

Index of Multiple Deprivation for Wales

Final Report



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Consultation

The Oxford Team have welcomed comments throughout the project. Two newsletters were sent out, and a project web site was maintained with further details about the project. The Oxford Team would like to thank all of the respondents who have contributed to the consultation process.

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PROPOSALS FOR THE NEW WELSH INDEX OF MULTIPLE DEPRIVATION

1 Background

1.1 At least since the mid 1960s the aim of creating an index (or indices) to measure deprivation at the local level, to identify priority areas and target programmes more effectively, has been a consistent feature of government policy. At times these indices have been concerned with specific areas of policy – education or health for example, but since the 1980s the idea of a national index of ‘multiple deprivation’ at the local level has become a central concern. The availability of the national decennial census in an electronic form with data from the enumeration district (ED) through to national level clearly contributed to this development.

1.2 In 1999 the Welsh Office, subsequently superseded by the National Assembly for Wales, invited tenders for a revised Index of Deprivation for Wales. As a result of this the Oxford University team was invited to produce a new Index of Multiple Deprivation. The previous Welsh Index of Social-Economic Conditions used 8 ward-level indicators, based on 1991 data. This was originally prepared to meet the needs of targeting the urban regeneration funds. As such, it was not concerned with a more widescale review of urban and rural deprivation.

1.3 Since the previous Index was created, new methodologies and sources of data have become available which are considered to be in some respects better and certainly more up to date than the Census data, or the ‘z score’ statistical approach (explained below). Increasingly there is the possibility of examining deprivation at small area level with greater accuracy.

2 Objectives and Key Questions

Objectives

2.1 The stated purpose for the Index of Multiple Deprivation for Wales is to identify levels of deprivation throughout Wales and use the results to inform the targeting of regeneration programmes on specific areas. This, as will be shown, meant devising an Index which will allow areas with the highest concentrations of deprived people or households to be identified. It is clear that the Index may be used in other policy areas to target resources on the most deprived areas. This presented a particular challenge in designing the Index.

2.2 ‘Multiple deprivation’ is an exceedingly difficult concept to define and measure. The previous Index of Social-Economic Conditions had to capture this complexity primarily by using the decennial census, as the only comprehensive national data available in a consistent form at small area level.

2.3 The aim of the new Index was to move further towards more *direct* measures of deprivation at the small area level, by making use of new sources of national administrative data. The conceptualisation of ‘multiple deprivation’ is as a composite of different dimensions or ‘domains’ of deprivation. The new data enabled a

description of these ‘domains’ with more precision, and in a more robust and consistent way than has been possible before. This new development allowed the conceptualisation of Domain Indices to summarise the individual aspects of deprivation which can be used individually and combined to identify concentrations of multiple deprivation on which to target area based policies.

2.4 A further objective of the Index is to be a building block for future small area deprivation analysis. It is conceived as a dynamic Index, capable of being regularly updated with the advent of new and robust data sources. Proposals for future improvements are outlined in the ‘Future Work: Recommendations’ Section.

Key Questions

2.5 Moving forward from these general objectives to measuring ‘multiple deprivation’ effectively at the local area level requires a range of questions to be addressed.

- First, the question of what is meant by ‘multiple deprivation’, and how it might be measured at any level must be addressed.
- Second, on the assumption that ‘multiple deprivation’ is some composite of *specific* deprivations, the way such information is to be combined to create an overall index must be considered. Should the Index’s components be equally weighted (often implicitly the case in earlier indices) and if not, what counts as more important – how are the weights derived?
- Should lack of deprivation in one domain cancel out or mitigate the effects of another domain?
- How are the different spatial levels (e.g. Unitary Authorities and Electoral Divisions) to be related, particularly if there are different sets of information collected at different spatial levels?

3 The Nature of Multiple Deprivation

Multiple Deprivation

3.1 In some of the discussions of ‘multiple deprivation’ there has been a danger of reifying this term, as if it represented an *separate* form of deprivation, that could, in principle, be *directly* measured, if only such a measure could be discovered. Simple aggregation of a set of components might be held to support this approach (they all add up to ‘multiple deprivation’). The working assumption, of this review, however, was that ‘multiple deprivation’ is not some separate form of deprivation. It is simply a combination of more specific forms of deprivation, which themselves can be more or less directly measured. It is an empirical question whether combinations of these different forms of deprivation are more than the sum of their parts, that is, they are not simply additive but interact and may have *more* impact, if found in certain combinations.

3.2 This perspective has no problem with varying combinations of deprivation and disadvantage in different types of areas, a persistent finding on the geographical distribution of different forms of deprivation and disadvantage since the pioneering work of Richard Webber in Liverpool in the 1970s. But it does raise questions about the simple addition of items to form an Index of ‘multiple deprivation’. And if multiple deprivation cannot be *directly* measured then there are problems in technically validating any overall Index, because technical validation requires something against which the Index can itself be measured. If this is correct, then the question of how components in the overall index might be weighted rightly becomes a central issue that must be faced.

Multiple Deprivation and Poverty

3.3 ‘Poverty’ and ‘deprivation’ have often been used interchangeably, but many have argued that a clear distinction should be made between them. It can be asserted that the condition of poverty means not having enough financial resources to meet needs. Deprivation on the other hand refers to unmet need, which is caused by a lack of resources of all kinds, not just financial. Atkinson notes that in recent debates on ‘Social Europe’, the terms poverty and social exclusion have been on occasions used interchangeably, but defines poverty as a ‘lack of money or material possessions.’¹

3.4 Townsend also distinguishes between poverty and deprivation: people can be deprived if they lack the material standards of diet and clothing, and do not participate in employment/recreation. If they lack the financial resources to obtain these conditions of life they are in poverty. He writes that ‘while people experiencing some forms of deprivation may not all have low income, people experiencing multiple or single but very severe forms of deprivation are in almost every instance likely to have very little income and little or no other resources’.² Thus deprivation hinges on the level of conditions/activities experienced, and poverty on the incomes and other (material) resources available to the individual or household. A distinction has also been made between ‘material’ and ‘social’ deprivation: people may not have material

¹ A. B. Atkinson and J. Hills (eds.) *Exclusion, Employment and Opportunity* (1998, London School of Economics Centre for Analysis of Social Exclusion).

² P. Townsend, ‘Deprivation’, *Journal of Social Policy*, 1987, vol. 16, part 2, pp. 125-146, p. 131.

goods, facilities and amenities. On the other hand they may not have access to ordinary social relationships and activities. Townsend notes that if there are these different forms of deprivation, then some people may experience several forms of deprivation and others only a single form.

Individual, Household and Area Level Deprivation

3.5 Measuring different aspects of deprivation and combining these into a single Index raises a number of questions about the links between different forms of deprivation at the individual, household and area level. First, how far do individuals and families experiencing deprivation in fact cluster together geographically, and how far are other individuals and families who are *not* experiencing deprivation affected by the overall level of deprivation in their area? Though much of the data collected may, in the final analysis, be based on individual or household levels of deprivation, the results in any index are likely to be presented in the form of an aggregate score for that area. But this will combine deprivations experienced by many *different* groups within that area. Finally there are several forms of deprivation that may be difficult to attribute on a precise geographical basis. Thus some aspects of crime, e.g. city centre vandalism or offences against vehicles in the city centre might legitimately be attributed to the areas of those who lived elsewhere, on the grounds that they were potentially at risk if they work or shop in the city centre.

The way forward

3.6 First, this brief debate on poverty and deprivation has underlined the importance of the financial component in any overall scale of deprivation. This theme runs through the approach to multiple deprivation taken in this review and is the basis for weighting the components in the overall Index.

3.7 Second, the debate also confirms the idea of separate forms of deprivation differentially experienced by different groups. For this reason the idea of separate ‘domains’ of deprivation has been developed. The methodology adopted focuses on the creation of a series of robust Domain Indices - that is for income, employment, education etc. separately. These Domain Indices can be validated, either because they directly measure the item itself (for example in the case of means tested benefit reliance or unemployment), or by reference to relationships or ratings from other research studies.

3.8 This approach implies rather more items in total than in earlier indices of deprivation. It also requires ‘domain specific’ items (that is, a domain should contain indicators that are measures of that domain’s deprivations, not items often associated with that deprivation). It also requires procedures for combining items *within* any Domain Index according to clear rules and procedures. These procedures are outlined in more detail in the section on domains and indicators, and combining the Domain Indices below.

4 The geographical scale of the Index

4.1 In the absence of data at the level of individuals or households, an Index that identifies areas with the greatest intensity of deprivation would ideally be constructed from data on small geographic units of a standard population size. The areas should be smaller than the minimal size for which targeted intervention would be considered, sufficiently small that the area could be assumed to be relatively homogeneous with respect to the intensity of deprivation, but large enough to produce acceptably reliable estimates. The Index would then offer great flexibility for both describing the geographic distribution of deprivation, and defining areas for targeted intervention based on adjacent areas which formed a distinct neighbourhood or non-adjacent areas with similar problems.

4.2 It is clear that the lack of suitable data for small areas has in the past been a major barrier to the development of an Index of deprivation. However, the increasing availability of benefits and other data at an Electoral Division (EDiv) level, means that this is no longer such a dominant constraint.

4.3 If concentrations of deprivation are to be compared between areas it is necessary to calculate rates in order to standardise for differences in the size of the population. However, this introduces a new difficulty resulting from the heterogeneity *within* areas in relation to the amount of deprivation. Even if, for example, a small Unitary Authority (UA) had a higher unemployment rate than a large UA, it is possible that the large UA contains within it many areas with an equivalent population to the small UA with a substantially higher unemployment rate. The rate for the large UA as a whole may therefore mask great variation within it. Although EDivs also vary in size, the problem is inherently much greater for UAs because of their larger population sizes. This heterogeneity within UAs, combined with variations in population size, makes comparisons of the degree of deprivation at a UA level extremely problematic.

The Approach taken

4.4 Since the lack of data is no longer such a constraint to the development of a more comprehensive Index for smaller areas, an EDiv level Index has been produced. The Index is based on the EDiv geography at 1st April 1998. Issues relating to geography are discussed in detail in Appendix A.

4.5 While there are clearly data which are not available at this relatively small spatial level, new sources of administrative information and the judicious use of ‘synthetic estimation’ have opened up new possibilities in the measurement of deprivation at small area levels.

4.6 Although the population of EDivs is variable, the differences are smaller (in absolute terms) than between UAs. The focus on EDivs therefore strengthens the case for measures of deprivation which are independent of population size (such as percentages) since there is less need to take account of gross differences in the size of areas. At this stage an Index cannot be generated at smaller area levels, such as Community Council level, because of the lack of robust data for many of the indicators across the whole of Wales, and significantly, the lack of robust and up-to-date population estimates at sub-EDiv level.

5 Domains and Indicators

Framework for the Welsh Index of Multiple Deprivation

5.1 The Index is based on a number of different ‘domains’, which reflect different aspects of deprivation. These are described in detail in sections 6 to 11. This approach reflects the view that multiple deprivation is a combination of different, though clearly inter-related, deprivations. For example, poor health may be related to inadequate housing or other factors linked to low income, but is also a deprivation in its own right.

5.2 The Index relates as closely as possible to 1999/2000, though the proposals sometimes involve the use of older data (including a small number of 1991 Census indicators) where this is not possible.

5.3 Indicators for each domain are produced at EDiv level. Each domain is summarised as a single measure, and these are combined in the overall Index. **As far as possible, the proposals are based upon indicators which could be updated regularly, so that the Index could be revised in future to reflect change over time.**

5.4 The Index seeks to measure concentrations of deprivation, which implies that it should measure deprivation independently of population size.

Domains

5.5 The following domains are included in the Index:

Income deprivation

Employment deprivation

Health deprivation and disability

Housing deprivation

Education, skills and training deprivation

Geographical Access to Services

Crime and Physical Environment Domains are substantial omissions. They are both clearly important aspects of deprivation but lack of consistent local data has meant that, at this stage, they have had to be omitted. Section 12 explains the main reasons for their omission.

5.6 Each domain reflects a particular aspect of deprivation. Thus in the Employment deprivation Domain exclusion from the world of work is captured – *not* the low income that may flow from it.

5.7 Domain Indices have been created. These provide information about the deprivation related to each domain in addition to the composite measure of the overall Index of Multiple Deprivation.

