

# Ghettos of the mind: the empirical behaviour of indices of segregation and diversity

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**Summary.** The effect of immigration on social cohesion is a political issue, expressed as a fear that racially skewed residential patterns represent ghettos which prevent integration. Residential patterns have been measured by indices of segregation. The range of indices is reviewed in the paper and measured empirically for England and Wales by using census data for 1991 and 2001, including a new index of migration dispersal. There has been an increase in residential mixing as a result of growing minority populations and their more even spread across localities. These two trends are identified by two commonly used indices of segregation which are moving in opposite directions for the most recent immigrant groups. The sensitivity of each index to modifiable area boundaries makes them unsuitable for evaluation of cities' relative performance. The residential patterns of cities after immigration are more clearly understood by using demographic measures of migration and age structure.

*Keywords:* Ethnic group; Index; Integration; Migration; Race; Segregation

## 1. Introduction

International migration is a feature of a world with national boundaries. This paper reviews the indices that are commonly used to measure the residential patterns resulting from international migration.

Most residents of North America, Europe and probably of much of the world are aware of ancestry originating outside our country of current residence. We respond with a sense of pride in the exotic, complex nature of our identity. But in North America and Europe current international migration is also viewed with suspicion and concern. Concentrations of residents with non-indigenous cultural and family roots have come to be viewed negatively in many a policy arena. In Britain, reports on urban tensions in 2001 noted 'the very worrying drift towards self-segregation, [and] the necessity of arresting and reversing this process' (Ouseley (2001), foreword) and 'the depth of polarisation of our towns and cities' (Cantle (2001), page 9). These reports led to Government insistence that each local authority defuse social tensions by implementing a local 'community cohesion plan'. In 2005, the Government's Commission for Racial Equality felt that in spite of these social policies

'Residentially, some districts are on their way to becoming fully fledged ghettos—black holes into which no-one goes without fear and trepidation, and from which no-one ever escapes undamaged'

(Phillips, 2005). The Commission's head of policy considers segregation as one of the two key problems facing race relations (the other being pervasive inequality):

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'We are also living in a society that is becoming more segregated by ethnic group. This is both residential and social. The census shows us that 80 local authority areas saw both a decrease in the White population and increase in the ethnic minority population between 1991 and 2001'

(Johnson, 2006). Policy concerns regarding race have for centuries inspired applied statistical research (for a review see Zuberi (2001); 'race' is used for convenience, as in 'race relations', and in this paper is synonymous with the use of 'ethnic group'). Indices of residential segregation were developed from the Chicago School's work on intergroup relations, including comparison of racial residential patterns (e.g. Wirth (1928), Duncan and Duncan (1955) and Lieberman (1963)). European and North American urban studies have continued to focus on the same indices and new versions of them. It has been usual practice to associate high values of measured segregation with a lack of social integration that is threatening to the social fabric of society (Fortuijn *et al.*, 1998). This association has not been universal and does not represent an assumption of this paper, but it explains the continuing fascination of geographers and politicians with measuring residential segregation.

Typical of research reports addressing residential segregation, a recent review of English cities for the UK Government uses the index of dissimilarity (which is defined below) to underpin one of its 14 chapters on social, demographic and economic change (Parkinson *et al.*, 2006). The index is used to measure both integration and segregation, which are considered to be at opposite ends of the scale which

'varies in value between 0 and 100, with values under 40 generally considered as low segregation, 40–59 moderately high, 60–69 high, and 70+ very high'

(Parkinson *et al.* (2006), volume 1, page 146). The report tabulates values of the index to compare cities directly, finding for example that 'segregation is significantly higher in cities in the north and west of England'. It identifies change over time for each city by comparing the segregation between electoral wards as they were defined for the 1991 and 2001 census outputs, finding that segregation 'declined between 1991 and 2001 in 48 out of 56 cities' (Parkinson *et al.* (2006), volume 1, page 153). In two cases the increase was significant. These two received adverse publicity for their trend opposite to the general increase in social integration; we shall see that in both cases the publicity was unwarranted because the report ignored the effect of area boundaries and population definitions, which changed over the period.

The index of dissimilarity is one among several indices that are recognized and commonly used in research literature on segregation. After summarizing the demography of ethnic groups in Britain, this paper defines these indices and reviews their use to measure different aspects of residential segregation and diversity. The paper then measures selected indices' values across electoral wards within England and Wales for 1991 and 2001, to assess whether a different dimension of change is measured by each index, and to act as a bench-mark for further empirical evaluation of the indices.

Some interpretations of the indices have been criticized for lack of relevance to the social conditions which should define ghettos, for an offensive focus on numbers of black and Asian people instead of recognition of cosmopolitan realities (Greater London Authority, 2005) for insensitivity to migration which more directly reflects 'self-segregation' (Simpson, 2004) and for lack of relevance to people's choices of housing and aspirations (Phillips, 2006). The association between segregation and negative outcomes has been questioned, citing the social solidarity that is gained in diverse areas, which historically has preceded and enabled integration (Peleman, 2002; Rex, 1981). This paper also interprets the indices but its empirical focus is their proper use to compare areas, to identify low and high levels of segregation and to monitor segregation over time. The paper examines the sensitivity of indices to geographical definition of the areas compared.

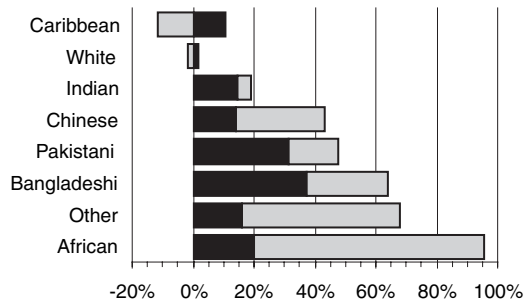


Fig. 1. Population change 1991–2001, England (source: Williamson (2003)): ■, natural change (excess of births over deaths); ▒, net migration

The results are interpreted in the wider context of historical demographic and social change, which suggests that current trends in the ethnic group dimension of residential geography are similar in nature to those following Irish and Jewish immigration (Peach, 1996a). Identification of research priorities focuses on the dynamic processes of population and social change rather than racial geography which indices crudely describe.

