The National Deprivation Index
For Health & Health Services Research - Update 2013

Small Area Health Research Unit
Department of Public Health & Primary Care
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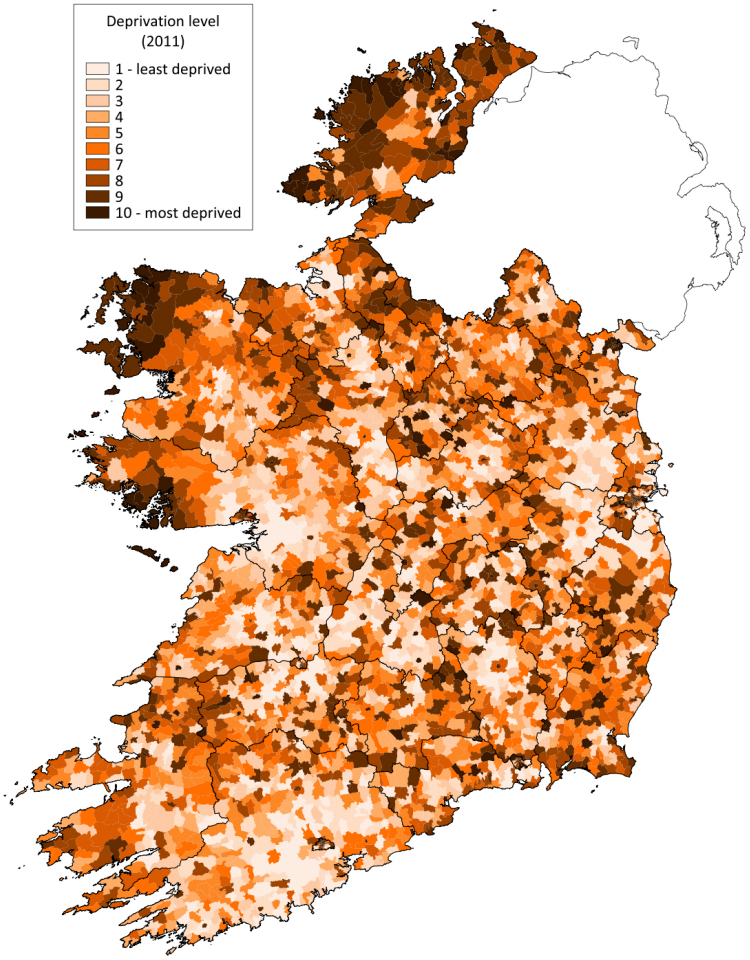

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SAHRU Technical Report

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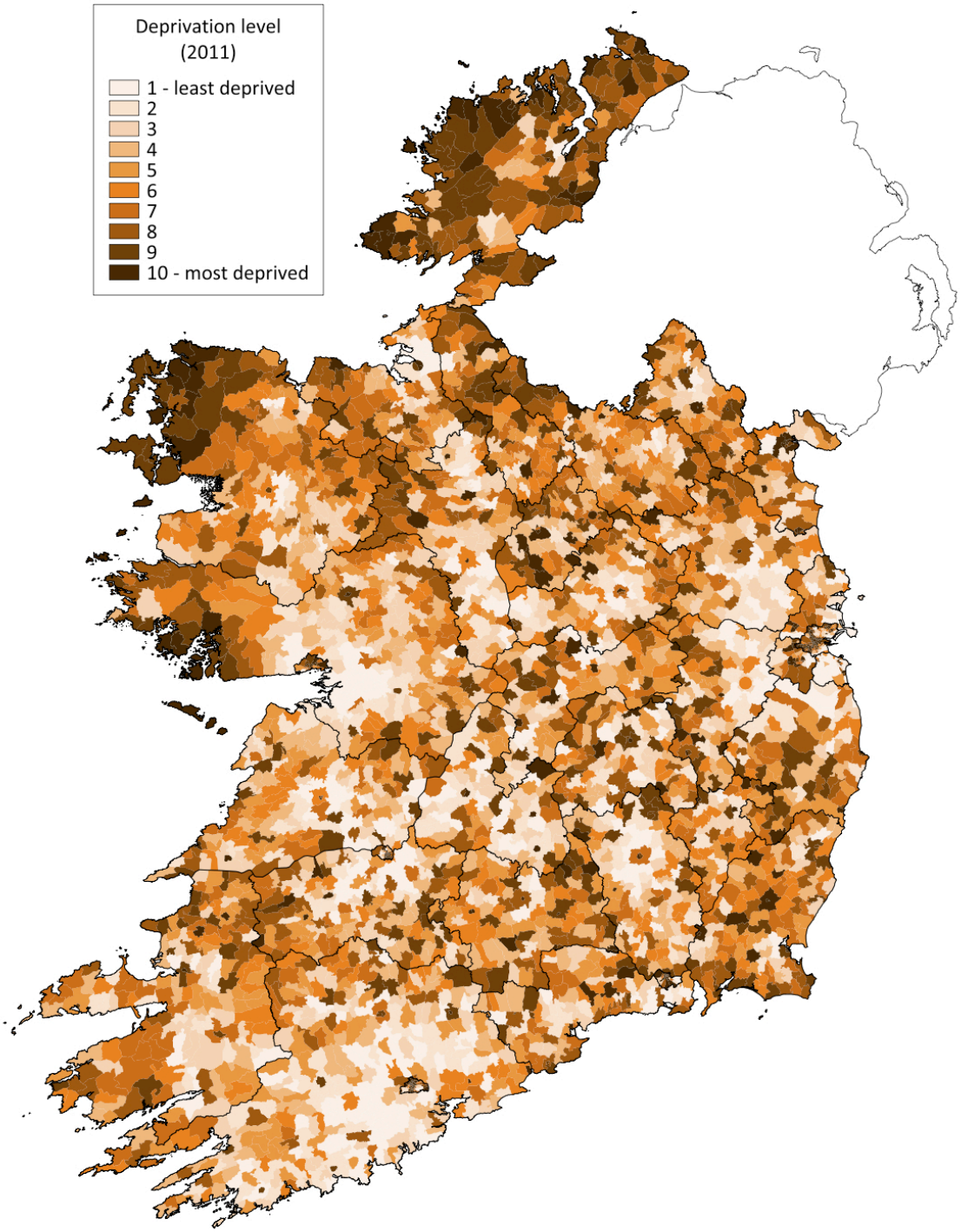
Background

