three lowest and highest income deciles groups respectively. Two aspects warrant a brief comment. The first is that the variation, as expected, is much higher at the lowest geographical scale and the variation decreases as the geographical unit gets larger. Secondly, the variation is consistently somewhat larger for the distribution of high income residents than for low income residents, indicating a higher level of segregation for the rich at all spatial levels. Quota between percentile 75 and 25 give the following values. Percentage lowest 3 income deciles: 100m: 2.34; SAMS: 1.90; municipality: 1.38. Percentage highest 3 income deciles: 100m: 3.63; SAMS: 2.26; municipality: 1.32. Ten per cent of the 100m by 100m units have more than 70 per cent of the population belonging to the upper three male income deciles.

Control variables

We operationalize the personal characteristics of individuals with a set of variables describing their demographic and household characteristics, and so forth. These are listed in Table 5. Some brief comments might be helpful. *Pre-retired status* means that a person is recorded to have received an income from an official pre-retirement scheme handled by the Social Insurance office. This could be a part or a full time pre-retirement status. Sweden has the most comprehensive paid parental leave system in

Table 3. Descriptive statistics for the dependent variable 'Average income from work 1999 and 2002' per metropolitan region (income measured as SEK 100).

	Stockholm		Gothenburg		Malmö	
Average income from work 1999 and 2002	Mean	Std dev	Mean	Std dev	Mean	Std dev
	2120.30	1772.72	1877.18	1372.42	1739.49	1323.77

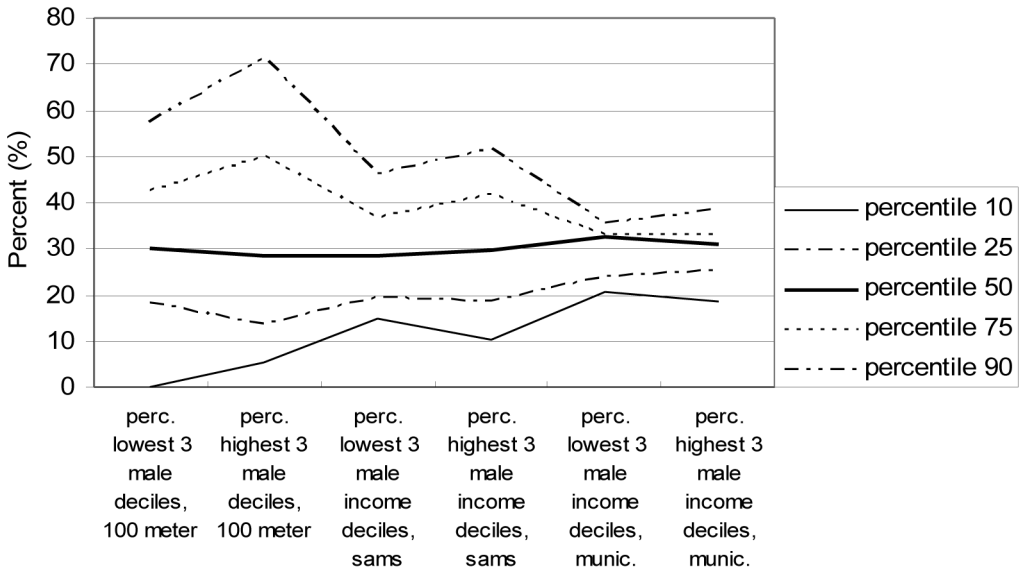

Fig. 2. Distribution of income categories over the 100m by 100m units, SAMS and municipalities in 1999.

the world. Parents are entitled to 13 months of paid leave (80 per cent of the salary) after a child is born and another 3 months of a lower level of benefits. Fathers (or mothers) are obliged to use at least 2 of these 16 months; remaining time can be transferred to either parent. The total time available for each child could be used by the parents until the child is 8 years old, but it is common to use most of the available time during the child's first and second year. Hence, being on *parental leave* does not affect income much but some effects are reasonable to expect. Income varies with age so that the average income rises with age up to age 50, and then declines. We also introduce a dummy in the models indicating if a person is *above age 50* or not. The *educational level* of individuals is classified according to number of years in schooling. A low level means less than 12 years, a medium level is 12–13 years, and a high level is 14 or more years in school. *Upward educational transitions* can thus be either from low to medium or high or from medium to high.