Indicators

5.8 Each Domain Index is based on a combination of indicators. The criteria for these indicators are that they should be:-

- ‘domain specific’ and appropriate for the purpose (that is defensible for being as direct as possible measures for that form of deprivation)
- able to measure major features of that deprivation (not conditions just experienced by a very small number of people or areas)
- up-to-date
- capable of being updated on a regular basis
- statistically robust
- available for the whole of Wales at a small area level

5.9 There is no ‘perfect number’ of indicators to include within an Index, but a parsimonious collection of indicators which covers aspects of deprivation as comprehensively as possible has been included. The indicators have been selected to minimise double-counting *within* each domain though people may well be experiencing more than one type of deprivation and would therefore be represented in more than one domain.

5.10 A wide range of indicators that could either be obtained at EDiv level or reliably ‘modelled down’ to EDiv level from UA level were considered and tested.

5.11 In domains where it was not possible to eliminate ‘double counting’ of people by different indicators e.g. in the Education, skills and training Domain, and the Health Domain, statistical techniques have been employed to cope with this problem.

Indicator Scores

5.12 One problem which had to be addressed is the question of how the indicators should be scored or scaled (if at all) to allow fair comparisons between areas and appropriate combination with other indicators. The data are not all in the same units of measurement and if the raw data were used the results would largely be driven by the size of the population. For this reason it is not possible simply to count the numbers of people experiencing each deprivation and add them together.

5.13 Deprivation should be scored according to concentration, independently of the size of administrative area (e.g. UA). Rates or some other standard form of measurement should be used which allow areas of different sizes to be compared. The size of the administrative area is obviously important when it comes to resource allocation, but it should not be a determinant of the final Index itself. Population size will need to be taken into account specifically in allocating resources and not built into the Index values.

5.14 An important implication of basing indicators upon rates is the need for appropriate denominators. Even where small area data are available to form the numerator for a rate (for example the number of people receiving particular benefits), it is a significant task to derive the appropriate denominator. After careful discussion with a number of specialists, the NHSAR (National Health Service Administrative

Registers) based population estimates were used. In the inter-censal period there is no 'gold standard' for sub-UA population estimates. For further details see Appendix B.

The Small Numbers Problem and the Shrinkage Technique

5.15 In some areas of Wales, particularly where populations at risk are small, data can be unreliable with particular EDIVs getting unrepresentatively low or high scores on variables in certain domains. The problem exists not only where data are derived from samples but also where scans of administrative data are, effectively, an entire census of a particular group. This is because such censuses can be regarded as 'super populations' - rather like samples in time. For example, in an area there may have been only three babies born in a year, one of whom had a low birth-weight. Taking another year, there may have been four births one of which had a low birth-weight. The proportions thus fluctuate between a third and a quarter probably by chance. By contrast another area might have 200 live births a year with 20 children whose birth-weight is low. The ten percent this represents is less likely to be the result of random fluctuation. The extent of a score's 'unreliability' can be measured by calculating its standard error.

5.16 This problem emerged in the construction of other Indices of Deprivation in the past and this has prompted the use of the signed chi squared statistic.³ However, this technique has been much criticised because it confuses population *size* with *levels* of deprivation.⁴ Given the problems with the signed chi squared approach, another technique - 'shrinkage estimation' - has been used in this review to deal with the problem where it emerges.

5.17 The procedure has not been applied to the Income and Employment Domain EDIV level proportions because the standard errors of the proportions are small and the procedure is not warranted.

5.18 Shrinkage involves moving 'unreliable' EDIV scores (i.e. those with a high standard error) towards the mean score of the UA within which the EDIV is located. This may be towards more deprivation or less deprivation.

5.19 In the three domains where shrinkage is appropriate (Health, Education and Geographical Access to Services), the technique is applied to all variables across all EDIVs. However, it is important to emphasize that the technique will not have the effect of 'moderating' *all* scores towards the UA average and will not necessarily result in the 'damping down' of extreme values. Although all scores will move a fraction, only 'unreliable' scores, that is those with a large standard error, will move significantly. The amount of movement depends on both the size of the standard error and the amount of heterogeneity amongst the EDIVs in a UA. An EDIV with a large standard error will move towards the UA mean more than one with a small standard error in the same UA. More specifically in UAs with EDIVs where populations are relatively large, 'shrinkage' will have virtually no impact. In UAs with small populations shrinkage will move only unreliable scores, as evidenced by large

³ See for example the English *Index of Local Conditions* 1991 (DETR, 1993).

⁴ See C. Connolly and M. Chisholm, 'The use of indicators for targeting public expenditure: the Index of Local Deprivation', 1999, *Environment and Planning C: Government and Policy*, vol. 17, pp. 463-482.

standard errors, towards the UA mean. Also, movement towards the UA mean is also affected by the extent to which the indicator in question varies between EDIVs across the UA. If two EDIVs with the same large standard error are taken, one in a UA where the indicator is otherwise homogeneously distributed, the other where the indicator is more heterogeneous in its distribution, more movement will occur in the homogeneous case. Because 'shrinkage' does so effectively deal with *unreliable* small numbers, it is an essential procedure to adopt and must be applied consistently across all UAs. It is worth emphasizing that where EDIVs do move this may be in the direction of more deprivation if the 'unreliable' score shows less deprivation than the UA mean.

5.20 The actual mechanism of the procedure is to estimate deprivation in a particular EDIV using a weighted combination of (a) data from that EDIV and (b) data from another more robust source (for example the UA mean). Using this method the estimate for any EDIV would then, for example, move towards the UA mean by taking a weighted average of the EDIV and UA values, thus reducing any EDIV-level 'noise' from small numbers. By this device the unreliability of the EDIV-level indicator is reduced by 'borrowing strength' from a more reliable source thus minimising the effect of random fluctuations and other sources of error. This methodology has a sound statistical basis and completely avoids the problem of index values being linked to the size of the area (scale dependency).⁵

5.21 There are many possible candidates for the more robust score to which an unreliable score could move. The UA mean has been selected but others could include the mean score for the whole of Wales, the means of areas of similar characteristics, or the mean of adjacent EDIVs.

5.22 Moving unreliable scores towards the mean score for the whole of Wales was considered inappropriate. Moreover 'borrowing strength' from neighbouring EDIVs could be very problematic especially near the edges of towns. Though using the mean of 'similar EDIVs' is superficially attractive there are problems. For example, the classification of 'similarity' will be contentious - there is no agreed classification of EDIVs which incorporate geographical and demographic changes since 1991. This leaves shrinkage to the UA mean as the best practicable option, and it has been adopted.

5.23 As has been indicated, shrinkage takes into account both the EDIV scores and the variation of scores between EDIVs in a UA, to decide by how much each EDIV will be 'shrunk' towards the UA mean. The shrinkage procedure and formulae are presented in more detail in Appendix C.

⁵ If the technique is applied, all wards are 'shrunk' in inverse proportion to the variance. Small wards with large standard errors are subject to greater shrinkage.

Combining the indicators into Domain Indices

5.24 The next problem to address is how to combine indicators into a Domain Index. This requires some discussion of weighting. Basically ‘weighting’ is the contribution the parts make to the whole when combination takes place. Weighting *always* takes place when elements are combined together. Thus if items are simply summed together to create an index this means they are given *equal weight*. It would be incorrect to assume that items can be combined without weighting.

5.25 Thus, when creating Domain Indices (or indeed, when combining Domain Indices into an overall Index) simply summing the items would be stating that the items were judged to be equally important in their contributions to the whole. Such an approach has the attraction of simplicity but could have unwanted (or even, unintended) consequences.

5.26 For each domain of deprivation (Income, Employment, etc.) the aim has been to obtain a single summary measure whose interpretation is straightforward in that it is, if possible, expressed in meaningful units (e.g. proportions of people or of households experiencing that form of deprivation). In some domains where the underlying metric is the same and where the indicators are non overlapping, such as in the Income Domain, the indicators have been simply summed. Where there are several indicators within a single domain that have different underlying metrics and cannot therefore be straightforwardly combined, a statistical procedure, factor analysis, has been used to identify the weights for each indicator on the underlying scale of deprivation for that domain. The domain score is then a combination of the component indicators weighted according to the factor analysis results. For further details on factor analysis see Appendix D.

5.27 The following sections provide further information about each domain. The following points are covered:

- the aspect of deprivation that each domain should ‘capture’
- the indicators that have been included within each domain
- some of the main indicators that have been considered but not included
- methodological issues raised by the particular domain such as the denominators that are likely to be used for each indicator, and proposals for combining the indicators in that domain.

The included indicators are summarised in the shaded boxes at the start of each domain section.

6 Income Deprivation

Income Deprivation: Summary of Indicators

- Adults in Income Support households (DSS) for 1998
- Children in Income Support households (DSS) for 1998
- Adults in Income Based Job Seekers Allowance households (DSS) for 1998
- Children in Income Based Job Seekers Allowance households (DSS) for 1998
- Adults in Family Credit households (DSS) for 1999
- Children in Family Credit households (DSS) for 1999
- Adults in Disability Working Allowance households (DSS) for 1999
- Children in Disability Working Allowance households (DSS) for 1999
- People in Housing Benefit/Council Tax Benefit Households who are not in receipt of Income Support, JSA (IB) or Family Credit/Working Families Tax Credit (HBMS) for 1999

Purpose of this domain

6.1 The purpose of this domain is to measure people who are in receipt of low income. Income deprivation is one of the most important dimensions of multiple deprivation.

6.2 An 'ideal' indicator of income deprivation might be 'the proportion of households in an area living below a fraction of national mean income after housing costs'. Following the Households Below Average Income (HBAI) series this might be 'the proportion of households in an area living below half average income'.

6.3 This domain could be extended to comprise an 'economic deprivation' domain. In this case some measure of wealth might be included. It has also been suggested that capturing spatial variations in Gross Domestic Product might at some stage be possible.

6.4 Such data is not, however, yet available at small area level. National and regional estimates of HBAI derive from the Family Resources Survey (FRS) which, whilst having a reasonably large national sample size (around 25,000) does not even allow reliable UA level estimates. Further data on consumption (and wealth) are collected in a variety of social surveys but not with sample sizes that would allow reliable small area estimates.

Indicators

Means tested social security benefits

6.5 Despite the lack of comprehensive data on economic deprivation at a small area level, robust data are now available in respect of means tested social security benefits. These data give valuable insights into low income at very small spatial units. Income Support (IS), Income Based Job Seekers Allowance (JSA(IB)), Family Credit (FC) and Disability Working Allowance (DWA) data have been obtained and aggregated to 1998 EDIVs. This gives a complete picture of those receiving centrally administered

means tested benefits. The data obtained allow identification not only of claimants of these benefits but also their partners⁶ and the numbers of children living in families reliant on the benefits.

6.6 The main groups on means tested benefits not captured are those not on IS/JSA(IB), FC or DWA who nevertheless claim Housing Benefit and or Council Tax Benefit (HB/CTB). Until recently such data have not been available at EDiv level on a national basis. However, during the past two years the Matching Intelligence Data Service (MIDAS) of the Benefits Agency has been collecting individual level data from local authorities' HB/CTB systems to help local authorities detect fraud. This is a voluntary scheme but does provide for the possibility of centrally collected consistent data on HB/CTB receipt across Wales. In fact, of the 22 Welsh UAs, 21 have signed up for the service and 19 were providing regular extracts of data when the Index was constructed. Working with the DSS in Newcastle, data for the 19 authorities were processed to generate EDiv level counts of people living in HB/CTB families who are not receiving the national means tested benefits (IS/JSA(IB)/FC/Working Families Tax Credit). Unfortunately it did not prove possible to eliminate DWA claimants but the very small numbers means that double counting by their inclusion is negligible. For the three authorities where no data were available synthetic estimates were produced and validated using available data for the rest of Wales.

Child poverty

6.7 There is a widespread national concern to place special emphasis on child poverty. The IS/JSA(IB)/FC/DWA data have been obtained in a form which allows separate identification of children. Children are included 'one for one' in the numerator in this domain and are therefore accorded equal weight to adults. Also, the principal measure of low earnings - families in receipt of Family Credit - also implicitly weights child poverty.

6.8 In addition, children in these low income households allow the presentation of a subset of this Domain Index in the form of a *Child Poverty Index*. This is not combined in the overall Index of Multiple Deprivation as the children are already counted in the Income Domain. This has been undertaken and is described in section 6.20

Rejected Indicators

Registered County Court Judgements

6.9 Although this indicator has been considered it could be argued that it is an imprecise measure of indebtedness/financial stress as it measures both people suffering economic deprivation and failed entrepreneurs who may or may not be so deprived. The attraction of the indicator was that it appears to be a measure of low income. However, investigation indicated that this is not a robust indicator, and it was therefore not included.

⁶ For all benefits except IS actual counts of partners have been obtained. The IS scan doesn't contain partners but these have been imputed using district level data from the Quarterly Statistical Enquiry (QSE).