- The Small Area Health Research Unit (SAHRU) at Trinity College Dublin was commissioned in early 1997 by the Directors of Public Health in Ireland to produce the 1st national deprivation index for health and health services research. The index and report was subsequently placed in the public domain. The original version was based on the 1991 Census.
- This report is the 5th in the series of short reports covering the SAHRU Census-based deprivation index at the level of electoral division (3,409 EDs). In addition, this report includes for the first time the deprivation index for the CSO's Small Areas (approximately 18.5 thousand geographically defined subsets of Electoral Divisions). Details of the construction of the the index may be found in the Appendix II. A report on the new Social Fragmentation Index is also available on the web site; this report includes comparisons between the Social Fragmentation index and the Deprivation index.
- A suitable index of deprivation must be based - in the first instance - on an appreciation of the functional role of the index. This requires that a distinction be made between an index of material deprivation and other potential at risk indices. A firm conceptual basis allows for the selection of the relevant individual indicators (subject to their availability in SAPS) - see the Appendix II for details.
- The SAHRU index is similar in design to the widely regarded Carstairs and Townsend indices employed in the UK, with certain modifications in view of differences in definition and scope between census variables in the UK and Ireland.

Important points to note on interpretation

- Do not compare scores over time. An ED with the same score for 2006 and 2011 does not necessarily mean that the indicator profile is unchanged. The score is relative: it is dependent on the national distribution of the 4 constituent indicators which change with time. Comparison of levels between censuses is more acceptable.
- We do not recommend that scores or deciles be aggregated (e.g. to county level). But if you require to do this, then use a population weighted average of decile values (but not the scores).
- Do not use the deprivation index as a proxy measure for poverty. Do use it as a measure of relative material deprivation.
- Do use the scores rather than the deciles for modeling, for example, in calculating correlations.
- Not everyone in a deprived ED is deprived and vice versa. By extension, the 10% most deprived EDs do not correspond to the 10% most deprived individuals!
- The deprivation scale is non-linear, that is, individuals in EDs in decile 10 are not twice as deprived as individuals in decile 5.
- Two EDs with the same deprivation level, need not share the same profile across the constituent indicators. One might achieve a given deprivation level due to high unemployment whereas another might achieve the same level due to a high proportion of local authority housing.



Map 1. Deprivation Index 2011

Results - Deprivation

Maps 1 above and Map 2 below, show the national picture for 2011 and 2006. A visual impression of how deprivation has changed may be seen in Map 3 on page 11.

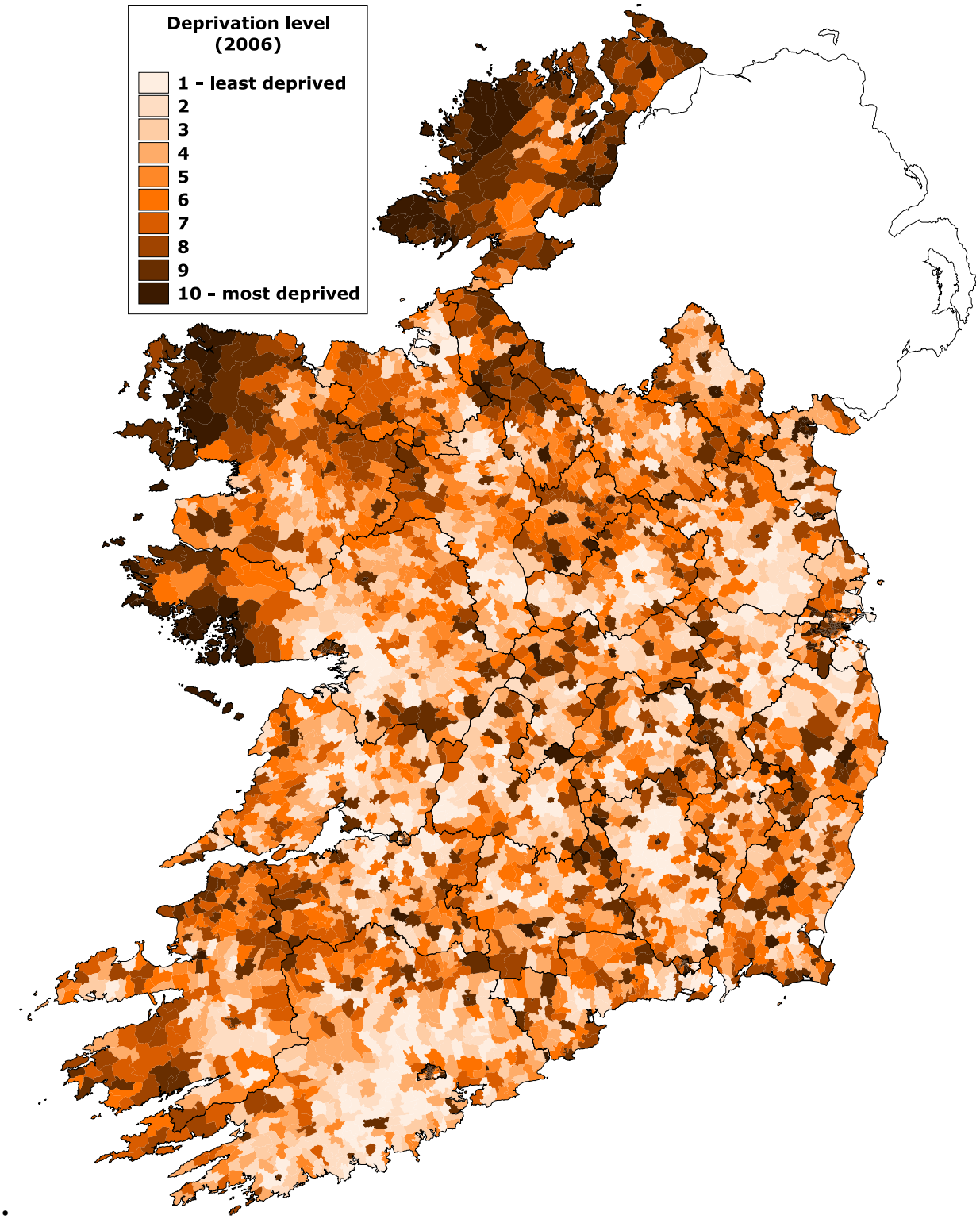
Summary statistics for the 4 variables comprising the index *viz*. unemployment (UE), low social class (SC), local authority housing (LA) and no car (NC) are provided in Table 1 while Table 2 lists the correlation coefficient between each pair of indicators following shrinkage (see Deprivation Report 07 for full details). It will be noted that these are all positive and range from a low of 0.47 (between Social Class and No Car) to a high of 0.67 (between Unemployment and Local Authority housing). All 6 pairwise correlations (corresponding to each off-diagonal cell in Table 1) are highly significant with $p<0.0001$.