What scale matters: empirical analyses

Multi-level model results

Multi-level modelling often starts with the calculation of a so called null model, or baseline model, which are very helpful for understanding the impact of predictor variables and the impact at individual and group levels (Hox 2002). In that baseline model only the grand mean is fit in the model in such a way that a distinction is made between the random group level effect (the variation between the spatial units at a certain level; for example the variation between SAMS areas) and the individual level effects (within the spatial units). The model results in an overview of how the total variation is divided between these two levels (see Table 6). This also allows for the calculation of the Intra-Class

Table 4. Descriptive statistics for the four neighbourhood variables (1999) per metropolitan region.

	Stockholm		Gothenburg		Malmö	
	Mean	Std dev	Mean	Std dev	Mean	Std dev
percentage unemployed	7.8	1.7	11.8	1.8	14.9	3.8
percentage non-western	10.4	3.6	8.8	3.4	7.8	3.5
percentage in lowest three income deciles	29.9	4.6	31.5	6.4	35.2	7.9
percentage in highest three income deciles	32.2	6.0	27.1	4.4	22.7	6.6

Table 5. Descriptive statistics for control variables (based on total population in selected age groups).

Control Variables	N	Minimum	Maximum	Mean	Std. Deviation
Demographics					
Age in 1995	1403980	20	57	38.05	10.67
Age at least 51 in 1999 (Y/N)	1403980	0	1	0.27	0.45
Household					
No of children under 7 1999	1403980	0	6	0.26	0.59
No of children99 (Incl 18+ at home)	1403980	0	13	0.92	1.09
No of children under 7 2002	1403980	0	5	0.24	0.56
No of children02 (Incl 18+ at home)	1403980	0	13	0.90	1.08
From couple to single 95-99 (Y/N)	1403980	0	1	0.08	0.27
From single to couple 95-99 (Y/N)	1403980	0	1	0.08	0.27
From couple to single 99-02 (Y/N)	1403980	0	1	0.05	0.21
From single to couple 99-02 (Y/N)	1403980	0	1	0.06	0.25
Education					
Education preschool in 1999 (Y/N)	1403980	0	1	0.01	0.08
Education less than 9 yrs in 1999 (Y/N)	1403980	0	1	0.06	0.24
Education 9-10 yrs in 1999 (Y/N)	1403980	0	1	0.13	0.33
Education 12-13 yrs in 1999 (Y/N)	1403980	0	1	0.10	0.29
Education 14 + yrs in 1999 (Y/N)	1403980	0	1	0.25	0.43
Education phd and licentiate in 1999 (Y/N)	1403980	0	1	0.01	0.11
Studying99 (Y/N)	1403980	0	1	0.08	0.27
Studying02 (Y/N)	1403980	0	1	0.04	0.20
Education up from low 95-99 (Y/N)	1403980	0	1	0.01	0.08
Educ up from medium 95-99 (Y/N)	1403980	0	1	0.03	0.17
Education up from low 99-02 (Y/N)	1403980	0	1	0.02	0.15
Educ up from medium 99-02 (Y/N)	1403980	0	1	0.02	0.12
Socioeconomics/restrictions					
Pre-retired 1999 (Y/N)	1403980	0	1	0.07	0.25
Parental leave99 (Y/N)	1403980	0	1	0.19	0.40
Sick99 (Y/N)	1403980	0	1	0.15	0.36
Pre-retired 2002 (Y/N)	1403980	0	1	0.10	0.30
Parental leave 2002 (Y/N)	1403980	0	1	0.20	0.40
Sick02 (Y/N)	1403980	0	1	0.18	0.38

Correlation (ICC), which may be read as a measure of the 'degree of dependence of individuals upon a higher structure to which they belong' (Roberts and Monaco 2006, p. 4). It is also referred to as the percentage of variance in the dependent variable that is associated with the higher (neighbourhood) level. The larger the ICC the more reason to run a multi-level model, because more of the variation might be explained at the higher level.