Deductions from Income Support/Job Seekers Allowance

6.10 The Income Support 100% scan contains some fields relating to deductions from the benefit e.g. in respect of repayments of social fund loans. It therefore seemed useful to pursue what potentially was an important measure of those living below the level of this means tested benefit. Since October 1997 unemployed people have been taken out of the scope of Income Support and paid a different means tested benefit JSA(IB). Unfortunately, the 100% scan of JSA(IB) does not contain any information on deductions. Inclusion of this indicator from IS but not JSA would mean that an important category of claimant (and, incidentally, one known to be particularly prone to deductions from benefit) would be missed. Accordingly it was decided not to include such an indicator.

Long term recipients of income related benefits

6.11 Despite its desirability, it has not proved possible to obtain data at a small area level on persistence of claiming income related benefits at small area level.

Direct measures of low income other than Family Credit/Disability Working Allowance

6.12 There are also groups in low paid employment who are not entitled to any help through the means tested system. For those in the tax system there is the possibility of obtaining data from the Inland Revenue. There are two principal computer systems here: COPS dealing with PAYE and CESA dealing with Self Assessment including the self employed. Despite extensive negotiations with the Inland Revenue there is little immediate prospect of obtaining useful tax data. This is partly due to issues of confidentiality (though this may not prevent release of EDiv level data), partly due to organization, as PAYE data is employer based and payee data is not always comprehensively postcoded; and partly due to the limitations of the computer systems themselves (particularly COPS). This is an area that should be kept under review for the future.

6.13 The other mechanism for obtaining information on low paid employees above the lower earnings limit for National Insurance contributions is through the Contributions Agency (soon to be Inland Revenue) computer NIRS2. Unfortunately there are substantial backlogs of work in the Contributions Agency to be processed on to NIRS2 and a reliable extract within the life time of this project was not possible.

Methodological issues

6.14 Numerators have been constructed in the form of 'numbers of people in households receiving'. This has enabled the use of 'population at risk' denominators and has allowed the calculation of a simple 'rate' of people in an area living in families reliant on means tested benefits.

6.15 Using the benefits listed has the advantage that, in the main, there is no overlapping and therefore no double counting. (In practice there is a small overlap with IS/JSA(IB) and FC – this can happen because FC is payable for six months irrespective of changes in circumstances. If someone loses their job they can claim IS/JSA(IB) and for the remainder of the period of their FC award will be in receipt of both benefits. Moreover the different dates of extracts of different benefits means some small amount of double counting is inevitable).

6.16 Despite some evidence of spatial variation in benefit take-up from small scale studies, no data were forthcoming which would have allowed appropriate weighting of the data to allow for low take-up in different areas. Furthermore adjustments to the figures to take into account low take-up by particular groups were also not attempted precisely because there is the possibility of geographical variation and also because the latest take-up figures are considerably older than the benefits data used in the Index.

6.17 The possibility of factoring in 'cost of living' in some way was considered. Both urban and rural areas have particular burdens in this respect. Undoubtedly, this is an important issue but there was no data to hand at a national and local level which would have enabled appropriate weights to be constructed. The question of costs associated with access in rural areas is, to a certain extent, dealt with in the Geographical Access to Services Domain.

6.18 The indicators for final inclusion in this domain are in the form of non overlapping counts of people in families in receipt of means tested benefits and are presented as the percentage of the total population living in such families, that is: the rate of population (including children) reliant on means tested benefits.

6.19 Having generated the standard error of the proportion, 'shrinkage' was not considered necessary to this domain and the Domain Index is the unadjusted rate.

6.20 Given the widespread concern regarding child poverty, the proportion of children under 16 living in means tested benefit reliant families is also presented. However, as this proportion is contained within the overall rate of reliance on means tested benefits, it has not been included separately in the construction of the overall Index of Multiple Deprivation.

7 Employment Deprivation

Employment Deprivation: Summary of Indicators

- Unemployment claimant counts 16 - 59 (JUVOS, ONS) average May 1998-February 1999
- People aged 18-24 on New Deal options (ES)
- Incapacity Benefit recipients 16 - 59 (DSS)
- Severe Disablement Allowance recipients 16 - 59 (DSS)

Purpose of this domain

7.1 Those who are 'employment deprived' are taken to be those who want to work but are unable to do so through unemployment or sickness. The domain is therefore seeking to measure enforced exclusion from the world of work. This is seen as a separate deprivation from the income deprivation to which lack of employment may lead.

Indicators

Unemployment Count

7.2 Unemployment counts at a small area level are published through the NOMIS database, but derive from JUVOS which is an individual level database maintained by Office for National Statistics. ONS/NOMIS do not yet provide data for 1998 EDiv boundaries. Accordingly individual postcoded data from the JUVOS SOC file were obtained from ONS and aggregated to 1998 EDivs. The SOC file is a 100% count of computerized claims that are live on the statistical count date. It excludes a small percentage (around 1%) of clerical claims. The file contains, amongst other things, the age of the unemployed person and the duration of unemployment.

7.3 In order to make some allowance for seasonal variation in unemployment, the average claimant count of the following quarters: May 1998, August 1998, November 1998 and February 1999 was taken.

7.4 There is a serious concern that measures based on the unemployed claimant count substantially under-estimate the numbers who would work if work were available. It is argued that these 'hidden unemployed' include those (particularly women) who are seeking work but not registered as unemployed, people on government training schemes, some who have taken early retirement, and long-term unemployed people (mainly older men) who have moved onto sickness and disability related benefits in the absence of any realistic prospect of finding work.⁷

7.5 In order to begin to take these into account, the possibility of using the Labour Force Survey (LFS) to adjust the claimant count figures to estimate unemployment in

⁷ C. Beatty, S. Fothergill, T. Gore and A. Herrington (1995) *The Real Level of Unemployment* (Centre for Regional Economic and Social Research, Sheffield Hallam University).

accordance with International Labour Organisation (ILO) definitions was explored. UA level ILO estimates from the LFS were obtained and compared with claimant count figures. The possibility of adjusting figures at EDiv level based on this ratio was considered.

7.6 However, experts consulted cast doubt on this approach. Most acknowledged that ILO definitional counts would be better, but doubted the power of the LFS as a basis for such adjustments at small area level. Accordingly unadjusted claimant counts are used. The other indicators in this domain identify a significant number of the hidden unemployed, but work needs to be undertaken to find ways to identify other groups not represented at present in the domain.

7.7 Whereas the ILO adjustment (were it feasible) might allow for the 'hidden' unemployment of women who are married or living with partners, there is another issue concerning lone parents. This group is traditionally regarded as 'economically inactive'. They are not required to 'sign on' to get benefit until their youngest child is aged 16. Those claiming benefit do not therefore count as 'unemployed'. In this domain those who are *involuntarily* out of employment are sought. Given the formal position of lone parents, how should those on Income Support be treated? Are they voluntarily or involuntarily out of employment? If the former they have no place in this domain. If the latter they should be counted. This is a sensitive issue. It is impossible to tell whether a particular lone parent on IS has decided that she cannot go to work because her children need her care or whether she cannot go to work because she cannot find an appropriate job or childcare. Lone parents on IS have, therefore, not been included in this domain.

Incapacity Benefit and Severe Disablement Allowance

7.8 Those who are incapable of work through sickness have been included in this domain. This is a widely supported measure of exclusion from employment. Those who are jobless through sickness can be captured by counting those below pension age on Incapacity Benefit (IB) and those in receipt of Severe Disablement Allowance (SDA). If the intention is to measure only hidden unemployment then a proportion could be calculated. Otherwise the entire group could be incorporated on the basis that they all face exclusion from work, whether due to sickness alone or to some combination of sickness and labour market conditions. The latter is the position adopted and all claimants of IB and SDA are included. The small numbers of those over pensionable age receiving IB and SDA were excluded.

People out of work but in training

7.9 There are two databases relating to people out of work but in training. They both contain individual level data and complement the claimant count. The first is TDS - the Trainee Database System - maintained by the DfEE. The second is the New Deal databases maintained by the Employment Service (ES).

7.10 The TDS contains data on Training and Enterprise Council (TEC) delivered government supported training and thus comprises information on Modern Apprenticeships (MAs), National Traineeships and other training. TDS covers adults as well as young people. The database contains individual postcoded data and was thus potentially available for incorporation into this domain. There are two issues. The first is which categories of trainee should be considered to be 'work deprived'? Thus, for example, one might want to exclude MAs while recognising that work

based and other training should be so regarded being the successor in title to Youth Training. The second issue relates to the integrity of the data itself. Some work would be necessary to ensure non overestimation of the stock due to under-recording of exits. Unfortunately, although the Assembly for Wales contacted the DfEE these data were not forthcoming in the timescale and have therefore not been included. No doubt inclusion would be possible in an updated version of the Index.

7.11 There are two New Deal databases developed by Employment Service (ES) and a third under development. They relate respectively to the New Deal for 18-24 year olds, New Deal for people aged 25 and over and the (relatively under-developed) New Deal for Lone Parents. Of the two databases fully implemented (the 18-24 and the 25 and over) only the first is of interest. This is because those in the various pathways of the second continue to receive JSA and are thus captured by the claimant count.

7.12 In respect of the New Deal for 18-24 year olds, people in the Gateway still receive JSA and are thus covered by the claimant count. The data also cover people in the four New Deal Options and is provided with postcoded data for these so that those in 'non-employment' New Deal options can be aggregated for inclusion in the domain.

7.13 The New Deal data has been made available and has been included in this Domain Index.

Rejected Indicators

Duration Data

7.14 An indicator of uninterrupted length of unemployment is often seen as a useful added measure of work/employment deprivation. However, this simple indicator has been rejected. Advice from experts in the field has suggested that such a measure is of doubtful value as it does not take into account the increasing number of courses/schemes available to unemployed people (especially those under 25) who would therefore be removed from the claimant count whilst on the courses. Furthermore, any such measure would not take into account seasonal employment and other factors that cause people to move in and out of employment.

7.15 The inclusion of duration data raises other significant questions. The domain currently measures people who are involuntarily deprived of employment, so if long term unemployment figures (taken from the claimant count) were to be included in the Index should not long term Incapacity Benefit (IB) recipients also be included within the long term measure? (i.e. double count long term IB claimants). This would also apply to Severe Disablement Allowance (SDA) claimants.

7.16 If duration data were to be taken into account, 'cyclers' should be included (i.e. those who move in and out of employment) in some way. For example, many people who are 'seasonally' employed might be otherwise long-term unemployed. Their brief periods of employment may not raise the likelihood of their return to more permanent employment and yet they are removed from the simple measure of duration. In a future version of the Index, as with the Income Domain, consideration should be given to a sub-domain about 'persistence' which takes into account issues such as repeated spells of unemployment.

7.17 In conclusion, there is a strong argument that when a more sophisticated measure becomes available, duration data should be included in this domain to take into account the additional disadvantages experienced by people who have not been in employment for a long period of time.

Quality of employment

7.18 There was an initial suggestion to incorporate measures on job quality (conditions of employment, unsociable hours, multiple part-time jobs etc.). However, it was felt that these measures contained a certain subjectivity, and that such data, while very useful, depended on the context - thus a plethora of part time vacancies in some areas might be indicative of the degrading of jobs - in other areas might indicate 'family friendly' policies.

7.19 In any event, the availability of relevant data on vacancies through the ES has been explored. There are two problems here. First a relatively low proportion of vacancies are recorded through the ES. Second much of the most useful data are recorded in a 'free form' text box and are extremely difficult to analyse quantitatively. An indicator on job quality has therefore not been included in this domain.

Methodological issues

7.20 There are several ways of dealing with the appropriate denominator for this domain. It is clear that the denominator for the unemployed is the economically active population. But because men over 60 who are unemployed can choose to receive Income Support rather than Income Based Job Seekers Allowance,⁸ the claimant count for men aged 60-64 is an undercount. This domain is therefore restricted to people aged 16-59. For those on Incapacity Benefit and SDA the position is less clear as they represent part of the economically inactive population. One solution is simply to place the unemployed and those on Incapacity Benefit and SDA over the entire adult population. The advantage is that this is a straightforward solution allowing a simple rate to be calculated for this domain. The disadvantage is that it brings all the other economically inactive into the denominator. Alternatively a denominator of the economically active and those on Incapacity Benefit and SDA could be constructed. It is this latter approach that has been adopted.

7.21 As with the Income Domain, the indicators in this domain constitute non overlapping counts of those excluded from the labour market through unemployment or ill health. As has been indicated a simple rate can be constructed - those unemployed or on certain schemes and those on Incapacity Benefit/Severe Disablement Allowance as a proportion of those economically active plus those sick.