## 2. Demographic change

Fig. 1 shows the net contribution of migration and of natural effects (births minus deaths) to population change, for each ethnic group in England between 1991 and 2001. The estimates include an allowance for census non-response in both years. A change in self-definition of individuals could appear as migration in the figure, but the net effect of such changes has been measured and is not sufficient to alter the conclusions that are drawn here from Fig. 1 (Simpson and Akinwale, 2006). The African group nearly doubled in size, the majority of its growth being due to immigration. The Caribbean group, in contrast, lost from migration during the decade. Each minority group grew significantly from natural change because the largest cohorts of immigrants are not yet elderly. The growth from natural change is a greater source of growth than is immigration for the Indian, Pakistani and Bangladeshi populations.

The growth of the non-white populations taken as a whole is confirmed by Parkinson *et al.* (2006) which also showed that it has occurred in every region and every type of city. This growth ‘*in situ*’, which is mainly due to a young population with fewer deaths than births, will help to explain the values of segregation and diversity indices when applied to England and Wales. The growth is characteristic of populations with origins in the post Second World War immigration to Europe. It is in contrast with the black and white populations of the USA for which the indices were developed.

## 3. Indices of segregation and diversity

‘Segregation’ has been used in public debates to express several different ideas. Four distinct concepts are identified below together with indices by which they have been measured: geographical *evenness* of groups, *exposure* to other groups, *movement* towards one’s own group and local *diversity*. Other classifications are possible. The comprehensive and influential review by Massey and Denton (1988) suggested that

‘Viewing segregation as a multidimensional construct will, we hope, encourage research into the many ways that segregation can affect people’s lives. Its effects are easier to imagine in terms of concrete spatial outcomes such as evenness, exposure, concentration, centralization, and clustering, than in terms of the ambiguous idea of “segregation”’

(page 312). They found empirically through factor analysis that indices measuring these five outcomes do represent different dimensions when measured for US cities. *Evenness* and *exposure* account for more than two-thirds of variation between areas in their study and correspond to the first two concepts that are considered below, whereas *concentration*, *centralization* and *clustering* refer to the occupation of physical space, central city areas and contiguous areas respectively and have not so often been used. Instead, the measurement of *movement* and *diversity* is included below, to represent important dimensions of current political debate.

### 3.1. *Evenness: an unequal geographical spread*

Here segregation is conceived as the spread of a group  $g$  relative to the rest of the population  $\bar{g}$ . It is usually measured by comparing the share in each locality  $i$  of the group's total population with the local share of the rest of the population, in the index of dissimilarity ID. The localities' absolute differences in shares are summed and divided by 2 so that the index takes values between 0 and 1.  $N_{gi}$  refers to the population of group  $g$  in locality  $i$ , and summation over an index is represented by the dot symbol:

$$ID = 0.5 \sum_i |N_{gi}/N_g - N_{\bar{g}i}/N_{\bar{g}}|.$$

ID is used so commonly that it is often known simply as *the* segregation index. Any value of ID has a simple interpretation: it is the proportion of the group's population which would have to move areas, to become distributed across areas in the same way as the rest of the population. It may also be used to compare the spread of any two groups, by replacing the locality's share of  $\bar{g}$  (the second term in the formula) with the area's share of a second group  $h$ . Other indices of evenness include the entropy index and the Gini coefficient (Plane and Rogerson, 1994), but these are not common in the literature of residential segregation.

Voas and Williamson (2000) discussed an appropriate downward adjustment of ID when the population of a group is small relative to the number of areas in the region that is under study. Gorard and Taylor (2002) pointed out how the index can be modified when individuals may change from one group to another, as with children's entitlement to welfare benefits. They relate a group's spread through areas to the spread of the whole of the population rather than the remainder of the population. The same modification was used by Dorling and Rees (2003) but is not necessarily suitable for the general use of ID because the modified ID is correlated to the group's overall proportion in the population which itself changes over time.

### 3.2. *Exposure: a high proportion of particular ethnic groups in a locality*

Exposure is the simplest concept, often used in the phrase 'a segregated area'. It often refers to a high proportion of all groups other than white taken together but might equally refer to a specific group—the proportion of Muslims; the proportion of Chinese. It is the growing proportion of ethnic minorities and decreasing proportion of white residents within Britain's cities that has concerned the Commission for Racial Equality, which was referred to in Section 1. Some researchers refer to enclaves of ethnic minorities; Johnston *et al.* (2002) defined mixed and polarized enclaves, the latter being a locality where white residents are less than 30% of the total, and one group accounts for at least two-thirds of the non-white residents. Many similar publications by Johnston and co-workers have also used 'threshold analysis' to display the cumulative distribution function of the group's proportion in the local population, a graphical expansion of the isolation index (Poulsen *et al.*, 2004). All these measures identify localities with relatively large populations of non-white groups and therefore the exposure or lack of exposure of one group to another. These proportions can change independently of the evenness

of a group's residents through localities. Most simply they may increase in all localities with no effect on evenness.

Measured across a city or a whole country, the proportion of a group in the population varies across localities  $i$ . The index of isolation, which is conventionally written  $P^*$ , measures the group  $g$  population as a proportion within the local population, averaged across all the members of that group wherever they live (Lieberman, 1981):

$$P^* = \sum_i (N_{gi}/N_{g.}) N_{gi}/N_{.i}.$$

For each area  $i$ , the left-hand term is the proportion of the group's population that lives there; this weight multiplies the group's proportion within the local population. Like the index of dissimilarity,  $P^*$  has a simple interpretation. It can be usefully thought of as the probability that a member of the group will meet someone of their own group locally. It is equivalently the probability that a member of that group will *not* meet someone of another group, from which the label 'index of isolation' derives. The upper value of 1 for the index of isolation means such high segregation that all members of the group are in areas where no other groups live.