From Table 6 we learn that the impact of the group level (scale) is potentially higher when the scale is smaller. The right hand part of Table 6 shows us the levels of (un)explained variance after running a model in which all individual predictors were included, except for the four key group level variables *i*. Here too, we can add the individual and group level residuals and use these – together with the information on total variance present in the baseline model – to calculate how much of the initial variance could be predicted by this model. We notice that the set of predictors better explain the variation in income in Gothenburg than in Malmö and also that higher levels of reduction of variance are generally reached at smaller scales. It is also possible to calculate which share of the group level variance was explained at group level by this model. This shows that between 58 and 76 per cent of the variation in income at group level could be explained by the selected individual variables in this model (without key group level variables, which will be referred to in Tables 7 and 8). This reflects the compositional effects.

Table 7 summarizes the core findings of this project. We summarized the findings of the models for each key group variable *i*, each scale *j*, and each context *k*. Since we intended to compare the estimates across scales and across metropolitan contexts, we first standardized our variables before running the model. Of course this does not impact the variation, ICC and t-values, but it provides better opportunities to compare the estimates. These are shown, together with the t-values. Except for a

Table 6. Baseline (null) multi-level models and multi-level models without characteristics of spatial units; (un)explained variance.

	baseline model				model 1jk				
Context	ind level variance a	group level variance b	total variance a+b	ICC b/(a+b)	ind level residual c	group level residual d	total residual c+d	% explained by predictors 1-((c+d)/(a+b))	% explained at group level 1-(((c/nj)+d)/(a/nj)+b)
Malmö									
MUNICIPAL	1.012	0.013	1.025	1.3	0.642	0.005	0.647	36.9	62.6
SAMS	0.967	0.088	1.054	8.3	0.621	0.035	0.655	37.8	59.2
COORDINATE	0.947	0.116	1.063	10.9	0.617	0.041	0.658	38.1	58.1
Gothenburg									
MUNICIPAL	1.031	0.005	1.036	0.5	0.554	0.002	0.556	46.3	60.1
SAMS	0.993	0.109	1.102	9.9	0.546	0.026	0.572	48.1	74.2
COORDINATE	0.977	0.121	1.098	11.0	0.542	0.027	0.569	48.2	70.7
Stockholm									
MUNICIPAL	1.043	0.008	1.051	0.8	0.591	0.002	0.593	43.5	73.0
SAMS	1.052	0.057	1.108	5.1	0.612	0.013	0.625	43.6	76.0
COORDINATE	1.036	0.082	1.118	7.3	0.614	0.020	0.634	43.3	67.4

all multi-level models on the basis of standardised z-scores and n100m>=10
per scale j only those who stayed in the same municipality, resp. SAMS area or coordinate were included
ICC is the share of total variance explained by group level
nj is the average number of individuals at group level (scale) j.
model 1jk (j=1..3; k=1..3) includes individual level predictors at 1 of j scales for 1 of k contexts

Table 7. Standardized estimates and t-values for full multi-level models with characteristics of spatial units (ij).

	model 2ijk								
	Malmö			Gothenburg			Stockholm		
Context	estimate	t-values		estimate	t-values		estimate	t-values	
MUNICIPAL									
% low income	–0.080	–6.788		–0.061	–11.853		–0.041	–9.557	
% high income	0.020	1.480	(p = 0.158)	0.010	1.206	(p = 0.244)	0.003	0.615	(p = 0.542)
% non-western	–0.075	–5.410		–0.051	–5.450		–0.025	–5.572	
% unemployed	–0.056	–2.543	(p = 0.022)	–0.021	–2.410	(p = 0.029)	–0.011	–2.011	(p = 0.052)
SAMS									
% low income	–0.182	–41.270		–0.152	–52.329		–0.106	–53.659	
% high income	0.105	14.930		0.105	23.786		0.062	19.410	
% non-western	–0.171	–27.000		–0.134	–32.324		–0.104	–28.186	
% unemployed	–0.139	–18.943		–0.128	–29.842		–0.071	–19.615	
COORDINATE									
% low income	–0.192	–57.412		–0.158	–63.960		–0.136	–92.164	
% high income	0.101	26.057		0.098	34.527		0.086	50.535	
% non-western	–0.173	–41.534		–0.135	–46.258		–0.111	–62.688	
% unemployed	–0.109	–26.342		–0.104	–35.617		–0.076	–42.416	