7.22 Again the small size of standard errors across the domain does not suggest that shrinkage techniques need be employed and the Domain Index is the unadjusted rate.

⁸ This makes no difference to the amount of money they receive, but they no longer have to sign on every fortnight, look for work or risk being sanctioned.

8 Health Deprivation and Disability

Health Deprivation and Disability: Summary of Indicators

- Age and sex Standardised Mortality Ratios (SMR) for people under 65 (ONS) using deaths data recorded by EDiv for 1995-98.
- People receiving Attendance Allowance or Disability Living Allowance (DSS) for 1998
- People (aged 16-59) receiving Incapacity Benefit or Severe Disablement Allowance (DSS) for 1998 and 1999 respectively
- Age and sex standardised ratio of limiting long-term illness (1991 Census)
- Proportion of births of low birth-weight (<2,500g) (ONS) for 1993-97

Purpose of this domain

8.1 While ill health is closely intertwined with other aspects of deprivation, it is also an important aspect of deprivation in its own right. Premature death is the ultimate manifestation of this, but chronic ill health also greatly impairs the quality of people's lives in many ways – both through the pain, discomfort and anxiety it causes and through hindering participation in a range of activities.

8.2 The critical importance of good health to individuals' quality of life is reflected in the high priority the Government attaches to health improvement, as demonstrated by the Green Paper, '*Better Health Better Wales*' (1998). Geographic variation in ill health is an important aspect of health inequality, and the Index will provide a tool to assist in reducing health inequalities.

8.3 This domain therefore seeks to summarise the health status of the population in different areas. In doing so, it needs to incorporate measures which both reflect the risk of premature death and the extent to which chronic illness or disability impair people's quality of life.

Indicators

(i) Measures of premature death

Standardised Mortality Ratios (SMRs)

8.4 Having considered and explored a range of alternative mortality measures, SMRs for ages under 65 have been calculated.

8.5 The calculation of SMRs requires population estimates for five year age bands by sex. The small size of many EDIVs also means that the mortality data needs to be aggregated for more than one year to produce estimates that reliably discriminate between mortality rates in different areas. Four years of mortality data have therefore been combined.

8.6 The standard errors for EDiv level SMRs are high, even with four years of mortality data. The technique of 'shrinkage estimation' has therefore been used to increase the level of confidence in the EDiv ratios.

8.7 It was decided to calculate SMRs for ages under 65. In particular it was argued that using deaths under 65 more effectively measured premature death and reduced any biases resulting from the movement of elderly people into residential care.

(ii) Measures of morbidity

8.8 Death rates provide a far from complete picture of the health status of the population. Although survival rates for certain conditions are very low and illness leads rapidly to death, large numbers of people live many years with chronic illnesses which cause them pain or discomfort or restrict their ability to participate in everyday life.

8.9 Ideally a measure of the prevalence of people affected to varying degrees by chronic illness would be available. In the absence of this, however, it is necessary to use several different indicators:

Disability Living Allowance (DLA) and Attendance Allowance (AA)

8.10 Attendance Allowance is a cash benefit for people aged 65 or over who need help with personal care because of an illness or disability. Disability Living Allowance is a benefit for those with substantial levels of disability and are aged under 65. DLA and AA are non-overlapping benefits, a person cannot be in receipt of both. These two indicators have been combined into a single measure of the percentage of people of all ages receiving either DLA or AA.

Incapacity Benefit plus Severe Disablement Allowance

8.11 Incapacity Benefit (IB) is a non means tested benefit paid to people who are unable to work due to ill health who have paid sufficient National Insurance contributions. Severe Disablement Allowance (SDA) is a similar benefit paid to people who have paid insufficient contributions to qualify for IB. The DSS have provided information on recipients of these benefits in 1999.

8.12 The two benefits cannot be paid at the same time, and the numbers of people receiving them have therefore been combined. This is expressed as a percentage of the population of working age (16-59).

8.13 There is a concern that by using IB and SDA in the Employment Deprivation domain as well as this domain there would be double counting of certain people in the Index. While variants of the same measure (but with different denominators) are used in the two domains, this reflects the fact that claimants are experiencing both employment deprivation and either disability or impaired health.

8.14 Ideally data would be available which enabled the separate identification of people receiving different combinations of deprivations (for example those who were unemployed, with poor health and in unsuitable housing), those experiencing single deprivations and those who were not deprived at all. While this particular indicator does provide a direct measure of multiple deprivation (albeit in respect of two dimensions of deprivation for a particular group of people), most of the others do not.

Because the Index has had to be constructed in a way which treats different deprivations separately rather than in combination, the multiple deprivation implicit in this indicator is counted as two different single deprivations. It is therefore perfectly legitimate to include it as a representative of two different aspects of deprivation.

Limiting long-term illness

8.15 The 1991 Census asked whether people have any long-term illness, health problem or disability which limits their daily activities or the work they can do. This information can be used to produce age standardised rates of long-term limiting illness. While this is potentially a useful and readily available measure, it does suffer from being potentially out of date. On the other hand it is not subject to take up bias which may be implicit in benefit data. It has therefore been included as an indicator.

Low birth-weight

8.16 Low birth-weight (less than 2,500g) is linked to both increased mortality and morbidity in infancy, and an increased risk of cardio-vascular disease in later life. This might, for example, relate to aspects of the mother's health during pregnancy. A measure of the proportion of live births in 1993-97 which were of low birth-weight has been included.

Rejected indicators

Infant Mortality Ratio

8.17 The Infant Mortality Ratio had previously been considered on the basis that this represents particularly premature death, and that areas with high infant death rates would not necessarily correspond to those in which mortality was high at other ages. However, the numbers of infant deaths are small (nationally only around 0.6%), and even if figures for several years were aggregated, EDiv level estimates would not be sufficiently reliable to enable meaningful comparisons between areas.

Welsh Health Survey Data

8.18 It was hoped that the Welsh Health Survey could provide data suitable for modelling to small area level. This would have allowed the inclusion of several new indicators, particularly a mental health indicator. Unfortunately the data could not be supplied to us in time.

Cancer Incidence

8.19 Information is collected about all new cases of cancer, of which there are, on average, around 13,500 new registrations per year (excluding non-melanoma skin cancer).⁹ Though experts disagreed, some thought that the data quality was variable across Wales and in any event was not available after 1995. It was therefore decided not to include it at this stage but to have further discussions with a view to its inclusion at a later stage if found to be sufficiently robust.

⁹Non-melanoma skin cancers are extremely common cancers which can usually be treated easily, and which typically do not recur. Reporting of non-melanoma skin cancers is also believed to be much less complete than for other cancers.

Prescriptions data

8.20 The possibility of obtaining data from the National Prescribing Centre analyses of the prescriptions issued by GP practices was investigated. This might have been used to obtain measures of the relative prevalence of certain conditions (for example depression or arthritis). However, because of variations in prescribing practice and the difficulties of relating prescriptions to numbers of patients, this is not a practical possibility.

Drug or Alcohol Misuse

8.21 Another potential indicator was a measure of drug or alcohol misuse. However even if data were available about people accessing services for drug misuse at the level of health authorities, comparisons would be problematic because the numbers of service users are heavily influenced by the distribution of service provision.

Dental Health of Children

8.22 Poor dental health among children was considered as an indicator, on the basis that it may reflect aspects of their diet such as consumption of refined sugar. However there is doubt about its value as a general indicator of the health of a population.

Inpatient and Day Case Hospital Episode Data

8.23 This source of data could not be exploited within the time frame of this project. However, it should be explored further in future versions of the Index.

Methodological Issues

8.24 Shrinkage estimation was applied to the indicators in this domain before factor analysis was undertaken. Unlike the Income and Employment Domains, it is not possible to sum the measures of the Health Deprivation and Disability domain to produce a meaningful estimate of the proportion of the population who experience poor health or who are disabled.

8.25 The statistical technique of factor analysis was therefore used to produce a single domain score. A factor analysis of the indicators in this domain identified a single underlying factor that adequately explained the pattern of correlations among all the indicators.

Education, Skills and Training Deprivation: Summary of Indicators

- Working age adults with no qualifications (3 years aggregated LFS data at UA level). Working age adults with high qualifications is also available.
- Children aged 16+ who are not in full-time education (Child Benefit data – DSS) for 1999
- Proportions of 17+ population who have not successfully applied for HE (UCAS) for 1997, 1998 and 1999
- Key Stage Two primary school performance data converted to EDiv level estimates (Welsh Assembly) for 1999. This has both a high and low measure.

Purpose of this domain

9.1 The purpose for the set of indicators in the Education Domain is to measure in as consistent a way as possible the key *educational* characteristics of the local area that may be held to form part of the overall deprivation and disadvantage experienced. This objective raises a number of questions about the way ‘educational deprivation’ is defined. Most debates about educational deprivation deal with both social and educational deprivation, using indicators such as free school meals as a proxy for both social and educational deprivation. This is not, however, consistent with the conception of deprivation used in this review. ‘Free school meals’ is a proxy for low income and not a form of education deprivation. In fact as eligibility to free school meals is linked to receipt of Income Support/JSA(IB) it is, in effect, already captured by the Income Domain indicators.

9.2 Several of the items considered for the Education Domain were concerned with *educational performance*, measured by examinations and qualifications. The debate on the meaning of educational disadvantage has increasingly focused on educational results, rather than other possible indirect proxies for educational quality (e.g. pupil teacher ratios). Some of these other measures are themselves influenced by educational policies; thus class size or the availability of nursery education will themselves be affected by the way resources are distributed within the education system.

9.3 It could be argued that to include data on educational performance in this domain is to penalise schools that do well in disadvantaged areas or reward under-performing areas and their schools. While there may be some unfairness here (effort is not rewarded), the objective fact is that, whatever the reason, one area has better educational results than another area that may be less disadvantaged in other respects. This has to be correct for the *Education Domain*; the broader economic and social deprivations will be picked up by other domains and measures.

Indicators

9.4 Although there are increasing amounts of local education data available on a range of topics, it is almost without exception *school based*. However, it has been possible to develop some new indicators that are not school based. These are dealt with first before consideration is given to the school indicators.

(i) Non School Based Indicators

Level of Qualifications in the Adult Population

9.5 A measure of adults with no (or low) qualifications is an important part of the Education, skills and training deprivation Domain. However there are no *direct* measures of this information that can reliably be obtained at a small area level. A synthetic estimate based on the very large national Labour Force Survey (LFS) was therefore used. This contains data on adult qualifications that are well completed for the adult population.

9.6 Specifically three years of LFS data at unitary authority level (for 1995/6, 1996/7 and 1997/8) were employed in the modelling process. The total number of working age individuals in these three years combined, resident in Wales, was nearly 22,000 cases. This gives a substantial number of cases at unitary authority level (ranging from more than 1500 cases in Cardiff to 400 in the smallest unitary). The *adult population of working age*, defined as those aged 25-59 was used for the denominator. The distortions caused by the presence of older groups no longer in the labour market (who may also be significantly less qualified) and students were thus avoided. The simple threefold classification of qualifications used in the LFS Annual Local Area Data summary version ('no qualifications', 'less than NVQ level 4', 'NVQ level 4 or better') was used. The denominators are built into the LFS. The UA level estimates for three years combined have then been modelled down to EDiv level using predictors such as social class, occupation and industry where these variables can be replicated in the 1991 Census. Advice has been sought from specialists on the best set of predictors of qualifications. An estimate of both high qualifications (level 4+) and no qualifications was generated. The high measure can be used to check against 1991 Census estimates, which contained a similar measure. The Census figures and the LFS estimates of high level qualifications correlate 0.86 at the EDiv level.

Children aged 16 and over who are not in full-time education

9.7 DSS Child Benefit data for 1999 have been used to estimate the staying-on rate in full time education, as Child Benefit continues to be paid only to those remaining in full time (non-advanced) education above compulsory school leaving age. Child Benefit data provide the total number of cases at EDiv level aged 16, 17, 18 and 19. The denominator could either be an estimate of the relevant population from the NHSAR population estimates, or the average of a range of Child Benefit for the compulsory school years to minimise fluctuations (e.g. 17+18+19/13+14+15 year olds). There are arguments in favour of either method. The advantage of using Child Benefit derived data for both numerator and denominator is that any under-recording or other bias in this data will effectively cancel out. The disadvantage is that the age group for the denominator *has* to be a *younger* one, when almost all children are still eligible for Child Benefit. The advantage of using the NHSAR data is that it is for a very similar age group (and thus controls for local fluctuations in the cohort size). This is what has been used - in fact a marginally younger NHSAR estimate has been

used as the NHSAR populations of older teenagers may be affected by mobility out of the home area particularly in rural areas. The final indicator comprised CB children aged over 16 as a proportion of the NHSAR population estimates for 15, 16 and 17 year olds. The negative of this staying on rate (those *not* staying on in full time education) was incorporated into the Index.