Table 1. Summary statistics (proportions) for constituent variables

VARIABLES	MEAN	STD. DEV.	MINIMUM	MAXIMUM
UE	0.112	0.03	0.199	0.298
SC	0.182	0..06	0.0256	0.482
LA	0.054	0.06	<0.001	0.64
NC	0.13	0.11	0.013	0.839

Table 2. Correlation between each pair of indicators

	UE	SC	LA	NC
UE	1.00	0.67	0.62	0.46
SC		1.00	0.56	0.47
LA			1.00	0.62
NC				1.00



Map 2. Deprivation Index 2006

The 1st principal component (PC_1) was computed as follows (with original indicators standardised):

$$PC_1 = 0.51\ UE + 0.50\ SC + 0.52\ LA + 0.46\ NC$$

It is useful to back translate the coefficients associated with the scaled variables as employed in the Principal Component Analysis to the original units as reported in the CSO's SAPS but after shrinkage. Equation of the 1st PC for the unstandardised variables:

$$PC_1 = 14.6\ UE + 8.3\ SC + 7.8\ LA + 4.2\ NC - 4.12$$

It will be seen that proportion 'Unemployed' carries the highest coefficient (14.6) while proportion 'No Car' carries the lowest coefficient (4.2), however, this largely reflects the actual variation across all 3409 EDs in these variables and does not imply a degree of importance.

The distribution of the Index for 2011 as a raw score derived from the 1st PC (prior to grouping into deciles) is graphed in Fig. 1. The score ranges from –3.1 to + 10.0; the median score is slightly less than zero at –0.4. Negative score values correspond to more affluent EDs, while the more positive the score the more deprived the ED. The distribution of this score is highly positively skewed. The blue vertical line marks the range of positive scores corresponding to deprivation index 10 (extending from a score of 1.95 -> 10.0).

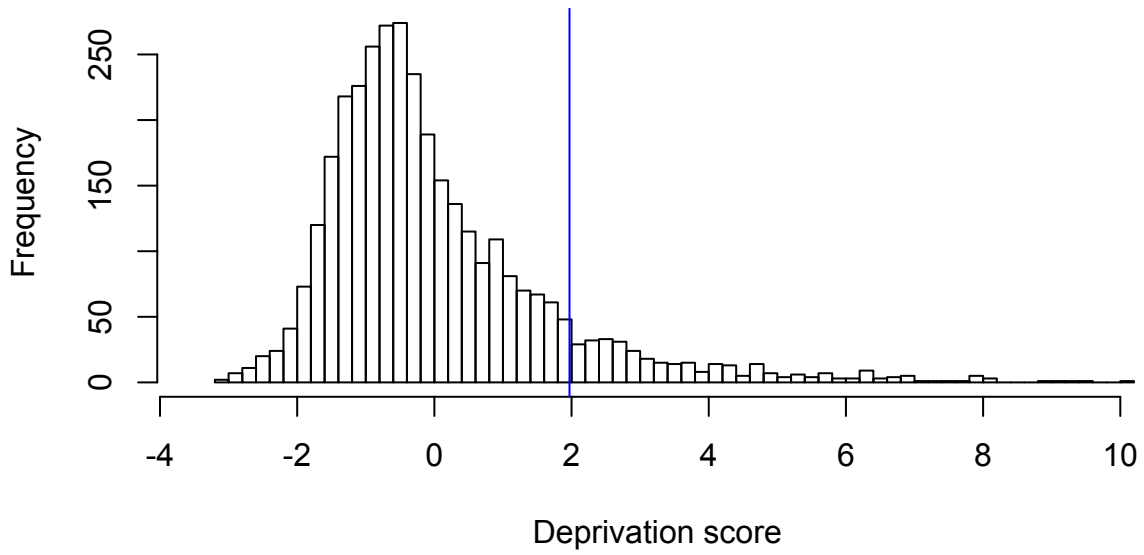


Figure 1. Distribution of Raw Deprivation Score.