all t-values and other values significant at $p < 0.00$ unless otherwise stated
all multi-level models on the basis of standardised z-scores and number of people in $100m^2$ grid ≥=10
model 2ijk (i=1..4; j=1..3; k=1..3) includes predictors for 1 of i key group level variables at 1of j scales for 1of k contexts
group level variables i are calculated per scale j (e.g. % low incomes per municipality)
per scale j only those who stayed in the same municipality, resp. SAMS area or coordinate were included

few that were explicitly mentioned, all parameters are highly significant. What we learn from this table is that there are generally significant effects of the area compositions on individual income, at all scales, although the impact at the municipal level is smallest and in fact there is not a significant relation between the municipal share of high incomes and the individual income level in either of the three metropolitan regions. However, the percentage of low income and share of non-western migrants in the municipality have negative impact on individual income. At SAMS level and in coordinates all

Table 8. Full multi-level models with characteristics of spatial units (ij); (un)explained variance.

	model 2ijk				
context	ind level residual c	group level residual d	total residual c+d	% explained by predictors 1-((c+d)/(a+b))	% explained at group level 1-(((c/nj)+d)/(a/nj)+b)
Malmö					
MUNICIPAL					
% low income	0.642	0.001	0.643	37.248	91.3
% high income	0.642	0.004	0.646	36.939	67.8
% non-western	0.642	0.002	0.644	37.202	87.8
% unemployed	0.642	0.003	0.645	37.022	74.1
SAMS					
% low income	0.621	0.004	0.625	40.711	92.0
% high income	0.621	0.021	0.642	39.105	73.6
% non-western	0.621	0.010	0.631	40.132	85.3
% unemployed	0.621	0.017	0.638	39.504	78.1
COORDINATE					
% low income	0.617	0.008	0.624	41.272	80.9
% high income	0.617	0.029	0.646	39.262	66.4
% non-western	0.617	0.017	0.634	40.383	74.8
% unemployed	0.617	0.028	0.645	39.324	67.2
Gothenburg					
MUNICIPAL					
% low income	0.554	0.000[å]	0.554	46.523	96.8
% high income	0.554	0.002	0.556	46.362	65.3
% non-western	0.554	0.001	0.555	46.481	88.6
% unemployed	0.554	0.001	0.556	46.398	72.3
SAMS					
% low income	0.546	0.002	0.549	50.231	94.9
% high income	0.546	0.013	0.559	49.261	85.5
% non-western	0.546	0.008	0.554	49.701	89.8
% unemployed	0.546	0.010	0.556	49.589	88.7
COORDINATE					
% low income	0.541	0.003	0.545	50.387	86.4
% high income	0.541	0.016	0.558	49.192	77.9
% non-western	0.542	0.010	0.552	49.737	82.2
% unemployed	0.542	0.014	0.557	49.290	79.1

key group variables have significant effects. In all models the strongest effects come from the shares of low incomes and the share of non-western migrants. Highest parameters were reached in Malmö.

In Table 8 a similar type of information as in the right hand side of Table 6 is presented, but here with the model we referred to in Table 7, that is, with the inclusion of the key group variables. These models again should be compared with the baseline and simpler models to understand the impact of the key group variables. We see higher levels of explained variance in all models (highest in Gothenburg). Models in which the share of low incomes is the group variable seem to contribute most to the explanation, both at the individual and at the group level.

In Table 9 the -2 Log Likelihood values (model fit values) are presented for the baseline model, the simple model (model 1) and the full model (model 2). The differences between these values within a scale *j* and a context *k* underline that the models with the share of low incomes, followed by those with the percentage of non-western immigrants, are most powerful in the explanation of the variation in individual income.