9.8 It may well be true that ‘staying on’ reflects the lack of other local opportunities, rather than a *positive* option. However it still remains an important relative measure, as it is very highly correlated with obtaining additional qualifications, entry to higher education etc.

Proportions of 17+ population who have not successfully applied to higher education

9.9 The Universities and Colleges Admissions Service (UCAS) database for 1997-1999, which is well postcoded, was used to derive an estimate of the number aged under 20 years who have not successfully applied to higher education. The database contains A level grades and A level point scores, as well as postcoded home address. It is ‘back-coded’ for late applicants who apply direct to HE institutions and records whether or not the applicant has been successful. The denominator is derived from the NHSAR population estimates for the EDiv – that is the number aged 15, 16 and 17. There are approximately 32,000 successful HE applicants aged less than 20 years from home addresses (with postcodes) in Wales over the three year period. Those from institutional addresses were excluded by using the PAF (post office address) file to identify non-domestic postcodes. Approximately 75% of UCAS applicants are aged under 20 years. There are a small number of applicants who tick ‘Wales’ as the country of origin but then give a postcode not in Wales. This group had to be excluded, as there was no way of linking them to an EDiv or UA in Wales.

(ii) School Based Measures

9.10 A significant amount of work has been done in Wales on assessing ‘value-added’ school level data for GCSE results at secondary level and in looking at progress across other key stages. Broadly this has not included data on school catchment area or linking of neighbourhood data to schools, using pupil postcodes. There is therefore a problem in linking school-based examination data to local area level. In order to deal with this issue, Geographical Information System (GIS) techniques have been used to link school level performance data to local EDIVs. Evidence from elsewhere shows that at primary level this GIS approximation works well –correlations between the true and modelled estimates are typically about 0.80. For this reason KS2 data (the end of the primary stage) rather than GCSE has been selected, as it would be far more difficult to model secondary school catchment areas.

Performance data at Key Stage 2

9.11 KS2, which reflects performance at the end of the primary stage, is now relatively well bedded down and data are available both at an individual pupil and school aggregate level. For Wales the data gives results in English, Maths, Science and Welsh.

9.12 The form of the individual KS2 data allow some flexibility in deciding on a measure of low performance (rather than published data that tend to give those obtaining level 4+ only). Both the proportions of high levels (number getting *more* than Level 4) and of low levels (*less* than Level 4) have been used as well as the

average level achieved. For some pupils taking KS2 their first language will be Welsh and for some it will be English. 'First language' is not recorded for individual KS2 pupils. A 'first language' score has therefore been created, which used whichever was the higher score for Welsh or English (where both were taken and different levels achieved). Just under 40,000 pupils were recorded with KS2 results in 1999. Those attending independent schools, those in special schools and special units were excluded from the analysis, as for those schools it is very difficult to produce any estimate as to how far their pupils might travel to these institutions. Less than 1% of all pupils taking KS2 were excluded on this basis.

9.13 The GIS procedure starts with an underlay of information about the overall distribution of the population, using data from postcode information. It then works separately for each unitary authority, taking the exact locations of each primary school in turn and distributing its pupils in relation to the adjacent schools in the same authority (and the underlying population). Thus in rural areas, catchment areas will be physically much bigger. Significant overlap is realistically allowed with other school catchment areas, and particular types of schools e.g. denominational schools, Grant Maintained schools, are given larger catchment areas. Welsh medium schools were given variable sized catchment areas depending on the type of area. In areas where primary schools were predominantly English medium, Welsh medium schools were given bigger catchment areas. In areas where primary schools were mainly Welsh medium these schools were given standard sized catchment areas.

Rejected Indicators

Absenteeism Rate at Primary Level

9.14 A measure of primary level rates of absenteeism might have been a useful indicator but these data are not available in Wales at primary level. Absentee data exist at secondary level, but cannot be allocated to a local area reliably at this stage.

Special Educational Needs (SEN) at Primary Level

9.15 Data on the number of pupils with statements at primary school level were also considered. Data on other levels of special educational needs are not collected separately in Wales. The proportion of pupils with statements at primary level in Wales is about 2% of pupils. This is probably too few to be a reliable indicator on its own, particularly as in some areas it may be the case that primary schools have special units or other policy reasons why they have above average numbers of pupils with statements.

Adult Literacy

9.16 Other possible candidates for non-school data considered included the Basic Skills Agency's estimates of adult literacy, which are modelled down to the local level. These data are based on national literacy surveys using weighted estimators based on the characteristics of the local population, for example using ACORN characteristics. This is an interesting technique, and well worth further examination. However at this stage the LFS basis for the adult population's qualifications is a stronger candidate, being a much larger sample and using a robust measure (highest qualification obtained).

Driving Licenses

9.17 As non possession of a full driving licence is a proven barrier to finding work, it would appear to be an important qualification to include within this domain. However, there are complex issues underlying this measure, in particular the unknown bias between rural and urban areas. As a result it was decided not to include this measure.

GCSE Performance Data

9.18 While GCSE data is clearly more publicly recognised than KS2 data, the much larger and more varied characteristics of secondary school catchment areas means that any attempt to relate school level data to an area using the type of procedures outlined above will be likely to be much less accurate. The alternatives would be to use a local authority level estimate based on amalgamating schools within the UA and modelling down to EDIVs within the UA. This could only be attempted if actual postcoded performance data were available in some areas in order to validate the estimates.

Teacher turnover

9.20 While teacher turnover may in some areas be a measure of educational deprivation, in others it reflects local labour markets, employment and residential patterns. Accordingly it was decided to reject this indicator.

Exclusions

9.21 While exclusions from school are an important form of educational deprivation, there are too few permanent and temporary exclusions per year to make it possible to derive reliable EDIV level estimates. This is exacerbated by the fact that the data is only available at school level. As outlined above there are considerable methodological difficulties in allocating secondary school level data to EDIVs.

Pupil Turnover

9.22 Recent research has underlined the importance of excess pupil mobility on performance. If a reliable way could be found to collect this uniformly it could be a useful additional piece of information for a future Index.

A Level results

9.23 There are the same methodological problems in allocating A level results to EDIVs as with the GCSE data. Reliable EDIV level estimates are therefore problematic. Moreover UCAS data could be viewed as a substitute for the data. Accordingly A level results have not been included.

Other

9.24 So far no reliable national source has been discovered for young people not in education, training or employment. Most local studies suggest they are very difficult to estimate.

9.25 Many measures of educational resources, such as per pupil expenditure, pupil teacher ratios and the quality of the physical educational plant are all in their different ways affected by the existing distribution of resources to local government and schools. This may already include a significant addition for social needs. Thus any resource measure is likely to be influenced by this already weighted allocation.

Methodological Issues

9.26 The data on adult qualifications, staying on in full time education and entry to higher education can be directly expressed as an EDiv based rate. For the school-based information a GIS allocation procedure was developed that took account of the exact location of the primary school, its proximity to other similar schools, school type (e.g. denominational, Welsh as the language of teaching, etc.), and the type of area. Drawing on data from a set of areas where exact pupil locations were known, parameters for different types of schools were fed into this allocation procedure. This procedure converted the school-level data to EDiv-level data.

9.27 In some areas, e.g. small rural EDivs, the number of cases in an age cohort (e.g. taking KS2, applying to Higher Education) may be very small. The shrinkage estimation technique was thus applied so that such areas ‘borrow strength’ from the wider area. The education variables at EDiv level were therefore ‘shrunk’ to their unitary authority mean, in line with the general shrinkage procedures outlined in Section 5. In most cases these adjustments were relatively small.

9.28 The indicators in the Education Domain represent a diverse set of data. Some apply to the complete adult population (i.e. ‘stock’), and some to various groups of pupils moving through the system (i.e. ‘flow’). They cannot therefore simply be aggregated to achieve a simple domain score. The method consistently used in these circumstances is factor analysis. Using this procedure makes the assumption that underlying the specific items selected for the Education Domain there is an underlying dimension (educational deprivation/poor educational performance). Factor analysis identifies this and any other underlying dimension and produces weighting for the inclusion of each item in the Domain Index.

9.29 In the factor analysis for the Education Domain, a single meaningful factor emerged explaining the majority of the variance. The factor analysis takes into account any overlapping between indicators. The resultant single factor score was used as the Education, Skills and Training Domain Index score.

10 Housing Deprivation

Housing Deprivation: Summary of Indicators

- Proportion of housing in disrepair (1998 Welsh House Condition Survey)
- Proportion of houses without central heating (1998 Welsh House Condition Survey)
- Proportion of houses lacking roof/loft insulation (1998 Welsh House Condition Survey)

Purpose of this domain

10.1 This domain seeks to identify people living in unsatisfactory housing. Ideally, the domain would provide a measure of the proportion of people not living in accommodation suited to their needs. The most extreme example of this is homelessness, but accommodation might also be considered unsuitable if it was insecure, was not appropriate to the needs of the individual or family (for example because it was overcrowded, lacked access to play space for children, was inaccessible to a person with impaired mobility), was too expensive, or was unfit or in serious disrepair. Unfortunately, this information is not only unavailable in combination, but few of these indicators are available at all. The Domain thus concentrates on poor housing condition, which is a deprivation suffered by the people living in the housing regardless of the presence or absence of other deprivations captured by other domains.

10.2 The indicators selected have been taken from the Welsh House Condition Survey (WHCS), which combines an interview survey of over 40,000 households, and a physical inspection of houses by surveyors of 12,000 houses.

Indicators

Proportion of Housing in disrepair

10.3 Housing quality is a critical issue and is central to notions of housing deprivation. Much relevant data on housing quality are collected in the WHCS. The first indicator is a synthetic estimate and has been created by modelling the physical condition survey variable of houses either unfit for habitation, or in disrepair, using explanatory variables from the larger interviewer survey. The parameter estimates from the model allow an estimation of numbers of houses in disrepair at the EDiv level.

Proportion of Houses without Central Heating and Roof/Loft Insulation

10.4 The inability to properly heat a house is considered to be a good measure of poor housing. The lack of central heating and roof/loft insulation indicate poorly maintained accommodation which will be difficult to heat or keep warm and dry. These indicators were produced from variables in the larger WHCS interviewer survey, and applied to all EDIVs in Wales.

Rejected indicators

Household overcrowding

10.5 Although it is now somewhat dated, the Census provides information about household overcrowding. Ideally overcrowding would be measured in relation to the 'bedroom standard', but it is not possible to derive this from the Census.

10.6 Rates of overcrowding can vary significantly between areas, reflecting the varying need for housing capital investment to tackle the problem. But household overcrowding potentially reflects property prices in an area more than the conditions of the house *per se*.

Unsuitable Housing

10.7 Various measures of unsuitable accommodation have been proposed at different times based upon the 1991 Census. These include the measure of children in unsuitable accommodation (those living in purpose-built flats, or accommodation which was not purpose built, permanent or self contained). However, such indicators have not been included as there are no recent data.

Affordability

10.8 Affordability is a key aspect of housing deprivation and one which might justifiably have been incorporated in some way. However, measurement of this issue is fraught with difficulty since it relates to the composition of the dwelling stock, the costs of buying or renting housing, and the incomes of households living, or wishing to live in an area. See the 'Future Work: Recommendations' section, below.

Methodological issues

10.9 This domain was constructed from individual level data, that is, the WHCS respondents, with the modelled physical condition variable appended to the larger interviewer survey. 'Points' were given to the indicators by using the lack of each amenity (a point each), or the presence of disrepair (two points) to create a score. The disrepair indicator was considered particularly important, and hence its double weight. At EDiv level the total score was calculated by combining the indicator scores and calculating a percentage, taking the maximum possible score as the denominator. Shrinkage estimation was applied to this percentage to create the final domain score.

11 Geographical Access to Services

Access to Services: Summary of Indicators

- Access to a post office (GPO Post Office Counters) April 1998
- Access to large food shops (Data Consultancy) for 1998
- Access to a GP (NHS, BMA) for October 1997
- Access to Accident and Emergency Hospital facilities (Welsh Ambulance Services NHS Trust) for 1999/2000.

Purpose of this domain

11.1 Everybody needs access to the services and amenities that enable them to participate fully in society. It is therefore important to incorporate some measure of access in the Index since it is such an important factor in people's daily lives, particularly in rural areas, but also in poorly serviced urban areas. However, access to services is a complex issue – the following paragraphs outline some of the reasons why.