There are many variations of the index of isolation. It can be adapted to represent the isolation of one group from another by replacing the right-hand local area proportion with that for a second group.  $P^*$  is dependent on the overall population composition since larger groups will tend to live with more of their own group.  $P^*$  has a lower limit of the proportion  $P_g = N_{g.}/N_{..}$  and an upper limit of 1. Johnston *et al.* (2004) reduced the dependence of  $P^*$  on population size by computing a 'modified index of isolation' which is equal to  $P^* - P_g$  and which takes values between 0 and  $1 - P_g$ . Full independence from relative population size would require further division by  $1 - P_g$ :

$$\frac{\sum_i (N_{gi}/N_{g.}) N_{gi}/N_{.i} - N_{g.}/N_{..}}{1 - N_{g.}/N_{..}}.$$

Burgess *et al.* (2005) used this form, which White (1986), page 207, showed is equal to the correlation ratio (the proportion of total variation  $N_{..} P_g (1 - P_g)$  which is found between areas rather than within them). Although it is attractive for its independence from overall population composition, this standardized index of isolation was dismissed by Massey and Denton (1988) for confounding the two dimensions of evenness and exposure and for losing the straightforward interpretation of the unstandardized index as the average local proportion of the group. These criticisms can also be levelled at the modified index of isolation of Johnston *et al.* (2004), which in addition remains correlated to population composition.

$P^*$  is appropriate when the group's proportion of local population is relevant, e.g. when the continued use of a second language may depend on the size of the local population that is available to use it. Unlike  $P^*$ , ID is not affected by the overall population composition but only by its distribution through the areas. The two indices can and do change over time in different directions, and as we shall see this is what would be expected after significant streams of immigration.

### 3.3. Movement: migration towards one's own group

Public debate already referred to has made much of the idea of 'self-segregation' and its colour-specific equivalent 'white flight'. The suggestion is that residents of a group are choosing to live with others of the same group. A retreat into one's own localities is not measured by the proportions of people in each group. A retreat into one's own localities is not measured by the proportions of people in each locality but by the extent of movement towards localities that

already have relatively high proportions of one's own group. It is most directly measured by the migration of a group to and from areas in which the group has greatest presence, e.g. by the net migration  $M$  (in-migrants subtracted from out-migrants) of a group away from the localities  $X$  where it is most prevalent, expressed as a proportion of its population in those areas. This is the migration dispersal index  $M$  which is developed for this paper:

$$M_g^X = \frac{\sum_{i \in X} (M_{gi}^{\text{out}} - M_{gi}^{\text{in}})}{\sum_{i \in X} N_{gi}}.$$

For debates about segregation, the net effect of migration *within* the country, after immigration, reflects particular concern. International migration may be of additional interest. The areas  $X$  with greatest presence of non-white population are defined in this paper as those with the highest percentage of non-white population that contain in total a fifth of the non-white population.  $M$  is then measured for each group  $g$ . Migration to and from this fifth quintile can be contrasted with migration to and from the first quintile. The first quintile contains the same total non-white population spread in low proportion across many more areas.

#### 3.4. Diversity: approximate equality of numbers of each group

The diversity of groups within an area may be measured simply by whether the proportion of white residents and all other residents both exceed an arbitrary specified value, say 10% or 25%. The proportion of mixed areas in a region or country gives a simple index of mixing, which was used by Simpson (2005) to show increasing mixing over time in most cities of Britain.

The reciprocal diversity index that has been developed by ecologists shows how close a set of species are to equal numbers within an area:

$$\text{RDI}_i = 1 / \sum_g \left( \frac{N_{gi}}{N \cdot i} \right)^2.$$

Unlike the other measures that are discussed here, the reciprocal diversity index captures the diversity between several groups in an area, appropriately to London's cosmopolitan population where the Greater London Authority (2005) computed the mean index value across electoral wards in both 1991 and 2001 and found increasing diversity over time. The index takes values between 1 and the number of groups  $G$  and can be standardized to the range  $[0,1]$  by deduction of 1 and division by  $G - 1$  as used later in this paper. In the standardized index, the value of 1 represents an equal number of each group in the area. The mean RDI across the areas in a region measures its average diversity.

Indices of diversity are strongly influenced by the classification of groups and by the overall population composition of the region that is under study. A set of groups that are close in population size for the region as a whole will tend to have higher diversity when measured as an average across its local areas.

#### 3.5. Interpretation of indices

The migration index  $M$  is the only measure of the *process* of population change. Even then, the effect of migration on an area is the net result of many factors including housing and economic pressures, social networks and individual motivations which are not directly measured by the index. The measures of exposure, evenness and diversity do not measure the multiple reasons for patterns of residence. Later discussion will refer again to the poor explanatory power of indices. The next sections examine the values of selected indices for areas within England and Wales, and their sensitivity to geographical boundaries.

#### 4. Sources of data and index values for England and Wales, 1991–2001

Racial or ethnic categories are not common in the administrative or population data sets which are used to describe settlement patterns (Social Exclusion Unit, 2000; Coleman and Salt, 1996). The population census in Great Britain has included a question on 'ethnic group' in 1991 and 2001, which is here used to evaluate six of the indices of segregation and diversity, including at least one representative for each of the four dimensions that were discussed above. Ethnic group is self-defined and collected by using a different question in the two censuses. The seven groups that are shown here are those for whom self-definition is most constant over time (Simpson and Akinwale, 2007): white, Caribbean, African, Indian, Pakistani, Bangladeshi and Chinese.

Data for the total population of each ethnic group are derived from Table S06 for 1991 and Table CAST03 for 2001, which are published for all standard areas: council districts, each comprising several electoral wards, which in turn comprise several small output areas (which were named enumeration districts in 1991). They are available to academic researchers through the CASWEB (2006) on-line interface and inform the tables in this paper. Each census was subject to different levels of undercount and to differences in the definition of population affecting students in particular. However, full population estimates are not available to evaluate the effect of these marginal aspects of quality of the data and definition on the values of segregation indices. It is sometimes the marginal changes in indices which draw attention but these can be the result of changing quality of data, as will be discussed later. Data using the ethnic group questions for both 1991 and 2001 are not released for UK local areas outside England and Wales.

Additional data are required for the migration index and are derived from Table KS24 for 2001 (which is available on line from Office for National Statistics (2006a)). The 1991 migration data are available only for districts and not for smaller areas. Migrants during the year before the census are counted. The difference between the numbers of migrants entering and leaving the area has been expressed as a proportion of the area's population at the time of the census. This is a close approximation to the true rates which would be expressed as a proportion of the population in the year before the census, which is not known.