What's in a label?

The index is intended to reflect degrees of material (not social) deprivation and the rationale for this was originally set out by Townsend and in the previous SAHRU report (Townsend, 1987, SAHRU, 1997). It is natural to refer to EDs with an index of 10 as 'most deprived' and those with an index of 1 as "most affluent" or perhaps "least deprived". The scale is of course relative, that is, EDs with an index value of 10 have generally higher levels of unemployment, low social class, etc. than EDs whose index value is lower (see Table 3). However, this is not to imply that an ED with an index level of '5' has 5 times more unemployment, etc. as compared to an ED with an index of '1'; the scale in not linear in that sense. EDs that are considered as deprived on this scale may well be far from deprived on another scale (for example, a scale measuring community cohesiveness). And, of

course, it is important to recall that not everyone living in a deprived ED will be personally deprived, and conversely, not everyone living in an affluent ED will be personally affluent – the index is a reflection of the average profile of the ED with regard to the selected factors. Nevertheless, this profile has been shown to be predictive of health outcomes and health service demands.

The typical levels of each variable within each decile of the score is shown in Table 3. Note the progressively increase in proportions from index 1 to index 10 for each variable. The right hand column shows the range of the score (1st principal component - see Figure 1) within each decile. The range for decile 10 is dramatically larger than than for each of the other deciles; evidently the constituent EDs in this decile differ from each other considerably.

Table 3. Median proportions for each variable within each decile

INDEX	UE	SC	LA	NC	SCORE RANGE
1	0.07	0.1	0.01	0.06	1.59
2	0.08	0.13	0.01	0.06	0.34
3	0.09	0.15	0.02	0.07	0.3
4	0.1	0.16	0.02	0.08	0.24
5	0.1	0.17	0.02	0.09	0.25
6	0.11	0.18	0.03	0.09	0.29
7	0.12	0.19	0.04	0.11	0.46
8	0.13	0.21	0.06	0.12	0.61
9	0.14	0.23	0.1	0.16	1.01
10	0.17	0.27	0.16	0.33	8.07

Persons by Deprivation Level

Table 4 shows the population numbers and percentages in each index level. The distribution of the percentages will be seen to be rather higher for levels 1 and 8 through 10 – with the highest percentage in level 10.

In terms of numbers of individuals living in deprived EDs, in 2011 some 18% of the national population lived in the 342 most deprived EDs. This corresponds to 839,012 persons. [NB: as already noted, clearly not everyone living in deprived EDs are themselves deprived and vice versa.]

Table 4. Persons living in EDs by level of deprivation

INDEX LEVEL	NO. EDS	POPULATION	% POPULATION
1	339	554953	12.0
2	341	291950	6.3
3	341	362395	7.9
4	341	347173	7.5
5	341	312364	6.8
6	341	369900	8.1
7	341	381901	8.3
8	341	456651	10.0
9	341	671953	14.6
10	342	839012	18.3

Table 5. Location by Area of the most deprived EDs

Area	No. EDs in Area	Total Population in Area	No. EDs in Decile 10	Population in EDs in Decile 10	% Pop in Decile 10
Waterford City	37	46732	27	27971	59.9
Cork City	74	119230	40	60598	50.8
Limerick City	37	50621	23	25485	50.3
Dublin City	162	527612	70	221488	42.0
Longford	54	39000	8	15921	40.8
Louth	43	122897	7	46089	37.5
Offaly	86	76687	5	27462	35.8
Galway City	22	75529	5	22694	30.0
North Tipperary	80	70322	4	18100	25.7
South Dublin	49	265205	10	66512	25.1
South Tipperary	95	88432	10	22130	25.0
Carlow	54	54612	6	13571	24.8
Wexford	124	145320	12	33728	23.2
Total	3409	4588252	342	839012	18.3
Sligo	79	65393	3	11054	16.9
Donegal	149	161137	23	27161	16.9

Area	No. EDs in Area	Total Population in Area	No. EDs in Decile 10	Population in EDs in Decile 10	% Pop in Decile 10
Laois	97	80559	5	11201	13.9
Monaghan	70	60483	6	7853	13.0
Wicklow	82	136640	4	15702	11.5
Roscommon	110	64065	5	7343	11.5
Cavan	89	73183	4	8131	11.1
Waterford	92	67063	4	7320	10.9
Westmeath	105	86164	3	9092	10.6
Galway	214	175124	9	15513	8.9
Kilkenny	113	95419	3	8111	8.5
Mayo	152	130638	11	10217	7.8
Fingal	42	273991	4	20585	7.5
Limerick	136	141188	5	10513	7.4
Clare	151	117196	5	8285	7.1
Kerry	164	145502	3	10106	6.9
Kildare	89	210312	5	12810	6.1
Leitrim	73	31798	2	1611	5.1
Dún Laoghaire-Rathdown	69	206261	3	10096	4.9
Cork	324	399802	5	17064	4.3
Meath	92	184135	3	7495	4.1

Comparison with 2006 and 2012

Changes in deprivation level between 2006 and 2012 are summarised in Table 5. About 41% of the EDs show no change in level between the two time periods. If we ignore slight changes (up or down 1 level), then the agreement rises to nearly 77%.