11.2 Some services are required on such a regular basis that they need to be provided locally. These might include shops selling goods to meet everyday needs, a doctor's surgery, post office and primary school. Other services may be essential, but may not usually be needed on such a regular basis. These could include a wider range of shopping facilities, sources of legal advice etc. Therefore, when considering the issue of access it is important to consider the frequency that people are likely to require the service.

11.3 The importance of different services may vary for different people, and the need for different services often changes throughout people's lives. Therefore, it may not be appropriate to measure access to some services for *all people*, as their needs may differ.

11.4 'Access' may not necessarily be a question of physical proximity to the services. For example, someone without a car and with poor public transport options could have more difficulty reaching a post office that is one mile away, than someone with a car or with good public transport options who lives five miles away from the nearest post office. Range, cost and frequency of public transport are key, as is availability of private transport. Also, the circumstances of the person can be a factor – disabilities, old age and number of young children can affect ease of access. Another matter to consider is that someone who lives far from certain services may commute to work and have a much wider choice of services near the place of work than at home.

11.5 Finally, there is the question of measuring distances to services. This could, in theory, be measured 'as the crow flies' (i.e. distance from one point to another as a straight line); by taking into account the route of public transport (e.g. bus) from one point to the other; the route if one was to drive there in a car; or the time taken to travel to the service by car/bus/train/bicycle/foot etc.

11.6 Unfortunately, such detailed information is not available for the whole of Wales and simpler options had to be explored which, whilst cruder, still provide an adequate approximation of the issue.

11.7 First, the focus has been on people with low incomes. While it could be argued that everyone is disadvantaged if services are a great distance away, people with higher incomes are more likely to have the resources to reach the services easily (i.e. money for public or private transport). People with low incomes are more likely to be experiencing the disadvantage of lack of access to services more acutely than those on higher incomes.

11.8 Second, distances ‘as the crow flies’ have been measured. While this does make the domain more crude, it is not yet possible to take the actual routes into account. The measurements will then be the very shortest distance that people travel to reach the service. In reality, people will have to travel further than this distance, and in some rural areas they may have to travel several times the distance (e.g. because of rivers, hills etc.).

11.9 Though there are many ways in which this domain could be refined in the future, (by calculating more accurate distances, based most likely on driving distance; by including a wider range of services; and by allowing for the cost, frequency and type of available private and public transport), these refinements would, at the present time, require significant resources devoted solely to such issues.

11.10 Although there is some issue of how geographical access differentially affects rural and urban areas, the domain is relevant for all areas because access to services is just as important an issue in run-down urban areas, and in the suburbs, as well as in rural areas. It is important that multiple deprivation should be identified by the Index in all areas in Wales, both rural and urban. Access to services that would inappropriately prioritise rural areas (e.g. access to museums) were not being measured, but rather services which were widely agreed to be important for every-day life.

Indicators

11.11 Access to post offices, large food shops, GP surgeries and A&E/casualty hospitals have been measured for low income people. The DSS provided an anonymised extract of the postcodes of all means tested benefit claimants in Wales. This included claimants of IS, JSA(IB), FC and DWA.

11.12 The postcodes of the claimants and postcodes of the services were assigned grid references. Using the post office indicator as an example, the distance from each claimant to the nearest post office, using the grid references of the claimants and all post offices was computed. The distances travelled by claimants were aggregated by EDiv and this total distance was divided by the number of claimants. This created an average distance from claimants to each type of service for each EDiv, as the crow flies.

Access to Post Offices

11.13 Access to post offices is measured in this domain. As well as providing access to the postal service, post offices offer a range of important services such as payment of pensions, cashing benefit giro-cheques, the facility to pay utility bills, and access to certain savings accounts. Post office counters has a large network of offices, often located within local shops.

Access to a GP Surgery

11.14 The BMA and the NHS provided the postcodes of GP practices in England and Wales. This is a valuable indicator of access to doctors for people with a low income. The GP data does not include most minor branch surgeries. In further developments of the Index it might be possible to obtain these addresses through the health authorities. However it may still be that some of these should be excluded if they are usually only open for limited periods of time and would not provide the same type of service as a main surgery.

Access to large food shops

11.15 The grid references of about 13,000 food retailers in the UK were obtained from a commercial company. This data set provides information about the access that people have to superstores, supermarkets and some other large food outlets. While it does not identify small corner shops, it is a valid indicator for access to 'higher tier' food shops.

Access to an Accident and Emergency/Casualty Hospital

11.16 The distance to an A&E/Casualty hospital has been measured for claimants, using data which was supplied to us by the Welsh Ambulance Services NHS Trust. This adds another important measure to the domain.

Rejected Indicators

Access to a Primary School

11.17 It was hoped to include an indicator measuring access to primary schools for all 5-8 year olds. Unfortunately, the anonymised, postcode level Child Benefit data extract post-dates the Central Postcode Directory available to the project team and due to the recent change in postcodes in certain areas in Wales it was not possible to assign grid references to a significant proportion of the children and this indicator was therefore excluded.

Number of cars

11.18 Data on car ownership was considered. Lack of car ownership has been used as a proxy for low income in the past. This proxy is no longer necessary because there are more direct measures of low income available (see Income Domain). It could be used as a measure of people's access to private transport. However, this measure fails to take into account the possibility that some poor people who possess cars might have made large financial sacrifices to keep the car, (particularly in rural areas), and that others may actively choose not to have a car because they have adequate alternative means of transport. Such a measure, by counting a non-car owner as deprived, would also work counter to efforts to reduce the use of cars and improve public transport. An additional reason for dropping this indicator is because of the EDiv-level distortions caused by centralised postcoding of car fleets.

Access to banks and building societies

11.19 This indicator was rejected because the location data available from banks and building societies is inadequately addressed and postcoded. It would be desirable to have an indicator for access to financial services in the future which would include, for example, access to banks, building societies, 'holes in the wall' and credit unions. However, any future inclusion of this indicator should be considered carefully, due to the increase in telephone based financial services.

Access to shopping centres

11.20 Another possibility was an indicator based on access to shopping centres. A commercial company produces an indicator of access to shopping centres. This is produced for every postcode, and is based on location in relation to 1,200 major shopping centres around the UK, measured in terms of the time to drive to the nearest shopping centre. The data have been evaluated and it was decided that because they are based on so few centres around the UK it would be inappropriate to use these data for the purpose of this Access Domain.

Non geographical barriers to access

11.21 Non geographical barriers to access have been considered, such as language difficulties, access for people with disabilities, and provision of culturally appropriate services. This would be an important dimension to include within this or another domain but it is not possible to obtain national data within the time scale. These issues should be explored in greater detail in a future version of the Index, as possibly another dimension of access.

Methodological issues

11.22 This domain allows some definition of 'access deprivation' but it is relatively under-developed. Whether the distance someone travels to a service causes them a problem will depend on many factors including household characteristics, and cost and availability of private and public transport. There are also many ways that the measurement of the distance could be refined, such as measuring road distances rather than 'as the crow flies' distances, or factoring in some kind of road network density. These refinements could not be made for this Index.

11.23 It was necessary to obtain service location data for England to ensure that, for claimants who live near the English border, services just over the border are also included in the calculations.

11.24 For each EDiv in Wales, the average distance for claimants to the nearest service of each type (A&E, Post Office, GP surgery and large food shop) as the crow flies was calculated. The shrinkage estimation procedure was applied to these distances. As the indicators measure different types of services (e.g. an A&E department is not needed as frequently as a food shop), it was decided to undertake a factor analysis of the four items to attain appropriate weights. One significant main factor, namely geographical access to services deprivation, was identified. The weighted items were then combined to create the domain score.

12 Crime and Physical Environment Domains

12.1 Unfortunately, robust small area data, for the whole of Wales, were not available to enable the inclusion of these two domains. Each domain presented particular problems, but there is optimism that future updates of the Index would be able to include indicators for both crime and physical environment, as more data is collected and becomes available.

Crime and Social Order

12.2 Crime and social order continues to be viewed as an important domain. However the data of the right quality and form were not been available during the review of the index, so this domain was not included. It is strongly recommended that work developed during the construction of the Index is taken forward. This should in due course, form the basis for a Crime Domain.

12.4 Police data on crime at a local area level were collected for some parts of Wales. Despite positive indications from all of the police authorities, and much support for the exercise, it was not possible to collect this for the whole of Wales, in a format that could be used at EDiv level.

12.5 Furthermore, local crime and disorder audits, required under the Crime and Disorder Act, were examined, but these do not necessarily hold such data in a consistent form. It would not be feasible to construct reliable national data from these audits.

12.6 IN 2000 the Home Office published the result of the first six months of the new system of collecting Basic Command Unit (BCU) data (Home Office *Recorded Crime Statistics*, 18th January 2000). This is the first time such data have become available below police authority area level across England and Wales. While the data are a substantial step forward, there are a number of remaining problems. First, a BCU is not a small area geography unit, it most closely relates to districts or UAs, but does not do so consistently as the BCU boundaries may vary substantially. For this reason, it has not been applicable to the Index which has taken EDivs as its basic level of geography. Second, it is as yet only six months of data and so would not take into account seasonal, or any other, variations; and finally there has to be further analysis of these data (for example whether there are variations in reportage). It is clear that the data require a significant amount of further testing and need to be available for a longer time period before they can be considered for inclusion in the Index.

Physical Environment

12.7 After careful consideration of the possible indicators and sources of data, this domain could not be included due to a lack of national, robust data that could be applied at small area levels. Despite this decision, this domain is still considered to be important, and there has been extensive support for its inclusion in future versions of the Index.

12.8 As well as the problems of data availability there remain conceptual problems relating to the measurement of exposure. For example, the quality of the environment may be very variable even within a small area, and people will often spend much of their time in places where they do not live – such as in the area where they work.

12.9 Several possibilities were explored relating to land use. There is currently no Land Use Database in Wales, although the Welsh Assembly has commissioned a study to look at the feasibility of such a project. This may mean that more data on land classification may be available for future updates of the Index. The last derelict land survey is now at least 10 years old and would not have been suitable for use in the Index. Further, some issues arose regarding whether derelict or polluted land is a poor measure of deprivation since it depends on the type of industry that was in decline. There were also questions about the consistency with which local authorities classify land as derelict and whether it would be possible to produce estimates for smaller areas.

12.10 The ‘Less Favoured Land’ European Community designation indicates land of limited potential which produces economic returns significantly lower than the national average, and was explored in relation to the Index. The information regarding such designations is kept by the Farming and Rural Conservation Agency at Aberystwyth University. However, this designation only applies ‘in terms of the handicaps to farming’ and is therefore not applicable to the whole of Wales. As such it could not be included in an Index designed to measure conditions which potentially apply to the whole country.

12.11 The three water companies which provide drinking water to Wales were co-operative in providing the data concerning drinking water quality which they provide to OFWAT. However, this data is collected for ‘Water Quality Zones’ which do not coincide with any administrative boundaries. The data is not collected at ‘tap incident’ level, and the compliance for Water Quality Zones is very nearly 100%. This indicator was therefore rejected.

12.12 Air quality indicators would provide a valuable measure of environmental pollution. Unfortunately it was not possible to obtain any robust air quality data that could be included in the Index, though this should become available in the future.

13 Combining the Domain Indices into an overall Index

Standardising the Domain Indices

13.1 Having obtained a set of Domain Indices these needed to be combined into an 'overall' index. In order to combine Domain Indices which are each based on very different units of measurement there needed to be some way to 'standardise' the scores before any combination could take place. For example although the Income and Employment domains are both expressed as proportions of the population, the Health, Housing, Access and Education domains are scores which cannot be so expressed. To simply combine them as they are would have been inappropriate.

13.2 The different domain measures needed to be put on to the same metric. This process is called 'standardisation'. One approach to this might be to calculate each EDiv score in terms of the numbers of standard deviations above or below the national mean - the so-called 'z scores'. Such scores could then be appropriately weighted and combined. An alternative might be to simply rank the EDivs in order of severity of deprivation and treat this rank as the new metric and combine the ranks.

13.3 Both these procedures were unsatisfactory for the purpose of this Index, as the distributions of the domain scores are not identical. If the 'z scores' were simply combined, this would build into the overall score an implicit weight which testing showed varies both across and within domains. This meant that if it was decided explicitly to weight education and housing equally, this equal weighting would be lost using 'z scores' - the implicit weights would be different (and variable) and the combination would not be the equal weighting that was wanted.

13.4 Using the ranks for each domain would solve some problems but would introduce others. Ranks would certainly have put domains on to the same metric. The problem is that the distance between each of the scores underlying the ranks is not equal. Once ranked this 'distance' is made equal and some of the values of the data are lost. Moreover the resultant symmetrical distribution again does not reflect actual distributions 'on the ground'.