There are some interesting outcomes concerning values for the different metropolitan areas. The

Table 8. Continued.

	ind level residual c	group level residual d	total residual c+d	% explained by predictors 1-((c+d)/(a+b))	% explained at group level 1-(((c/nj)+d)/(a/nj)+b
Stockholm					
MUNICIPAL					
% low income	0.591	0.001	0.592	43.691	93.5
% high income	0.591	0.002	0.593	43.532	73.4
% non-western	0.591	0.001	0.592	43.636	86.4
% unemployed	0.591	0.002	0.593	43.554	76.2
SAMS					
% low income	0.612	0.001	0.613	44.680	95.8
% high income	0.612	0.008	0.619	44.108	85.1
% non-western	0.612	0.005	0.617	44.348	89.6
% unemployed	0.612	0.007	0.619	44.133	85.6
COORDINATE					
% low income	0.613	0.003	0.616	44.879	82.7
% high income	0.613	0.012	0.626	44.031	74.1
% non-western	0.614	0.001	0.616	44.938	84.1
% unemployed	0.614	0.013	0.627	43.893	73.3

all group level residuals significant at $p < 0.05$ except å (p=0.202)
all multi-level models on the basis of standardised z-scores and number of people in 100m2 grid >=10
model 2ijk (i=1..4; j=1..3; k=1..3) includes predictors for 1 of i group variables at 1of j scales for 1of k contexts
group level variables i are calculated per scale j (e.g. % low incomes per municipality)
per scale j only those who stayed in the same municipality, resp. SAMS area or coordinate were included
a, b, nj: see model 1jk, table 6
nj is the average number of individuals at group level (scale) j.

contextual effects on individuals' income seem to be stronger in Malmö than in Gothenburg and especially in Stockholm, a finding that holds for all geographical levels.

Turning our attention to our key question and hypotheses concerning the scale issue, it turns out that the effects – as expected– are weakest for the municipality level. Concerning the other two levels, differences in magnitude are not very big but in most cases they support our main hypothesis that effects are expected to be more pronounced at the lowest geographical level, the 100m by 100m context. Exceptions are most clear with the share of unemployed as a context variable; in that case the SAMS level shows more pronounced effects. Apparently, contexts based on the share of unemployed tend to exert most effects on income at a slightly higher scale, between the direct environment of an individual (100m grids) and the municipality.

The higher values for the municipal level in the Malmö region compared to the other two metropolitan regions could be attributed to the fact that patterns of segregation in Malmö do conform more strongly to the municipal level. It could of course also be due to the partly related fact that the size of Malmö municipalities is smaller in terms of geographical and population size than in Stockholm and Gothenburg.

It is beyond the scope of this article to present all parameters for all models. Just for illustration purposes we show the relevant coefficients, t-values and significance levels for the strongest model: impact of the share of the three lowest income deciles in the 100m grid neighbourhood in the metropolitan area of Malmö (Table 10). From the parameters we see that the neighbourhood context has a relatively firm impact on income from work, in magnitude comparable to the effect of having a very low level of education. However, as shown in all tables, the absolute dominant part of the variance in income in 1999–2002 is explained by individual level control variables.

Stigmatization

One of the underlying assumptions about neighbourhood effects relates to the existence of stigmatization, which is primarily a correlated effect. Contrary to most other correlated effects, stigmatization is clearly a phenomenon that might affect

Table 9. Comparison of model fit for baseline models, models jk, and models ijk.

	scale	Malmö -2LL	fit improve model 2 *	Gothenburg -2LL	fit improve model 2 *	Stockholm -2LL	fit improve model 2 *
MUNICIPAL							
baseline 1k		395646	564895	1651552			
model 1.1k		332530	442593	1326205			
model 2.11k	% low income	332511	19	442566	27	1326162	43
model 2.21k	% high income	332528	2	442591	2	1326205	0
model 2.31k	% non-western	332515	15	442578	15	1326183	22
model 2.41k	% unemployed	332525	5	442588	5	1326202	3
SAMS							
baseline 2k		267930	373147	1248461			
model 1.2k		225597	294136	1014155			
model 2.12k	% low income	224967	630	293007	1129	1013021	1134
model 2.22k	% high income	225421	176	293702	434	1013856	299
model 2.32k	% non-western	225183	414	293491	645	1013632	523
model 2.42k	% unemployed	225339	258	293547	589	1013861	294
COORDINATE							
baseline 3k		247465	346283	1116549			
model 1.3k		208797	272691	910177			
model 2.13k	% low income	206707	2090	269906	2785	904242	5935
model 2.23k	% high income	208189	608	271635	1056	907879	2298
model 2.33k	% non-western	207497	1300	271024	1667	907021	3156
model 2.43k	% unemployed	208189	608	271627	1064	908568	1609