In considering these changes (or indeed, lack of change) it should be recalled that coefficients associated with the set of variables in 2006 differ from that for 2012 (as would levels of unemployment, etc.) as noted above. Also, the population in any given ED will have changed to a greater or lesser degree in terms of numbers (inward and outward migration) and socio-economic status and other demographic and social characteristics. With this *caveat* in mind, the ED-level changes are mapped in Map 3 below.

Comparison of persons living in EDs by Deprivation Level

It is of interest to compare the numbers of persons living in more or less deprived areas in 2011 and 2006. The caveat already noted is repeated: it should be borne in mind that not everyone living in a deprived area is necessarily personally deprived and conversely, relatively deprived individuals will be found living in affluent areas.

Table 6. Cross-tabulation of deprivation index for 2011 and 2006

		2006 INDEX										
	Level	1	2	3	4	5	6	7	8	9	10	Total
2011 INDEX	1	219	69	24	18	7	2					339
	2	73	126	69	34	26	10	1	1	1		341
	3	22	70	83	84	43	23	13	3			341
	4	15	35	74	81	61	49	17	7	1	1	341
	5	2	29	54	61	75	60	42	16	1	1	341
	6	6	6	26	42	70	81	73	30	7		341
	7	2	4	8	15	47	76	99	72	18		341
	8		2	2	6	11	37	80	128	73	2	341
	9			1		1	2	15	80	203	39	341
	10						1	1	4	37	299	342
	Total	339	341	341	341	341	341	341	341	341	342	3409

Table 7 and Fig. 3 display the population percentage in each decile of deprivation for 2011 and 2006. The general profile across the deprivation level is broadly similar with a slight rise in percentages in deciles 1, 3, 6 and 9 in 2011 as compared to 2006.

Table 7. Percentage of the population in each decile of deprivation in 2006 and 2011 (NB: Total population in 2011 = 4,588,252 and in 2006 = 4,239,848)

DEPRIVATION LEVEL	%POPULATION 2006	%POPULATION 2011
1	10.9	12.1
2	7.1	6.4
3	6.1	7.8

DEPRIVATION LEVEL	%POPULATION 2006	%POPULATION 2011
4	7.9	7.6
5	8.2	6.8
6	7.3	8.1
7	8.7	8.3
8	10.4	9.9
9	14.4	14.6
10	18.9	18.3