As a preliminary summary, Table 1 shows a threshold analysis of the exposure of the white group to other groups taken as a whole. In part (a) of Table 1, the 376 districts in England and Wales have been sorted according to the increasing proportion of their population recorded in ethnic groups other than white and allocated to quintiles, each of which contains as closely as is possible to a fifth of the non-white population. In parts (b) and (c) the same analysis is repeated for the 8850 electoral wards in England and Wales with mean 6000 residents, and for the 175434 output areas which each contain about 200–400 residents. The totals of each part of Table 1 do not agree exactly owing to the random rounding of small census output cells as part of the Office for National Statistics programme to limit disclosure of potentially confidential information; this rounding particularly affects the statistics for output areas as discussed in the context of migration statistics by Stillwell and Duke-Williams (2007).

England and Wales's population in ethnic groups other than white is clustered. It numbers 4.5 million or 9% of the total, but a fifth of these in the first quintile live spread through 306 local authority districts where they make up 3% of the population. The same number of non-white residents in the fifth quintile live in six districts where they are 36% of the population (Leicester, Bradford, Ealing, Brent, Newham and Birmingham). The same analysis for wards and for output areas in the lower part of Table 1 shows that smaller areas have a greater variation in the white and non-white populations. The clustering is more evident for smaller areas. A fifth of the non-white population reside where their immediate locality (output area) has on average three-quarters non-white population and one quarter white.

**Table 1.** Distribution of population: quintiles of ethnic groups other than white

	Number of areas	Population not white		White population	
		Number	%	Number	%
<i>(a) Local authority districts</i>					
All districts	376	4521050	9	47520866	91
Fewest not white population	306	903385	3	33451363	97
Low not white population	37	863958	11	6820269	89
Medium not white population	16	886917	19	3722401	81
High not white population	11	958149	33	1902498	67
Highest not white population	6	908641	36	1624335	64
<i>(b) Electoral wards</i>					
All wards	8850	4521048	9	47520868	91
Fewest not white population	7554	904007	2	37376562	98
Low not white population	726	903762	13	6077788	87
Medium not white population	288	903894	27	2411771	73
High not white population	180	900383	43	1180437	57
Highest not white population	102	909002	66	474310	34
<i>(c) Output areas</i>					
All output areas	175434	4521162	9	47520754	91
Fewest not white population	136341	904228	2	39052134	98
Low not white population	20892	904189	14	5338139	86
Medium not white population	9511	904272	32	1959102	68
High not white population	5583	904181	51	880345	49
Highest not white population	3107	904292	76	291034	24

Table 2 shows the values of selected indices from each conceptual dimension of segregation, measured across the electoral wards of England and Wales in 1991 and in 2001. In this and subsequent tables the indices of dissimilarity, isolation, migration dispersal and diversity are multiplied by 100 for greater legibility. The number and boundaries of wards are regularly reviewed, resulting in a reduction in the number of wards between the two years from 9509 to 8850, with average population size correspondingly increasing from 5247 to 5880. In the next section these changes will be seen to have some effect on comparisons over time but do not detract from the general picture that is shown by Table 2.

First, evenness, represented by ID, is 59% for the contrast between white residents and all others. It has decreased since 1991, indicating a more even distribution between white and all other residents. ID is greater for each of the individual groups taken separately, because they do not each live in the same places in England and Wales. The groups with the most recent history of immigration to England and Wales, the Pakistani, Bangladeshi and African populations, are most clustered. For every group the average clustering has decreased over the decade, mostly by 2–3 percentage points.

Second, exposure as represented by the index of isolation  $P^*$  has increased for the Pakistani, Bangladeshi and African groups and decreased slightly for the white group. On average, white people live in areas with fewer white people than they did in 1991, whereas Pakistani, Bangladeshi and African people live in areas with more of their own group. This is consistent with the growth of those three populations during the decade (Fig. 1).  $P^*$  for the Chinese group has also

**Table 2.** Indices of segregation and diversity, for wards of England and Wales

<i>Index</i>	<i>Group</i>	<i>Results for 1991</i>	<i>Results for 2001</i>
<i>Evenness</i>			
Index of dissimilarity	White	61.4	58.8
	Caribbean	68.9	67.0
	African	71.1	70.6
	Indian	65.3	62.1
	Pakistani	75.1	71.7
	Bangladeshi	74.2	71.6
	Chinese	42.2	41.3
<i>Exposure</i>			
Index of isolation	White	95.3	93.5
	Caribbean	7.6	7.3
	African	4.3	8.2
	Indian	15.6	15.5
	Pakistani	13.9	17.4
	Bangladeshi	10.9	13.8
	Chinese	0.8	1.2
Number of polarized enclaves		8	8
<i>Movement</i>			
Migration dispersal index (net % moving from non-white areas)	White		2.0
	All others		1.4
Migration dispersal index (net % moving from white areas)	White		-0.1
	All others		-1.1
<i>Diversity</i>			
% mixed areas (with 10% each of white and other)		9	12
Standardized reciprocal diversity index		1.07	1.78

increased slightly from a relatively low level. The high value of  $P^*$  for white people—which is by far the most isolated group—shows again how the index of isolation is strongly related to overall population composition. None of the ethnic minority groups' index of isolation reaches 20%, meaning that each lives in areas where on average more than 80% of the population are from other groups.

The number of 'polarized enclaves' remained at 8 between 1991 and 2001. In these wards white residents are less than 30% of the total, and one group accounts for at least two-thirds of the non-white residents. There is not an increasing tendency toward 'ghettos', measured purely in terms of areas with a single dominant group. If mainly white areas are considered as ghettos, then their preponderance is reducing. The eight polarized enclaves are not the same at each census. Six were of Indian population in 1991 and four were of Pakistani population in 2001, with a shift from London to the north of England.

If the minority populations are increasing in size (some with slightly higher indices of isolation) and their evenness is increasing (slightly lower indices of dissimilarity) then we might

expect that there has been migration away from the existing clusters. The migration dispersal indices in Table 2 confirm this. Both white and non-white residents moved from the non-white areas (the fifth quintile for electoral wards in Table 1), in similar proportion to their population in those areas (2.0% and 1.4% respectively). In absolute numbers, there are fewer white residents leaving than others, because the white population is smaller in these least white wards (Table 1). The index shows that the outward movement is similar relative to the size of each population. When restricting attention to the highest decile of non-white wards (which is not shown in Table 2), the proportional net out-migration is the same for each of whites and others, equal to 2.0% of their respective populations.