*difference between -2 LL values (model 2-model 1);
significant at a value of 42 ($p < 0.05$) or 58 ($p < 0.001$) with 32–3=29 degrees of freedom

people residing at particular addresses and in specific neighbourhoods. We lack precise information about which neighbourhoods might be more affected than others but we have run a test based on the assumption that neighbourhoods selected for state and municipal area-based restructuring efforts are more affected by bad reputation and stigmatization than others. These areas are officially called exposed urban neighbourhoods and they are all characterized by high shares of non-western immigrants, a high share of low-income households and low levels of labour market participation (see Andersson and Bråmå 2004). In fact, that characterization also implies that areas with a high share of low-income households, with many non-western immigrants and with many unemployed may be stigmatized because of that, with potentially more negative impacts on social outcomes. The delineation of the 24 urban districts (109 SAMS areas) in Stockholm, Gothenburg and Malmö that have been targeted by such programmes since the late 1990s follows the SAMS units.

We hypothesize that people residing in the targeted areas suffer more from stigmatization than those who are residing in a non-targeted area. We run our models separately for the targeted and non-targeted areas, but focus on the lowest level (coordinates) only, since at that level the strongest neighbourhood effects are found (see Table 7). A comparison between residents who live in buildings geo-referenced as part of a targeted area with residents who live outside such targeted areas is expected to give us some indication of whether or not neighbourhood effects have a stronger magnitude in areas that can be expected to be highly stigmatized.

We ran the multi-level models (with the natural logarithm of average work income 1999/2002 as the dependent variable) for three particular key group level variables, which are found to be characteristic for the exposed urban neighbourhoods (see above): percentage in the coordinate belonging to the three lowest income deciles, percentage non-western migrants in the coordinate and share of unemployed in the coordinate. We included all three metropolitan areas in this analysis. Table 11 gives the results, all highly significant.

It is interesting to see that, indeed, neighbourhood effects tend to be stronger for people residing in the targeted areas compared to those residing in non-targeted areas. However, there are important differences for different compositions of the areas under consideration.

As expected, the negative relation between the

Table 10. Estimates of fixed effects and significance parameters for model 2.131 (full model 2, % low income as group level variable coordinate level, Malmö).

Estimates of fixed effects (a) standardized variables	Estimate	Std. Error	t	p
Intercept	–0.014	0.004	–3.719	0.000
percent in three lowest income deciles	–0.192	0.003	–57.412	0.000
No of children under 7 1999	–0.047	0.005	–10.325	0.000
No of children99 (Incl 18+ at home)	0.009	0.006	1.412	0.158
Sick99 (Y/N)	0.045	0.003	15.368	0.000
Pre-retired 1999 (Y/N)	–0.266	0.004	–63.143	0.000
Parental leave99 (Y/N)	0.050	0.004	13.094	0.000
Studying99 (Y/N)	–0.100	0.004	–27.577	0.000
No of children under 7 2002	–0.042	0.005	–7.629	0.000
No of children02 (Incl 18+ at home)	–0.043	0.006	–6.652	0.000
Sick02 (Y/N)	0.049	0.003	17.377	0.000
Pre-retired 2002 (Y/N)	–0.253	0.004	–56.775	0.000
Parental leave 2002 (Y/N)	0.080	0.004	19.041	0.000
Studying02 (Y/N)	–0.110	0.004	–31.238	0.000
Age in 1995	0.012	0.005	2.178	0.029
Age at least 51 in 1999 (Y/N)	–0.015	0.004	–3.522	0.000
Education preschool in 1999 (Y/N)	–0.125	0.002	–51.671	0.000
Education less than 9 yrs in 1999 (Y/N)	–0.051	0.003	–18.913	0.000
Education 9–10 yrs in 1999 (Y/N)	–0.049	0.003	–16.148	0.000
Education 12–13 yrs in 1999 (Y/N)	0.035	0.003	10.071	0.000
Education 14 + yrs in 1999 (Y/N)	0.066	0.003	22.166	0.000
Education phd and licentiate in 1999 (Y/N)	0.037	0.003	14.830	0.000
Education up from low 95–99 (Y/N)	–0.019	0.003	–6.049	0.000
Educ up from medium 95–99 (Y/N)	0.012	0.004	3.058	0.002
Education up from low 99–02 (Y/N)	–0.008	0.003	–2.478	0.013
Educ up from medium 99–02 (Y/N)	0.028	0.004	7.636	0.000
From single to couple 95–99 (Y/N)	0.020	0.004	4.830	0.000
From couple to single 95–99 (Y/N)	–0.044	0.005	–9.286	0.000
From single to couple 99–02 (Y/N)	0.022	0.004	5.209	0.000
From couple to single 99–02 (Y/N)	–0.015	0.003	–5.378	0.000