13.5 The symmetrical nature of ranks (and 'z scores' of normal distributions) means that a 'good' score on one domain could fully cancel out a 'bad' score on another. This means that a relative lack of deprivation in one domain, would have had a major impact on a more severe deprivation in another domain, when combined into an overall deprivation result.

13.6 This issue of cancellation is clearly important for the understanding of the nature of multiple deprivation. If, for example, there were data on an individual who was known to be at the top of the income distribution, but who had no educational qualifications, an argument *might* be made that the *lack* of income deprivation should cancel out fully the education deprivation, and that this individual should be judged to be not deprived. (However, even here there would be arguments against such a direct and full cancellation.)

13.7 Furthermore, working as the Index does, not at an individual level, but at an *area* level raises further issues regarding cancellation. First, it is not possible to tell whether within an area the same individuals are being affected by the different

deprivations (or lack of them). Thus, it is not possible to assume what the relationship is between the 20% in a population lacking educational qualifications, and the 20% not health deprived. These groups may be entirely separate within an area. This means that it would not be appropriate to use the lack of health deprivation to cancel out the educational deprivation at an area level, as this would mask the true nature of deprivation in that area. (Even if they were known to be the same group, the argument about the individual level deprivation might also apply, that cancellation does not give a true or meaningful picture regarding deprivation).

13.8 In addition, as in this Index the domain scoring primarily looks at deprivation and not the converse measures of achievement or gains, a low score in a particular domain does not necessarily imply the presence of the attribute in abundance. So for example, the absence of low income in the Income Domain should not be taken to imply wealth. Throughout the Index, relative deprivations are being examined. Thus, a 'low' deprivation score in one domain still contributes to an overall picture of deprivation in an area. Each of the separate deprivations at small area level is an undesirable feature in its own right and the effect of each is in some way cumulative.

13.9 Given that the various deprivations are seen as largely non compensatory, the challenge was how to standardize/transform the domain scores in readiness for combination to give effect to this.

13.10 The solution was to rank the scores in a domain and then transform the ranks to an exponential distribution. Such a distribution has a number of properties. First the exponential distribution effectively spreads out that part of the distribution in which the Index has most interest - that is the 'tail' of deprivation which contains the most deprived EDIVs in each domain. In fact such a 'tail' is similar to what is seen if the untransformed distributions of the individual deprivations are examined, so in a sense some of the power of differential distance lost by standardizing the data by ranking, is being re-imposed on the ranks. Second, if the scores which have been transformed are combined in this way there is not a full compensation effect between domains. Indeed the slope of the curve can be adjusted to allow some compensation of a good score on a bad score but to restrict this in some way. To some extent the slope of the curve (or the amount of 'compensation' between domains permitted) is a matter of judgement.

13.11 However, actual distributions have a tail that reflects approximately 10% cancellation properties and it is thus possible to construct an exponential distribution which has these properties. The formula and shape of this distribution is detailed in Appendix E.

Combining the standardised Domain Indices and deriving appropriate weights

13.12 A procedure was adopted whereby combining the standardised Domain Indices into an overall Index of Multiple Deprivation was carried out using explicit weights.

13.13 The criteria for selecting the proposed set of weights for the standardised domains are as follows:

- **Income and Employment Domains should carry more weight than the other domains.**
- **The domains with the most robust indicators should be given greater weight.**

13.14 From the outset it was stated that the Income and Employment Domains should carry more weight than the other domains, a position supported by the research of the Oxford University Team and the wider academic literature. It would therefore have been inappropriate to simply sum the Domain Indices because this would have given each Domain Index equal weight.

13.15 On the second criterion it is important to stress that only indicators which were sufficiently robust were included within the Index. Nonetheless, some indicators are more robust than others, but only those which are sufficiently robust, as well as meeting the other criteria ('domain specific', measuring major features of that deprivation, up-to-date, capable of being updated on a regular basis, available across Wales at a small area level) were selected.

13.16 On the basis of these criteria greater weight was given to the Income and Employment Domains, followed by the Health deprivation and disability and the Education, skills and training Domains, with slightly less weight being given to the Geographical Access to Services and the Housing Domains.

13.17 Based on the criteria outlined above, the following weights were assigned (weights must total 100%):

Income deprivation	25%
Employment deprivation	25%
Health deprivation and disability	15%
Education, skills and training deprivation	15%
Housing deprivation	10%
Geographical access to services	10%

14 Presenting the Results and Interpretation

14.1 Results have been released at EDiv level for each of the Domain Indices and for the overall Index of Multiple Deprivation.

14.2 The EDiv level Index of Multiple Deprivation and the component Domain Indices have been published in an EXCEL spreadsheet. This will enable people to examine where EDivs are positioned in each of the Domains and the overall Index of Multiple Deprivation. So, for example, it will be possible to present information about the EDivs in a UA for the Education, Skills and Training Domain separately from aspects of deprivation measured in the other domains.

14.3 At the EDiv level there are eight Indices for each EDiv in Wales: six Domain Indices (which are combined to make the overall Index of Multiple Deprivation); an overall Index of Multiple Deprivation and a supplementary Child Poverty Index. These eight Indices are also each assigned a national rank. There are 865 EDivs in Wales. The most deprived EDiv for each Index is given a rank of 1, and the least deprived EDiv is given a rank of 865. The ranks show how an EDiv compares to all the other EDivs in Wales and are easily interpretable. However, the scores indicate the distances between each rank position, as these will vary.

The six Domain Indices and Ranks

14.4 Each Domain Index consists of the combined indicators in that domain (this is the factor analysis score in the case of the Health, Education and Geographical Access to Services Domains, a combined score for the Housing Domain and a rate for the Income and Employment domains). These are then ranked. These Domain Indices can be used to describe each type of deprivation in an area. This is important as it allows users of the Index to focus on particular types of deprivation, and to compare this across EDivs. There may be great variation within a UA, and the EDiv level Domain Indices allow for a sophisticated analysis of deprivation information.

14.5 The scores for the Income and Employment Domains are rates. So for example if an EDiv scores 38.6 in the Income Domain, this means that 38.6% of the EDiv's population are Income deprived. The same applies to the Employment Domain. The scores for the remaining four domains are not rates. Within a domain, the higher the score, the more deprived the EDiv. However, the scores should not be compared between domains as they have different minimum and maximum values, and ranges. To compare between domains, the ranks should be used.

The overall Index of Multiple Deprivation

14.6 The overall Index of Multiple Deprivation describes the EDiv by combining information from all six domains: Income, Employment, Health, Education, Housing and Access. These were combined in two stages; first each domain was ranked and then transformed to a standard distribution – the exponential distribution described above. Then the domains were combined using the explicit domain weights chosen. The overall EDiv level Index is ranked in the same way as the Domain Indices.

14.7 The IMD score is the combined sum of the weighted, exponentially transformed domain rank of the domain score. Again, the bigger the IMD score, the more deprived the EDiv. However, because of the exponential distribution, it is not possible to say,

for example, that an EDiv with a score of 40 is twice as deprived as an EDiv with a score of 20. In order to make comparisons between EDivs the use of ranks is recommended. The most deprived EDiv according to the IMD is assigned a rank of 1, and the least deprived EDiv, a rank of 865.

The supplementary Child Poverty Index

14.8 The Child Poverty Index is a subset of the Income Domain Index, and shows the percentage of children in each EDiv living in families that claim means tested benefits (Income Support, Job Seekers Allowance (Income Based), Family Credit and Disability Working Allowance). The Child Poverty Index is not combined with the other domains into the overall Index of Multiple Deprivation. A Child Poverty Index score of e.g. 24.6 means that 24.6% of 0-16 year olds in that EDiv are living in families claiming means tested benefits.

Maps

14.9 The **attached maps** show the spatial distribution of the Domain Indices and the Overall Index of Multiple Deprivation at EDiv level. The EDivs have been quintised (divided into five equal groups) according to the deprivation scores in each domain. Each quintile contains 173 EDivs. The light yellow colour depicts the least deprived quintile and dark blue depicts the most deprived quintile.

13 Future Work: Recommendations

This section draws together many of the recommendations and indications for future work which have been mentioned throughout the report. In keeping with the conceptualisation of the Index as dynamic and capable of being updated and improved, suggestions for future work made during the consultation process have been incorporated here.

Updating the Index

The Welsh Index of deprivation was constructed with the understanding that it would be revised more regularly than is possible if one depends solely on the decennial census of population. The innovative use of benefits and other data allow for regular updates. The Index should be updated centrally to ensure that the data remains comparable. This will be the responsibility of the National Assembly for Wales.

Population Estimates and the geography of the Index

One of the key problems facing the construction of an Index at a sub-EDiv level, is the absence of inter-censal robust population estimates for small areas. For the purpose of this Index the NHSARs have been used, but as with all population estimation, there is the potential for refinement. Advances in this area are welcomed, primarily to increase robustness at EDiv level and also to allow deprivation analysis at a sub-EDiv level.

If a sub-EDiv level analysis were possible then presentation of the Index for geographical areas such as Community Councils would be possible. It can already be presented for larger geographical areas, such as Health Authorities and Parliamentary Constituencies, so long as these areas are made up of 1998 EDivs as building blocks.

Future changes to EDiv boundaries present particular challenges to any methodology for determining small area deprivation. Decisions will need to be taken regarding the adoption of new boundaries, and the creation and maintenance of 'look-up' tables to allow comparisons between different geographies.

Criteria for accepting new data into domains

Although the strength of this methodological approach is its capacity to allow the incorporation of new and better measures of aspects of deprivation, as they become available, it is imperative that the quality of such measures is assured. Such quality assurance was undertaken in respect of indicators currently included. Any future indicators should:

- be 'domain specific' and appropriate for the purpose (that is defensible for being as direct as possible measures for that form of deprivation)
- measure major features of that deprivation (not conditions just experienced by a very small number of people or areas)
- be up-to-date
- be capable of being updated on a regular basis
- be statistically robust
- be available consistently for all of Wales at a small area level

Income Domain

The Income Domain would be improved by obtaining:

HB/CTB data for all the UAs

At the time of the construction of the Index, three authorities in Wales did not supply extracts of HB/CTB data to the Benefits Agency. Since this time, two of the three UAs have contributed data. It is hoped that soon all the UAs will take part in this process. This would mean that the Income domain would not rely on any modelled data, which however robust, is less preferable than the data extract itself.

Data on earnings from the Inland Revenue

See paragraph 6.12 for details about this issue.

Data on the cost of living

If small area data on variation on cost of living could be obtained, this might be used to weight this domain.

Benefit take-up

If robust data became available on small area variation in take-up, this might be used to weight the benefit components of the domain.

Persistent low income

A measure of persistent low income at EDiv level would strengthen this domain. A possible future candidate for such a measure would be long-term claims of means tested benefits. This would need to take into account brief interruptions to claims.

Employment Domain

Persistent unemployment/worklessness

As with the Income Domain, a measure of persistent unemployment or worklessness at EDiv level would contribute to this domain. However, as we have indicated, current unemployment duration data is inadequate, as it takes no account of 'cyclers'. See paragraph 7.16 and 7.17.

People out of work but in Training

Data on people out of work but in training could be obtained from the DfEE and future versions of the Index should incorporate this.

Health and Disability Domain

Welsh Health Survey

The possibility of modelling health status variables from the Welsh Health Survey should be explored. If robust small area estimates can be generated, consideration should be given to their incorporation.

Inpatient and Day Case Hospital Episode Data

As has been indicated, this source of data should be explored further in future versions of the Index.

Cancer Incidence

As we have indicated, further work should be undertaken to explore the incorporation of data on new cancer registrations in Wales.

Education, Skills and Training Domain

Secondary School Performance Data

If GCSE/GNVQ results were pupil postcoded, then these data could be reliably allocated to local areas. Many secondary schools have postcoded pupil data and, separately, individual pupil examination results. This development would significantly enhance a future education domain.

Absenteeism

If such secondary school pupil postcoding was available across Wales, then it would make sense also to include secondary school absenteeism that is currently collected at school level, but cannot be allocated to local geographic areas.

Pupil Turnover

As we have indicated, recent research has underlined the importance of excess pupil mobility on performance.¹⁰ If a reliable way could be found to collect this uniformly it could be a useful additional piece of information for a future Index.

Adult Literacy

Other possible candidates for non-school data might be adult literacy levels, for example the Basic Skills Agency's estimates of adult literacy, which are modelled down to the local level. However at this stage the LFS basis for the adult population's qualifications is a stronger candidate, being a much larger sample and using a robust measure (highest qualification obtained). Further years of LFS data can be added to enlarge the number of cases in each area.