Both white and non-white residents moved to the mainly white areas, proportionately increasing the non-white population more than the white population (1.1% compared with 0.1%). This is strong evidence against 'retreat' into own areas, certainly for the non-white population. We could talk of white movement towards white areas, but the similarity of the movement for each group also suggests non-racial explanations such as limited housing in inner cities and movement towards better housing by those who can afford it.

Finally, the proportion of areas which are mixed, with 10% of both white and other populations, grew from 9% to 12% of all electoral wards between 1991 and 2001. The standardized reciprocal diversity index likewise grew slightly. Greater diversity can be seen as a result both of population growth of the minority populations and of their movement away from original settlement areas. In Greater London Authority (2005), only 10 of London's 630 wards were found to have decreased in diversity during the decade. In each case this was because of an increase in the white populations of those wards, not in the black and Asian populations.

Table 3 shows the change in indices of dissimilarity and isolation between 1991 and 2001, for

**Table 3.** Change between 1991 and 2001 in indices of segregation and diversity, for wards in England and Wales and in local authority districts

<i>Index</i>	<i>Group</i>	<i>Change (%) for wards in England and Wales</i>	<i>Change (%) for wards in local authority districts†</i>		
			<i>Median</i>	<i>Lower quartile</i>	<i>Upper quartile</i>
<i>Evenness</i>					
Index of dissimilarity	White	-2.6	-3.4	-6.7	-0.8
	Caribbean	-1.8	-2.8	-7.8	5.1
	African	-0.4	-3.7	-9.6	3.1
	Indian	-3.1	-4.2	-8.3	-0.3
	Pakistani	-3.4	-7.7	-14.9	-3.3
	Bangladeshi	-2.6	-7.5	-14.3	-2.0
	Chinese	-0.9	-3.9	-9.1	1.0
<i>Exposure</i>					
Index of isolation	White	-1.9	-0.9	-1.9	-0.5
	Caribbean	-0.3	0.0	-0.1	0.0
	African	3.8	0.1	0.0	0.2
	Indian	-0.1	0.1	0.0	0.2
	Pakistani	3.5	0.1	0.0	0.3
	Bangladeshi	2.9	0.0	0.0	0.2
	Chinese	0.3	0.1	0.0	0.3

†281 local authority districts with unchanged boundaries have been included.

England and Wales, and also summarized for local authority districts. Only the 281 districts (out of 376) whose boundaries have not changed between 1991 and 2001 have been included.

The median reduction in index of dissimilarity is considerably greater for districts than for England and Wales as a whole and is particularly marked for the Bangladeshi and Pakistani populations. This difference between the measured segregation across all wards of England and Wales, and the average of its values when measured across wards separately in each district, is an example of the effect of changes in the regional boundary, which will be discussed further in the next section. The interquartile range does suggest, however, that the reduction in index of dissimilarity is persistent across most local districts. The populations of Pakistani and Bangladeshi origin (the main Muslim groups in Britain) have in particular become more evenly spread between localities, within districts. However, not too much should be made of the changes over time that are illustrated in Table 3, because they are affected by ward boundary reviews, which are also discussed in the next section.

## 5. Indices' behaviour in response to geographical boundaries

Openshaw (1984) showed that social indicators can take on apparently very different geographical patterns and relationships dependent on the boundaries of the localities that are compared. Three aspects of this modifiable area unit problem are now evaluated with respect to indices of residential segregation and diversity.

### 5.1. Effect of geographical scale

Table 4 shows the same indices as already considered in Table 2, again for England and Wales, for the year 2001. The column for electoral wards repeats the column in Table 2 for ease of comparison, whereas the other columns present the indices' values when considering areas that are smaller than wards (output areas) and larger than wards (districts).

In general, the same patterns are reproduced at each scale, but the clustering of groups is made clearer at smaller geographical scales. The index of dissimilarity shows greater unevenness between smaller areas than between larger areas, and the index of isolation shows that each group lives in greater average proportion in its immediate vicinity than in its wider locality. The average proportion remains below 30% for each non-white group.

The average populations of the different sized areas decrease by a factor of approximately 20 from districts (138409) to wards (5880), and by a similar factor from wards to output areas (average population 297). The increase in both indices is similar when moving between the scales, for each group, suggesting a smooth effect of scale for each index. The exception is Bangladeshis for whom both indices increase noticeably faster when moving to the smallest scale. This is consistent with relatively small localized clusters.

Two results regarding scale are of importance when interpreting the changes over time that are presented in Table 2. First, the effect of scale is greater than the effect of changes over time. For example, the index of dissimilarity changes by between 3 and 16 percentage points when moving from one scale to the next, compared with the decade changes of 2–3 percentage points. Unless the size of locality population is approximately maintained, we cannot fairly compare across cities or countries or across time. For example, the size of the smallest census area in the UK census reduced by a third between 1991 and 2001: comparisons over time of indices that mix these geographical scales will be misleading. Second, the number of wards reduced between 1991 and 2001, such that their average population increased from 5247 to 5880. This change by a factor of 1.1 is likely to have contributed to the reduction in unevenness during the decade that is observed in Table 2, but only marginally and certainly not to account for it all. Since a

**Table 4.** Indices of segregation and diversity in 2001, for different units of analysis, England and Wales

<i>Index</i>	<i>Group</i>	<i>Results for the following areas:</i>		
		<i>Output areas</i>	<i>Wards</i>	<i>Local authority districts</i>
Mean population		297	5880	138409
<i>Evenness</i>				
Index of dissimilarity	White	62	59	52
	Caribbean	72	67	63
	African	78	71	68
	Indian	69	62	56
	Pakistani	79	72	62
	Bangladeshi	88	72	61
	Chinese	75	41	32
<i>Exposure</i>				
Index of isolation	White	94	93	93
	Caribbean	9	7	5
	African	11	8	7
	Indian	20	15	9
	Pakistani	26	17	6
	Bangladeshi	21	14	10
	Chinese	3	1	1
Number of polarized enclaves		839	8	0
<i>Movement</i>				
Migration dispersal index (net % moving from non-white areas)	White	2.3	2.0	0.8
	All others	2.0	1.4	0.6
Migration dispersal index (net % moving from white areas)	White	-0.1	-0.1	-0.2
	All others	-0.4	-1.1	-0.7
<i>Diversity</i>				
% mixed areas (with 10% each of white and other)		20	12	15
Standardized reciprocal diversity index		2.78	1.78	1.99

factor of 20 produced changes of a maximum 16 percentage points, a factor of 1.1 is likely to have produced changes below 0.1 percentage points.