(a) Dependent Variable: Zscore: ln (work income (99+02)/2) avg work income.

share of residents in the lowest three income deciles and income from work turns out to be stronger in targeted (and presumably stigmatized) neighbourhoods than in non-targeted neighbourhoods. A similar effect can be shown for the negative relation between the share of unemployed and income from work – however, with the exception of Gothenburg. Therefore it seems as if the socio-economic composition has stronger impact in targeted areas than in other areas. Gothenburg may be the exception because of low unemployment figures at the time of measurement.

What is more interesting, perhaps, is that the relative share of non-western immigrants in a 100m by 100m square does not appear to have an extra negative effect in targeted areas compared to non-targeted areas. There is a negative relation between the share of non-western immigrants and income from work, but that relationship does not seem to become stronger in targeted areas. This may be a result of special government interventions. Governments give extra attention and provides more resources per capita to targeted areas known for their large share of recently arrived immigrants.

It must be underlined, however, that while we hypothesized and suggested that targeting and stigmatization are interrelated, and play a crucial role in creating neighbourhood effects, we were not able – in this research – to actually test these associations by first-hand data on the level of stigmatization. Neither does the data allow for saying more on causal directions. More research is required.

Discussion and conclusions

In this article we have investigated the impact of scale: what scale matters? By running multi-level models with average income from work as the dependent variables, a range of individual and household characteristics can be observed to affect the dependent variable, but in most cases the neighbourhood context also has a significant impact. For

Table 11. Estimates for the effect of the percentage of three key group variables at coordinate level on average work income 1999–2002, residing in targeted and in non-targeted urban neighbourhoods. Malmö, Gothenburg, Stockholm.

Coordinate-level	Malmö		Gothenburg		Stockholm	
Lowest 3 income deciles	estimate	t	estimate	t	estimate	t
Targeted neighbourhoods	–0.264	–20.683	–0.227	–13.731	–0.163	–29.615
Non-targeted neighbourhoods	–0.148	–40.935	–0.146	–56.177	–0.125	–77.092
Percentage non-western migrants						
Targeted neighbourhoods	–0.123	–13.061	–0.108	–8.753	–0.115	–25.790
Non-targeted neighbourhoods	–0.131	–21.444	–0.132	–37.010	–0.114	–42.985
Percentage unemployed						
Targeted neighbourhoods	–0.132	–6.819	–0.088	–3.617	–0.101	–14.403
Non-targeted neighbourhoods	–0.071	–18.503	–0.092	–31.247	–0.059	–30.780
n in targeted neighbourhoods	12069		4121		33318	
n in non-targeted neighbourhoods	75366		116940		350927	

income from work and for one particular variable – the proportion of low income residents – the smallest environments tend to be most important while other contextual measures, particularly the share of unemployed, appear to have the strongest effects at the SAMS level. The municipal level is found to have less impact for both dependent variables and for all contextual measures. Albeit dealing with different types of social outcome, this result supports the conclusion from earlier studies (Johnston *et al*. 2004, 2005) and it also lends support for those arguing that scale needs to be taken seriously in studies of neighbourhood effects (Dietz 2002; Lupton 2003).