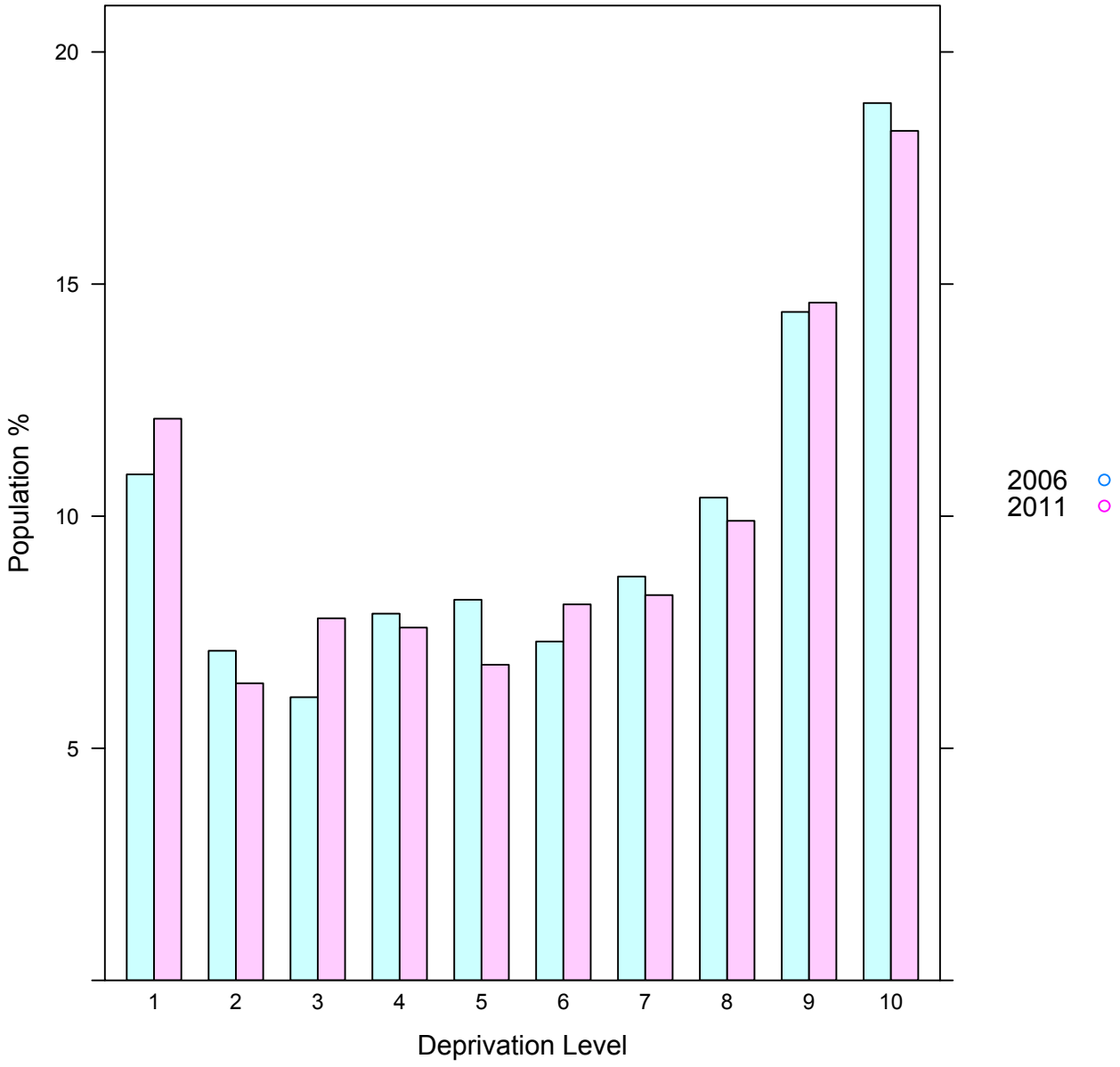
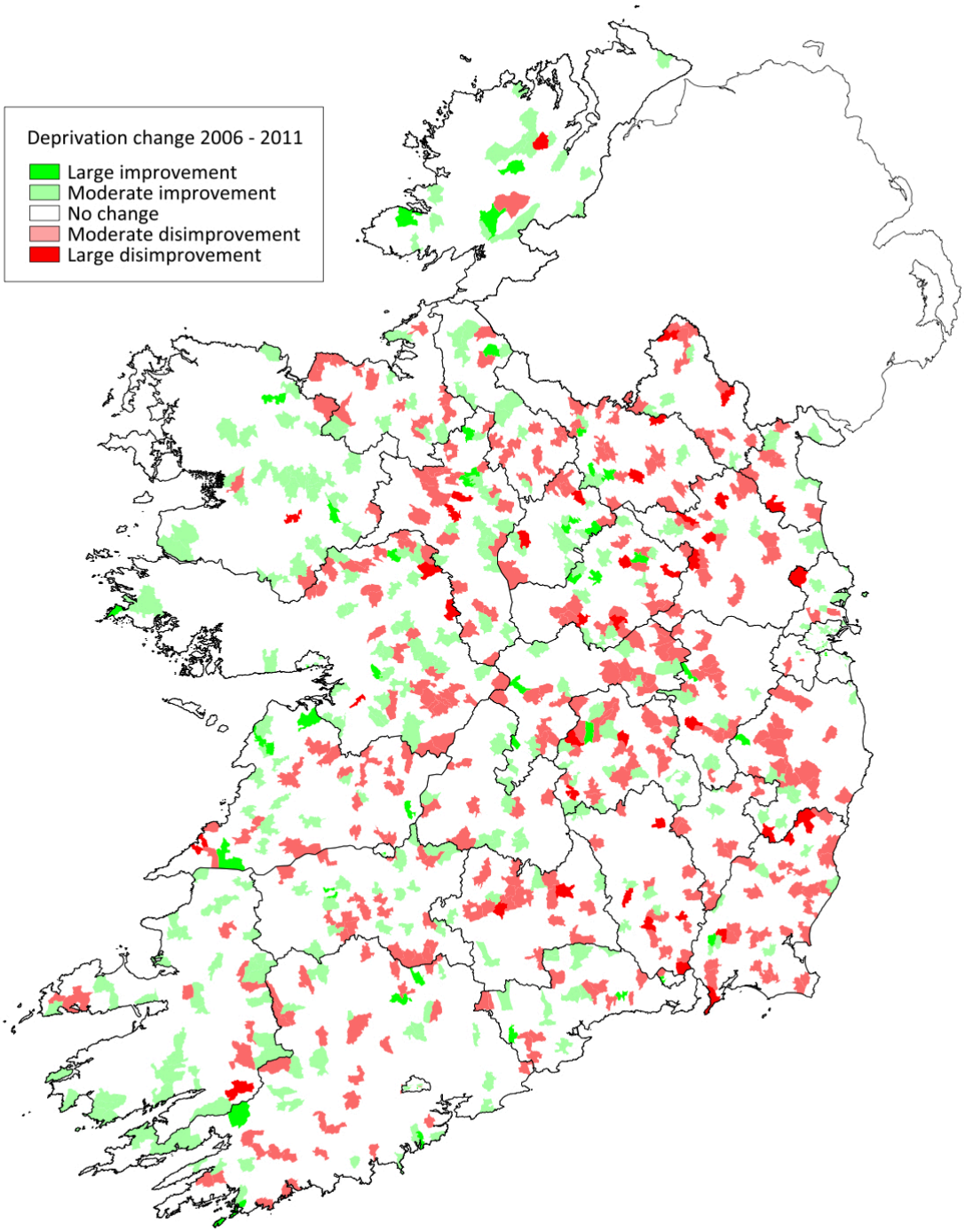


Figure 3. Bar chart of percentage population in each decile of deprivation



Map 3. Changes in deprivation level between 2002 and 2006

Deprivation by Small Area

For the first time, in the 2011 Census, the CSO provided comparable data to that for the 3409 EDs for the 18,488 small areas. EDs were partitioned into SAs with anywhere from 1 SA/ED to 120 SAs/ED. The deprivation index was computed in the same manner as for the EDs for all 18,488 small areas.

Within EDs - particularly for those with several SAs - there can be marked differences in the deprivation levels across the SAs.

For example ED "Carlow Urban" has a deprivation index of 10. It comprises 24 SAs with the following deprivation index distribution: (e.g. 1 SA with deprivation index = 3; 3 SAs with deprivation index = 8, etc.)

1	2	3	4	5	6	7	8	9	10
		1			1	3	3	9	7

The Gini coefficient may be used as a statistical measure of dispersion within each ED based on the differences in the deprivation index computed for the small areas within EDs (http://en.wikipedia.org/wiki/Gini_coefficient) and weighted by the SA population.

A Gini coefficient of 0 implies a perfectly homogeneous ED (i.e. all small areas have the same deprivation level) while a coefficient of 1 implies a perfectly heterogeneous ED (i.e. with all small areas differing in deprivation levels). As some EDs only have 1 SA, there is clearly no possibility for heterogeneity in these. The mean Gini coefficient across all 3409 EDs is 0.11; the maximum is 0.49. Table 8 list the EDs with a Gini coefficient greater than 0.4.