As we would expect, the number of polarized enclaves (dominated by one non-white group) rises rapidly for smaller geographical units because groups are more likely to be the majority in a small residential area. For the same reason, the percentage of areas which are mixed is greater when measured for the smallest areas. However, the percentage of areas which are mixed is lower for wards than for districts, a pattern which is repeated for the standardized reciprocal diversity index. This is almost certainly a consequence of there being many small rural wards with unmixed white population. This depresses the scores of average diversity that are used here, which do not take account of the relative sizes of each locality population.

The pattern of migration away from areas of existing non-white population and towards mainly white areas is reproduced at each geographical scale. The net movement away from

existing areas of non-white population is rather less when measured for districts, suggesting that much of the movement is to other areas within the same districts. The similarity of patterns of migration of white and other residents within the UK that was noticed above for wards is even more evident when measured for either output areas or local authority districts.

### 5.2 Effect of regional boundary

In Tables 2 and 4, the regional boundary within which localities are compared was the whole of England and Wales. In many research studies the regional boundary is a local city area, and the segregation of different regions is compared. *A priori* we might expect some effect on the indices of where the regional boundary is drawn. Manchester local authority for example is bounded tightly around an urban area, whereas Bradford local authority includes a large population in rural areas which are predominantly white. The inclusion of those rural areas is likely to increase the indices of segregation and to reduce the measures of diversity.

Table 5 demonstrates this effect by categorizing the 2001 census output areas as below or above the median population density. The dense half of output areas are the most urban and can be thought of as a tightly bounded urban version of England and Wales. Considering only those areas, the indices suggest less unevenness (a lower index of dissimilarity), greater average pro-

**Table 5.** Indices of segregation and diversity in 2001 in densely populated areas, England and Wales†

<i>Index</i>	<i>Group</i>	<i>Results for all output areas</i>	<i>Results for densely populated half of output areas</i>
<i>Evenness</i>			
Index of dissimilarity	White	62	61
	Caribbean	72	66
	African	78	72
	Indian	69	66
	Pakistani	79	76
	Bangladeshi	88	82
	Chinese	75	70
<i>Exposure</i>			
Index of isolation	White	94	91
	Caribbean	9	10
	African	11	12
	Indian	20	23
	Pakistani	26	29
	Bangladeshi	21	23
	Chinese	3	3
Number of polarized enclaves		839	765
<i>Diversity</i>			
% mixed areas (with 10% each of white and other)		20	31
Standardized reciprocal diversity index		2.78	4.26

†The migration index is not available for dense areas.

portions (a higher index of isolation) and greater diversity within the dense areas. The difference is of the same order as the changes in index values between 1991 and 2001, and affects all indices.

### 5.3. Effect of locality boundaries

In the UK and to a differing degree in other countries, the boundaries of localities that are used for population statistics are reviewed and change regularly. In this section the effect of such boundary changes is discussed with reference to specific areas including the two urban areas that were identified by Parkinson *et al.* (2006) as moving against the trend of decreasing segregation between white and other residents.

‘There are only eight cities . . . where segregation has increased over the past decade. In only two cases was it by a significant amount, Blackburn +0.08 and Norwich +0.06’

(Parkinson *et al.* (2006), volume 1, page 153). Parkinson *et al.* (2006) measured the index of dissimilarity by using the same census data for electoral wards in 1991 and 2001 as have been used in this paper for Table 2.

Table 6 shows the indices of dissimilarity and isolation for four regions, including the Blackburn and Norwich urban areas as defined in Parkinson *et al.* (2006). The first two rows for each region show the measurement direct from the two censuses. The 2001 census output for wards uses the boundaries that were available at the time of output, at the end of 2003. These pairs of values show the increase in the index of dissimilarity that was noted by Parkinson *et al.* (2006) for both urban areas. Their detailed data are no longer available for Norwich, but the slight discrepancy with Table 3 (an increase in ID of 0.04 rather than 0.06) does not affect the conclusions that are drawn here. A decrease in ID is recorded for the other two areas shown, Bradford and Calderdale, as is more general in Britain. Table 6 also illustrates some of the earlier results from this paper. The index of isolation tends to be lower where the proportion of population in groups other than white is low (Norwich). The index of dissimilarity tends to be lower where the

**Table 6.** Index of dissimilarity before and after ward boundary reviews†

<i>Region (mean ward population (%) non-white in 2001)</i>	<i>Year of data</i>	<i>Year of ward boundaries (number of wards)</i>	<i>Index of dissimilarity ID</i>	<i>Index of isolation P*</i>
Blackburn urban area (5900, 15.4%)	1991	1991 (21)	58	42
	2001	2003 (23)	66	53
	1991	2003 (23)	66	44
Norwich urban area (6000, 2.2%)	1991	1991 (51)	23	2
	2001	2003 (40)	27	3
	2001	1991 (51)	27	4
Bradford (15600, 21.7%)	1991	1991 (30)	57	40
	2001	2003 (30)	56	47
	2001	2004 (30)	63	51
Calderdale (10700, 7.0%)	1991	1991 (18)	58	17
	2001	2003 (18)	53	20
	2001	2004 (17)	57	35

†The mean ward population is of all groups from 2001 census output. Each index is calculated from data for electoral wards within the local authority indicated, except Norwich urban area which also includes electoral wards in Broadland. The indices refer to ‘non-white’ groups taken as a whole.

average ward size is relatively large (Bradford compared with Blackburn), but it is also lower when the non-white population is small (Norwich).