Our study does not allow us to differentiate directly between different types of neighbourhood effects, but if we hypothesize that correlated neighbourhood effects primarily operate at a higher spatial scale the results indicate that such effects are of less importance compared to effects of micro contexts at least in a well developed welfare state of the Swedish kind. Although levels of labour market participation, work income and local taxes differ across Swedish municipalities, the State guarantees that all municipalities have enough resources to fulfil their basic function to provide social services to their citizens. Living conditions do of course vary from municipality to municipality, but they are not radically different. Public transportation is well developed and although urban spatial labour market mismatch does exist, it is not very pronounced (Åslund *et al*. forthcoming). Furthermore, it seems reasonable to assume that endogenous and exogenous effects would be stronger in the immediate surrounding of an individual and our results would thus lead to the conclusion that such effects do exist and that they add to the correlated effects, producing stronger neighbourhood effects at the very local level. In earlier work, we argued that one of the most valid arguments for area-based interventions and anti-segregation policies is the presumed existence of negative effects of spatial concentrations of certain population categories (Andersson and Musterd 2005). If spatial clustering of the unemployed or the poor has an impact upon diminishing opportunities for individuals in such a cluster, targeted assistance might be needed and justified. If spatial clustering of minorities results in poor school results, poorer environment for language acquisition and such like, then compensating such areas, or decreasing barriers for mobility, or restructuring neighbourhoods to achieve social mix might be considered – at least if clustering is basically not by free will. This, however, is easier said than done, since segregation processes are so called strong processes. Especially those who are better-off, who have most choice, will often separate themselves from the rest of the population, with as a result more instead of less segregation. It will be difficult to change these processes, also because the causes of segregation cannot all be controlled by local urban politicians; consequently, other types of interventions may have more effect.

As stated in the introduction, the issue of neighbourhood effects is not only of academic interest; it is a political and social policy issue. In this piece of research we find clues for the scale at which the effects seem to be largest. This may be of some help in the discourse on the development of instruments for intervention, and the development

of policies that aim at overcoming the negative effects, especially at a micro-geography level. We have found strong indications that interventions in poor neighbourhoods are justified; the magnitude of neighbourhood effects is clearly stronger in such neighbourhoods. It is reasonable to argue that this finding supports the stigmatization hypothesis. However, further analysis is required before such recommendations can be formulated rigidly.

We already referred to the need for additional research on stigmatization effects; there are also always questions about the impact of omitted variables – we paid attention to that in a separate study (Galster *et al*. 2008); and there is the issue of self selection effects on the outcomes measured. In this study we have made efforts to reduce the impact of self-selection effects by just focusing on those who had lived in the 100m grids between 1995 and 1999 and by excluding the individual her-/himself when calculating the aggregate contexts. Yet, even though in this study we did not have to overcome problems related to sampling – because we were able to apply the entire population at individual level – and thus issues of statistical significance due to small sample size are not relevant to us, there are quite a few challenges left. These could not all be tackled here. Some receive ample attention elsewhere; others require in-depth study in future research.

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Footnotes

1. The log-linear transformation is appropriate given the positive skew of the variables.
2. We are aware of the fact that labels like western and non-western are contestable. Although these seven categories are all "visible minorities" they indeed comprise a heterogenous group. Most of them are refugees or relatives to refugees and they have dominated the influx of migrants to Sweden since the 1970s. Taken individually, each category scores high or very high on segregation indices but segregation tends to be decreasing especially for people originating in Iran, Chile and Bosnia.
3. Formally, income from work is computed here as the sum of: cash salary payments, income from active businesses, and tax-based benefits that employees accrue as terms of their employment (sick or parental leave, work-related injury or illness compensation, daily payments for temporary military service, or giving assistance to a handicapped relative).

Roger Andersson
Institute for Housing and Urban Research
Uppsala University
P.O. Box 785
SE-801 29 Gävle
Sweden
E-mail: roger.andersson@ibf.uu.se

Sako Musterd
Faculty of Social and Behavioural Sciences
Department of Geography and Planning
University of Amsterdam
Nieuwe Prinsengracht 130
NL-1018 VZ Amsterdam
The Netherlands
E-mail: s.musterd@uva.nl

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