For example, Delgany, with the largest Gini coefficient, has 20 SAs based on the following composition:

1	2	3	4	5	6	7	8	9	10
11	2	2			1		1	1	2

Contrast this with the Carlow Urban with 24 SAs and a Gini coefficient of 0.11. The latter is relatively more homogeneous as compared with Delgany.

Table 8. List of EDs with a Gini coefficient greater than 0.4

ED ID	ED NAME	GINI COEFFICIENT
15032	Delgany	0.49
5007	Ballybrack	0.48
5035	Dalkey Hill	0.47
5068	Stillorgan Priory	0.47
5047	Dun Laoghaire Sallynog-	0.47
5060	Shankill Rathmichael	0.47
5057	Glencullen	0.46
2085	Raheny Foxfield	0.46
5021	Cabinteely Pottery	0.46
5041	Dundrum Taney	0.45

ED ID	ED NAME	GINI COEFFICIENT
5039	Dundrum Sandyford	0.45
4032	Portmarnock South	0.45
17008	Bishopstown C	0.44
3011	Edmondstown	0.44
5043	Dun Laoghaire Glasthule	0.44
6059	Bodenstown	0.44
4014	Blanchardstown Roselawn	0.44
22027	Ballina	0.44
5013	Blackrock Newpark	0.43
10030	Haggardstown	0.43
4034	Skerries	0.43
3016	Lucan Heights	0.43
2090	Whitehall A	0.43
4029	Malahide East	0.43
2028	Botanic B	0.43
11009	Dunboyne	0.43
4019	Donabate	0.43
6064	Downings	0.43
5030	Clonskeagh Roebuck	0.42
2058	Grace Park	0.42
15056	Kilcoole	0.42
5051	Dun Laoghaire Salthill	0.42
3025	Rathfarnham St. Enda's	0.42
4024	Howth	0.42
18081	Caherlag	0.42
5016	Blackrock Templehill	0.42
18295	Cloonkeen	0.42
18086	Douglas	0.41
6034	Celbridge	0.41
6033	Balraheen	0.41
5031	Clonskeagh Windy Arbour	0.41

ED ID	ED NAME	GINI COEFFICIENT
5033	Dalkey Bullock	0.41
21052	Ballysimon	0.41
5034	Dalkey Coliemore	0.41
15005	Bray No. 3	0.41

For practical purposes, the addition of SAPS for SAs is somewhat limited in value is so far as these SAs do not correspond to Townlands and the geographical identifiers provided (e.g. A017011001) are hardly intuitive. The CSO has however provided a map-based interactive search tool to locate Electoral Divisions, Small Areas, etc. and the associated details from the census. This is a sophisticated tool and well worth investigating. See http://census.cso.ie/sapmap/

Appendix I

This is a list of the 50 most deprived EDs nationally starting with the highest score.
NB: all of these are index level 10; the corresponding Deprivation index for 2006 is also listed.

ED NAME	AREA	DEPRIVATION SCORE	POPULATION 2011	DEPRIVATION INDEX 2006
Ballymun D	Dublin City	10.0	2961	10
John's A	Limerick City	9.4	863	10
Ballymun B	Dublin City	9.3	4012	10
Knocknaheeny	Cork City	9.2	4301	10
Galvone B	Limerick City	8.8	878	10
Ballybeg North	Waterford City	8.1	2789	10
Shortcourse	Waterford City	8.1	274	10
Larchville	Waterford City	8.0	942	10
Mayfield	Cork City	8.0	2890	10
Tallaght-Killinardan	South Dublin	7.9	3915	10
Custom House	Limerick City	7.9	570	10
Priorswood B	Dublin City	7.9	2673	10
Blanchardstown-Tyrrelstown	Fingal	7.8	2112	10
Ballynanty	Limerick City	7.8	2918	10
Gurranebraher C	Cork City	7.4	979	10
Clondalkin-Cappaghmore	South Dublin	7.3	2605	10

ED NAME	AREA	DEPRIVATION SCORE	POPULATION 2011	DEPRIVATION INDEX 2006
Killeely A	Limerick City	7.1	1445	10
Longford No. 1 Urban	Longford	6.9	3163	10
Glentworth C	Limerick City	6.9	524	10
Merchants Quay A	Dublin City	6.9	2275	10
Ballybough A	Dublin City	6.8	3482	10
The Glen A	Cork City	6.8	2354	10
Rathbane	Limerick City	6.7	1567	10
Tallaght-Fettercairn	South Dublin	6.7	7607	10
Mountjoy A	Dublin City	6.7	5326	10
Wood Quay A	Dublin City	6.6	2669	10
Morrisson's Road	Waterford City	6.6	508	10
Rathmichael (Bray)	Wicklow	6.5	2380	10
Royal Exchange B	Dublin City	6.4	1914	10
Mountjoy B	Dublin City	6.4	2732	10
Newport's Square	Waterford City	6.4	556	10
Ballymun C	Dublin City	6.3	5585	10
Clondalkin-Rowlagh	South Dublin	6.3	4058	10
Roanmore	Waterford City	6.3	814	10