Electoral boundaries have changed since 1991 in all four regions. The third row recalculates one of the year's indices by using census data which have been reprocessed to allow comparison over time. In Blackburn and in Norwich the changes were between census output dates. In Blackburn a fair comparison between censuses is achieved by converting 1991 data to 2003 ward boundaries, and vice versa for Norwich.

The increase in index of dissimilarity for Blackburn from 0.58 to 0.66 is seen to be purely a result of boundary changes between the two censuses: there is no change at all when using consistent boundaries. The use of consistent boundaries has reduced the disparity between the Blackburn and national change in index of dissimilarity ( $-0.03$ , from Table 3) from 11 percentage points to 3 percentage points. However, an increase in the index of isolation is still apparent when measured with consistent boundaries, as expected from a growing Asian population.

Norwich presents a different story that further suggests the need for a times series with consistent definition of population categories. Although the number of wards reduced in Norwich urban area, the index of dissimilarity increased between the two censuses. This is contrary to the general expectation of lower dissimilarity with higher ward populations. When 2001 data are recast onto 1991 boundaries for comparison, the increase in unevenness persists. In this case the comparison suffers from a change in definition of population between the two censuses; the 1991 census counts students at their vacation address and the 2001 census at their term-time address. Norwich has a major university so in 2001 the population of the eponymously named university ward had nearly doubled from 1991 and the number of non-white residents in it had trebled. The increase will be partly due to the change in counting method and partly due to a real increase in numbers of students during that period. These were not the changes in social cohesion that the use of a segregation index by Parkinson *et al.* (2006) was intended to monitor.

In Bradford and Calderdale, ward boundaries did not change between censuses. Boundary reviews after the census, in 2004, resulted in higher measured segregation for 2001 when measured for the new localities. One may speculate that in areas of diverse population there is a tendency to redraw electoral boundaries that respect to some extent the visible demarcations of ethnic groups.

## 6. Interpretation and conclusions

Immigration often leads to the established residence of significant new populations with a common overseas origin. The composition of local areas changes over a period of several decades. This section reviews the changes that are highlighted by indices of segregation and diversity, discusses the appropriate use of these indices and the consequences of their misuse, and suggests alternative approaches to measuring local population change.

### 6.1. Population change after immigration

Implementation of indices of segregation and diversity has provided a clear indication of strong trends. The index of dissimilarity has shown a decrease in the unevenness of residence between each ethnic group and the rest of the population. This decrease in unevenness has occurred for all groups but is greatest for the mainly Muslim Pakistani and Bangladeshi groups for whom concern about segregation has been voiced most loudly. This paradox is somewhat explained by the simultaneous growth of visible black and Asian populations throughout England and

Wales. As a consequence the index of isolation has increased for the fastest growing groups, the same Pakistani and Bangladeshi populations. The 'isolation' that is referred to is the average proportion of one's own group across all the areas where the group lives. It does not reach 30% for any non-white ethnic group even when measured for the smallest census areas of 200–400 households. 100% would represent complete isolation from other groups.

The increased ethnic minority population has not resulted in an increase in the number of localities that are dominated by one ethnic group. Instead there are more mixed areas and more diversity. The combination of increased population and increased evenness of distribution is confirmed by migration away from the areas of least white population, towards predominantly white areas. This migration is of the same order for both white and non-white residents. It is noticeable at different geographical scales and from the lowest concentrations of white populations.

Putting these results against the claims that motivate anxieties about the 'colour' of localities, there has not been increased segregation in the sense of more uneven distribution of ethnic groups across localities. Nor is there self-segregation in the sense of minority groups moving towards their existing areas of highest concentration. White flight also appears to be a misnomer; the movement away from the most non-white areas is less for white people than for others in absolute numbers and similar in proportion to their population in those areas.

Historical studies of Huguenot, Jewish and Irish immigration identify very different historical contexts yet show many demographic parallels with more recent immigration that is discussed in this paper. In those historical studies, early clustering has been seen as social solidarity in a strange and largely unwelcoming land, enabling integration and later dispersal as experience increases in the labour and housing markets (e.g. Gwynn (2002), Busteed (2000) and Waterman and Kosmin (1987)).

Whether historically or recently, natural population increase and further chain immigration tend to fill up the original settlement areas, creating pressure on housing for all local residents. Dispersal from these areas is then inevitable, either to neighbouring areas (which has the effect of enlarging the visible cluster) or to areas that are further away, where family resources allow it. Both the growth of population and the dispersal should be expected. It has stabilized for the Caribbean population, is in full swing for the Indian group and will continue for decades for the Pakistani and Bangladeshi groups. In the long run we should not expect a residential melting-pot but more a mosaic (Peach, 1996b). Clusters will remain as with the Jewish population whose main migration to Britain was a century ago. The Jewish population none-the-less has the highest index of dissimilarity in England and Wales among groups defined by religious affiliation recorded in the 2001 census (Dorling and Thomas, 2004).

Other research results support this twin notion of population growth and dispersal, and reject the notion of increasing segregation. This supporting research includes subnational demographic analysis making full use of census data (Salt and Rees, 2006; Simpson, 2005; Simpson *et al.*, 2006) and qualitative work with Asian households (Phillips, 2006; Harrison *et al.*, 2005). The increasing *social* spatial segregation that was found over three decades by Dorling and Rees (2003) may ironically be a reason for decreasing *racial* spatial segregation. New communities not only come of age demographically but also divide along English class lines and migrate accordingly.

In short, the rich data of the population census do not support the much publicized claims of increasing segregation and the creation of ghettos. Instead, the behaviour of the indices of segregation and diversity reflect the demographic consequences of relatively recent immigration streams. The young age composition of immigrants creates an engine for population growth for several decades before the original immigrants become elderly. Greater diversity and more mixed

areas are to be expected, as are many smaller clusters in less urban areas as dispersal becomes more noticeable than population growth. European experience of changing ethnic composition will continue to be multidimensional in the way that is illustrated here for England and Wales because it is also based on recent immigration, in contrast with the residential patterns of the established black and white populations in the USA where segregation indices were developed.

### *6.2. Appropriate and inappropriate use of indices of segregation and diversity*

The pressure for a single index to answer politicians' anxieties about segregation is strong. Even Massey and Denton (1988, 1989), who so forcefully argued for the multidimensional picture of residential patterns which this paper supports, later used a scale of 'hypersegregation' to identify cities that were segregated on all their five dimensions. That approach is not appropriate when it is clear that the indices are changing in opposite directions for some groups.