ED NAME	AREA	DEPRIVATION SCORE	POPULATION 2011	DEPRIVATION INDEX 2006
Prospect B	Limerick City	6.3	751	10
Priorswood C	Dublin City	6.2	4491	10
Inns Quay C	Dublin City	6.2	2709	10
Farranferris A	Cork City	6.2	1812	10
John's B	Limerick City	6.1	976	10
Mount Sion	Waterford City	6.0	747	10
Cherry Orchard C	Dublin City	6.0	4551	10
Finglas South C	Dublin City	5.9	2507	10
Ushers E	Dublin City	5.9	1830	10
Killeely B	Limerick City	5.8	810	10
Rotunda A	Dublin City	5.8	4698	10
Ushers C	Dublin City	5.8	3730	10
Lisduggan	Waterford City	5.8	1052	10
Abbey C	Limerick City	5.7	509	10
Gurranebraher B	Cork City	5.7	565	10
Blackpool A	Cork City	5.6	663	10

Appendix II

Deprivation has been defined by Townsend as a state of "observable and demonstrable disadvantage relative to the local community to which an individual belongs". (1) The idea has come to be applied to conditions (i.e. physical and social circumstances) rather than resources or income and can therefore be distinguished from the concept of poverty, though the two are closely related. This conceptualisation can explain why people can experience deprivation but do not necessarily live in poverty. In the original (1997) SAHRU report on the development of the national deprivation index we set out a rationale for the choice of 5 variables from the SAPS data on which to base the index (2,3) The following is based on that report describing the constituent variables. It should be noted that minor, but not necessarily unimportant changes have occurred in the way the CSO provide information in relation to two of these variables, i.e. 'unemployment' and 'overcrowding'. The past definition is presented alongside the current for clarity.

Indicators considered for the national deprivation index

As originally developed, a total of five census based indicators, widely believed to represent or be a determinant of material disadvantage, were considered for possible inclusion in the SAHRU Deprivation Index. (1) These were:

Unemployment
Low social class
No car
Rented accommodation
Overcrowding

The rationale for choosing each indicator is given below.

Unemployment (UE)

Unemployment reflects lack of access to earned income and the facilities of employment. Moreover it may impose other pressures on individuals through loss of self-esteem, and on families through problems and tensions generated.

The 'unemployment' indicator is:

Proportion of the economically active population (15 years or older) unemployed or seeking a first time job.

[NB: Previously this read: Proportion of the economically active population (15 – 64 years of age) unemployed or seeking a first time job.]

Low Social Class (SC)

The Irish Social Class Scale is an ordinal scale from 1 (higher professional) to 6 (unskilled manual). It is based on the concept of groups whose members possess capacities for the generation of income through their occupations, not the status/prestige associated with particular occupations. A social class code of seven is assigned to people who can not be assigned to any of the other six groups. Being in a low social class — i.e. Class 5: semi-skilled manual occupations (including farmers farming less than 30 acres) and Class 6: unskilled manual occupations — reflects earnings at the lower end of the income scale. Low income limits access to material resources and the ability to make choices in life.

The 'low social class' indicator is:

Proportion of population (social classes 1 to 6 only) in social class 5 or 6.

No Car (NC)
Car ownership has been suggested as a surrogate for current disposable income. Apart from the cost of purchasing a car there are the necessary licensing, insurance, maintenance and repair costs, as well as day-to-day running expenses. Car ownership also confers benefits in terms of access to other resources. It might be argued that in city areas, with good access to public transport services, owning a car is not a necessity. Nevertheless despite the availability of public transport ownership of a car appears to be something that many households do wish to achieve. This may be a reflection of the inconvenience and/or limited scope of public transport as well as the prestige associated with owning a car. In rural areas car ownership is more of a necessity and its value as a discriminator between affluent and deprived areas may be diminished.
The following 'no car' indicator has been used:
Proportion of permanent private households with no car.

Local Authority Rented Accommodation (LA)
Non-owner occupation has been suggested as a surrogate for income in the long term. Taken together with car ownership these two indicators are likely to provide a fairly good reflection of income levels in different areas.
The 'rented accommodation' indicator is:
Proportion of permanent private households rented from a local authority, or in the process of being acquired from a local authority

Overcrowding (OC)
Overcrowded accommodation reflects living circumstances and housing conditions. It may also reflect wealth as people in overcrowded circumstances are likely to wish to improve their circumstances provided financial resources are available.
For purposes of the 2006 and subsequent indices, the 'Overcrowding' indicator has been dropped. This decision was taken in view of the comparative lack of variation in overcrowding across EDs nationally as reported in recent censuses. As a consequence, 'overcrowding' no longer serves adequately as a discriminator between affluent and deprived EDs.

Steps in index construction
Given the 4 indicators measured on 3,409 EDs, the task is to reduce the dimensionality of these data whilst preserving as much of the original information content as possible. For example, if the original 4 indicators can be combined into a single index then this would constitute a more manageable model, provided the reduction in dimensionality is not at the expense of excessive information loss as we discuss below. In our previous report on deprivation we employed a population weighted Principal Components Analysis (PCA) (2), that is, the contribution of each ED to the PC model was weighted by the population size of the ED. This practice is typical in the statistical analysis of areal (i.e. geographically aggregated) data. An obvious consequence is that EDs with larger populations (i.e. urban areas) are inevitably more influential in the formation of the model. Since the 2002 Census and the corresponding update to the SAHRU index (4) and having regard to recent developments in the construction of deprivation indices for England & Wales, Scotland and Northern Ireland an alternative approach was employed, namely 'shrinkage' (5). This latter technique is intended to reduce the impact (on the model parameters) of EDs with quite small populations prone to exceptionally large swings in levels of unemployment, or low social class, etc. In such populations, a very slight

change in absolute numbers (for example, in numbers unemployment) can result is a very large shift in the corresponding proportion. To remedy this, we computed an adjusted estimate for all EDs for each constituent indicator such that EDs with small populations had their proportions 'shrunk' towards the respective county average.

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