The two common indices of segregation have straightforward interpretations. The proportion of a group that would have to move to be distributed through localities like the rest of the population (the index of dissimilarity) and the average proportion of a group across all localities (the index of isolation) can be usefully employed to describe respectively the evenness and the exposure of each ethnic group. However, both are crude summary measures of residential patterns and are not amenable to change through policy. They do not describe any of the multiple factors that cause local population change and therefore cannot isolate the particular factors that social policy may be able to influence. In particular, the natural population growth of the non-white populations will continue to keep both indices relatively high, and to push up the exposure indices that reflect population composition. Since policy does not generally ask people to have fewer children or to die younger, this growth is not properly a policy concern. The number of localities with more than any stated proportion of non-white residents is likely to increase for a considerable time (though there are currently no electoral wards with less than 10% white), and certainly as long as population growth exceeds the dispersal from existing areas of greatest immigrant settlement. Is there reason to view these areas as segregated any more than we would areas which are more than a stated proportion white (7771 of the 8850 wards of England and Wales in 2001 were more than 90% white)? To use indices of exposure that are based on the proportion of non-white groups in an area in a normative or evaluative manner seems to be prejudicial to areas on the basis of their colour.

Among the measures that were considered here, the direction of migration may be preferred as a measure of change in residential patterns which does reflect the fluidity of the housing market, which policies can aim to influence. Changes in the indices of dissimilarity and isolation might be better related to population movement if they are limited to cohorts as suggested by a referee of this paper. In that case the segregation of those aged 0–49 years in one census might be compared with the segregation of those aged 10–59 years in the next.

The analyses have shown that the indices are sensitive to regional boundaries, to small area boundaries within the region of study and to the scale or mean population size of the small areas. The effect of each of these modifiable aspects of areal units has been shown in practice to be at least as great as the observed change in the index values over a decade. There are three important consequences. First, there can be no norm for 'high' segregation. Second, a comparison between countries' or cities' segregation is misleading if it is used as an evaluation of performance. Third, a comparison over time is misleading unless referring to consistent boundaries and definitions of population. The lack of such consistency allows extreme changes in the indices to be interpreted erroneously as Section 5.3 showed for a Government assessment of social cohesion in English cities.

Attempts to compare school segregation with neighbourhood segregation are similarly mis-

leading unless they construct and compare equivalent catchment areas. When this is not done, small differences in indices of segregation are woefully inadequate as measures of the effect of parental choice, as used for example by Burgess *et al.* (2005).

### 6.3. *Alternative approaches to measuring local population change, integration and concern with ghettos*

There are many factors which make up the changing geographical distribution of social groups, which can be better measured directly than by the indices that were discussed in this paper. With the exception of the migration dispersal index these indices measure only the pattern of residence rather than the processes that produce that pattern. Demographic methods can model and predict the demographic processes that are expected in populations of young adults associated with immigration. An understanding of this purely demographic pressure on housing is a priority.

But demographic pressure is only one factor in dispersal from poor inner city housing, where economic immigrants are often placed after arrival. Social policy should also aim to understand the importance of family and cultural ties, including the role of shops, services and religious facilities, and the perceptions of safety and suitability of potential destination areas (the environment and type of housing). These are things which Government regional and local policy can affect.

Equality, interaction and participation are three aspects of integration which are highlighted by the Commission for Racial Equality in Britain. Inequality between ethnic groups in the labour market is as great in predominantly white areas in Britain as in diverse inner city areas (Simpson *et al.*, 2006). Census data allow measurement of concentrated poor local social, housing and employment conditions which are an integral part of the notion of a *ghetto* for they identify the economic incapacity of residents to escape. Interaction and participation are perhaps more suited to qualitative studies than to population estimation, although the proportion with mixed ethnic group, which is increasing in Britain (Simpson, 2005) is a measure of the most intimate degree of interaction. There need be no assumptions that interaction and participation will be of the same nature for every person. Sufficient interaction for comfortable, trusted, safe cities is compatible with preferences that maintain social and family networks.

The response of indigenous residents to the changing diversity of their neighbourhood is a further area of political concern which is not well served by any of the indices of segregation and diversity that were examined here. Although this paper has shown that there is not white flight from highly non-white areas, such an analysis could and should go much further. What is the pattern of migration for each group from areas of other concentrations and how may it be explained in terms of economic and social changes and aspirations? Is the net out-migration of white residents more or less than in other areas of different ethnic make-up? To what extent is there avoidance of some areas: less in-migration, rather than more out-migration, as suggested by Brama (2006) for Sweden? Many inner city areas are areas of great 'churn' of temporary residents. Might immigrant populations be the most stable part of those areas?

These various paths which are open for productive research on the changing diversity of urban and not-so-urban localities will take understanding and social policy further than continued focus on segregation indices. In Britain a consistent time series of population estimates would help this research, extending to smaller areas the current experimental tabulations of ethnic group by age and sex for local authority districts published by the Office for National Statistics (Office for National Statistics, 2006b). Current work at the University of Manchester aims to create a consistent time series backwards to link the 1991 and 2001 censuses for ethnic group, age, sex and small localities, in preparation for linkage to estimates of current and future population.

#### 6.4. Conclusions

This paper brings good news from census analysis to suggest that a doom-laden view of increasing segregation and the threat of ghettos is not supported by the evidence. Perhaps we can expect pessimistic insistence on the ethnic dimension of geography to continue. Anxiety about other people's colour and origins has long affected demographic and statistical study and it may be premature to hope for a reduction in the use of crude indices of segregation and the assumption that high values have negative connotations. The statistics in this paper suggest that the anxieties are better seen as ghettos of the mind rather than ghettos of reality.

Analysis of indices of segregation and diversity show more mixing through a natural process of growth of immigrant origin populations and a greater evenness of population distribution. But these indices do not include the poor educational, housing and employment conditions which do deserve concerted attention and which are also shown by the census to be disproportionately associated with ethnic minority populations. Nor do the indices help to mobilize the positive aspects of social networks within residential clusters which support integration in the longer term.

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