Housing Domain

Affordability

There is potential to use information on Council Tax bands to 'grade' areas of housing by cost, and to use Housing Benefit management systems to estimate the proportions of people who cannot afford local rents. However, this is conceptually a difficult area as this issue may not directly relate to deprivation but encompasses area desirability as well as differences in the housing stock. It is therefore recommended that it is a low priority for future versions of the Index.

Geographical Access to Services Domain

Measuring Distance

The measurement of distance should be refined to take account of distance by road, rather than 'as the crow flies' distances. This will become increasingly possible with the rapid development of GIS packages which can currently only efficiently handle smaller numbers than are involved in this domain.

¹⁰ For example, research by J. Dobson at the Institute of Education, London.

Non-geographical barriers to access

The report mentions non-geographical barriers to access. These might include culturally acceptable facilities, access for people with disabilities, and access to internet services etc.

Access to a GP Surgery

In future versions of the Index it might be possible to incorporate data on branch surgeries as well as main surgeries, by obtaining these addresses directly from the health authorities. However as outlined above, it may still be that some of these should be excluded if they are usually only open for limited periods of time and would not provide the same type of service as a main surgery.

Access to food shops

In future versions of the Index the access to food shops indicator could be enhanced by including smaller food shops if such data become available.

Private and Public Transport

The incorporation of information about cost, frequency, and type of available private and public transport would enhance this domain.

Other Indicators

There are many indicators relating to core services which may be usefully considered for incorporation in a future version of this domain.

Crime Domain

The Crime Domain has been discussed above in section 12. Future work on this Domain relies upon the development of comparable small area data for the whole of Wales on important indicators such as household burglary, and crime against the person. From the research undertaken for the Index, it seems possible that new data compilation and extraction techniques will soon allow police authorities to provide such information for deprivation analysis, subject to suitable agreements regarding confidentiality.

Physical Environment Domain

This Domain and the potential indicators for inclusion are discussed above in section 12.

Appendix A: Geography – EDivs, Enumeration Districts and the use of 1998 Boundaries

A1 At the time of the 1991 Census, OPCS (now the Office of National Statistics) used two sub-district output geographies- EDivs (EDivs), and Enumeration Districts (EDs).

A2 Since the 1991 Census there have been a number of EDiv boundary changes. Some have been *ad hoc* and some have related to the creation of unitary authorities (22 in 1996). The former are relatively small in number, the latter more extensive.

A3 In order that the borders should be current, EDivs as of the 1st April 1998 were used in this study. This does, though, create a problem of ‘fitting’ ED level data to 1998 EDivs if any 1991 Census data is to be used in the index.

A4 A ‘look up table’ from 1991 Enumeration Districts to 1998 EDivs needed to be constructed if any 1991 base data were to be utilised. ONS have ledger entries (often in manuscript) which give some help. Ordnance Survey produces annual text descriptions of boundary-line updates and some academics (e.g. Wilson and Rees in Leeds, and Barr in Manchester) have done some useful work. Wilson and Rees’s work is useful at district level and Barr’s work is useful in referencing to 1997 boundaries. None of these sources, however, provide the required information, so a look up table using GIS techniques was produced for the project. This involved overlaying household weighted postcode centroids and 1998 EDiv boundaries on 1991 ED boundaries and creating a look up table of 1991 EDs (and fractions thereof) to 1998 EDivs.

Appendix B: Population Estimates for Unitary Authorities and EDIVs

Introduction

B1 Within each spatial level in the Welsh Index of Local Deprivation – unitary authorities (UAs) and EDIVs (EDIVs) – there is variation in the size of the population. To allow for this in measuring the prevalence of any type of deprivation, it is therefore necessary to relate the number of people experiencing deprivation to the number who could potentially experience it. The indicators therefore need denominators.

What denominators are needed?

B2 The list below therefore summarises the denominators which were required:

Total population

Adults: aged 18 or over
 working age (16-retirement)
 economically active population of working age

People of pensionable age

Children: aged under 16
 aged under 18

The solution

B3 While the Office for National Statistics (ONS) publishes annual estimates of the population of each UA by sex and year group, they do not produce inter-censal estimates of the populations of smaller areas (such as EDIVs or enumeration districts).

In Wales considerable work has been undertaken on developing NHS age/sex registers for use in population estimation. The resultant NHSARs have been produced on behalf of the National Assembly and are available at EDIV level. The Oxford Team developed an alternative methodology whereby Child Benefit, retirement pension, and electoral register data were used to distribute ONS district level mid-year estimates to wards.¹¹ There is no ‘gold standard’ and both methods are undoubtedly subject to error. There is no *prima facie* reason to choose one over the other.

Because of the work invested in the NHSARs it was decided to undertake some validation using benefit data and ONS mid-year estimates. NHSAR estimates were compared with Child Benefit (a virtually universal benefit) figures for the relevant age groups and points in time. There was a high correlation. When both sets of figures were aggregated up to a UA level and compared with the ONS estimates of population there was again a high degree of correspondence. This exercise was also carried out with pensions data, which again gave confidence in the NHSAR population estimates. It was not possible to undertake any validation of the working age population, but this group is also the most problematic in any alternative methodology. It was therefore decided, in consultation with the Index steering group, that the NHSARs should be used as a source of denominators in the project.

¹¹ See REF?

B4 The economically active population of working age still had to be estimated. This was done using the following methodology.

B5 At a UA level:

1. For each UA calculate economic activity rates (proportion of people of working age who are economically active) for 5 year age groups for both men and women from the 1991 Census.
2. Multiply these rates by the numbers of men and women of working age in each 5 year age group.
3. Separately for men and women sum the UA totals within counties.
4. Estimate the number of men and women in each UA who are economically active by scaling the UA level estimates proportionally to be consistent with county level estimates (1995 Counties) of men and women who are economically active from the summer 1997 quarter of the Labour Force Survey .

At an EDiv level:

5. Estimate the number of men and women in each EDiv who are economically active by repeating steps 1-4 for EDivs within UAs. However, the calculation for EDivs were done for all men and women of working age (rather than in 5 year age bands) because estimates are only available for all men and women of working age .

Appendix C: ‘Shrinking’ the estimates of EDiv level proportions/ratios

The ‘shrunk’ estimate of a EDiv-level proportion (or ratio) is a weighted average of the two ‘raw’ proportions for the EDiv and for the corresponding UA. The weighted average is calculated on the logit scale, for technical reasons, principally because the logit of a proportion is more nearly normally distributed than the proportion itself. The weights used are determined by the relative magnitudes of within-EDiv and between-EDiv variability.

If the data for the EDiv j are r_j individuals with a particular attribute out of n_j in total, the empirical logit is

$$z_j = \log \left[\frac{(r_j + 0.5)}{(n_j - r_j + 0.5)} \right]$$

whose estimated standard error (s_j , say) is the square root of

$$s_j^2 = \frac{(n_j + 1)(n_j + 2)}{n_j(r_j + 1)(n_j - r_j + 1)}$$

[See, for example, D. R. Cox (1970), *Analysis of Binary Data*, pp. 33-34]. The corresponding counts r out of n at UA level give the UA-level logit,

$$z = \log \left[\frac{(r + 0.5)}{(n - r + 0.5)} \right]$$

The ‘shrunk’ EDiv-level logit is then the weighted average

$$z_j^* = w_j z_j + (1 - w_j) z,$$

where w_j is the weight given to the ‘raw’ EDiv- j data and $(1-w_j)$ the weight given to the overall rate for the UA. The formula used to determine w_j is

$$w_j = \frac{1/s_j^2}{1/s_j^2 + 1/t^2}$$

where t^2 is the inter-EDiv variance for the k EDivs in the UA, calculated as

$$t^2 = \frac{1}{k-1} \sum_{j=1}^k (z_j - z)^2$$

Thus large EDivs, where precision $1/s_j^2$ is relatively large, have weight w_j close to 1 and so shrinkage has little effect. The shrinkage effect is greatest for small EDivs in relatively homogeneous UAs.

The final step is to back-transform the shrunken logit z_j^* using the ‘anti-logit’, to obtain the shrunken EDiv level proportion

$$p_j^2 = \frac{\exp(z_j^*)}{1 + \exp(z_j^*)}$$

for each EDiv.

Appendix D: Appendix E: Factor Analysis

E1 In the Employment and Income domains individuals can be identified who are or are not deprived in terms of the domain definition. The number of deprived can then simply be summed and divided by a suitable denominator to create an area rate. This is not possible in the other four domains. These deprivations tend to exist in different spatial and temporal forms so, for example, an individual is health deprived if they die prematurely or are long-term sick. They clearly cannot be both at the same time. Instead it is hypothesised that an underlying factor exists at an ecological level that makes these different states likely to exist together in a local area. This underlying factor cannot be measured directly but can be identified through its effect on individuals (eg premature death, long-term sickness, low birth-weight children etc.). A number of variables has therefore been collected that measure the effect of this underlying factor on the individual. These variables need to be combined at an ecological level to create an area score. Fundamentally this score should measure, as accurately as possible, the underlying factor.

E2 There are a number of problems in achieving this goal. The variables: [1] are measured on different scales, [2] have different levels of statistical accuracy, [3] have different distributions, [4] may or may not apply to the same individual and [5] measure, to different degrees, the underlying factor imperfectly. Maximum Likelihood (ML) factor analysis is a method that deals with all these problems. Other methods, such as applying a linear-scaling model (i.e. adding a large number of items that purport to measure the same construct together to increase the reliability of a scale – assuming error elements to be non-additive and random), deal with only some. Even within the factor analysis family of techniques other methods, such as Principal Components Analysis (PCA), do not address all these problems. PCA, for example, ignores measurement error (*error variance*) or the variables' imperfect measurement of the underlying construct (*specific variance*). This is because it does not attempt to separate *common variance* (i.e. variance shared between three or more variables) from *specific variance* and *error variance*. The appropriate technique, where specific and error variance are suspected (i.e. problems 2 and 5), is a form of *common factor analysis* of which ML factor analysis is a type.

E3 The premise behind a simple one-common factor model is that the underlying factor is imperfectly measured by each of the variables in the dataset but that variables that are most highly correlated with the underlying factor will also be highly correlated with the other variables. By analysing the correlation between variables it is therefore possible to make inferences about the common factor and indeed estimate a factor score for each case (i.e. EDiv). This, of course, assumes that the variables themselves are all related to the underlying factor to some extent and are in most cases fairly strongly related to it.

E4 It is not the aim of this analysis to reduce a large number of variables into a number of theoretically significant factors as is usual in much social science use of factor analysis (i.e. exploratory factor analysis). The variables have been chosen because they are believed to measure a single area deprivation factor. The analysis therefore involves testing a one-common factor model against the possibility of there being more than one. If a meaningful second common factor was to be found it would suggest the need for a new domain or the removal of variables. Decisions over whether a meaningful second common factor existed are aided by standard tests and

criteria. Because a great deal of the unexplained variance may be due to either unique or error variance, a large residual proportion of the total variance not explained by the one common factor *does not* indicate that there are other significant factors or that the one common factor model is not an appropriate solution.

E5 Although *derived* on the basis of an assumption of normality, normal-theory ML as a method for estimating the factor model is not invalidated by non-normality (Howe, 1955). The situation is analogous to the use of least squares in linear regression models: least squares is ML if the errors are normal, but remains valid when they are not. It is therefore possible to use untransformed variables in the analysis. The process of transformation to a normal distribution would add an extra stage of complexity and its avoidance is therefore desirable. Principal Factoring (PF) has, in the past, been the favoured method of common factor analysis but this was because of its relative computational simplicity. With the advent of high powered computers more sophisticated methods, such as ML factor analysis, are now easily accomplished. PF has a number of disadvantages compared to ML factor analysis. The PF solution depends on the scale of measurement of the input variables (i.e. depends on whether or not they have been standardized), which means that there is not one but an infinity of PF solutions, the choice among which is arbitrary (Venables and Ripley, 1999). The factor model itself is intrinsically scale free, and thus any procedure for its estimation should be scale invariant. ML is scale invariant. ML also treats the correlation matrix as a sample correlation matrix and attempts to explain variance in the *population* correlation matrix. This treatment of the data as a sampled dataset is consistent with the theory of super populations that runs throughout the project. It also allows for the statistical testing of a one factor model.

E6 Bartlett's method was used, in this instance, because it does not require normality to give an unbiased estimator. As noted above, the data is not necessarily normally distributed.

E7 Once a satisfactory solution is achieved a factor score can be estimated for each EDiv. That is, the combined indicators, weighted according to the factor analysis results, are then used as the domain score.

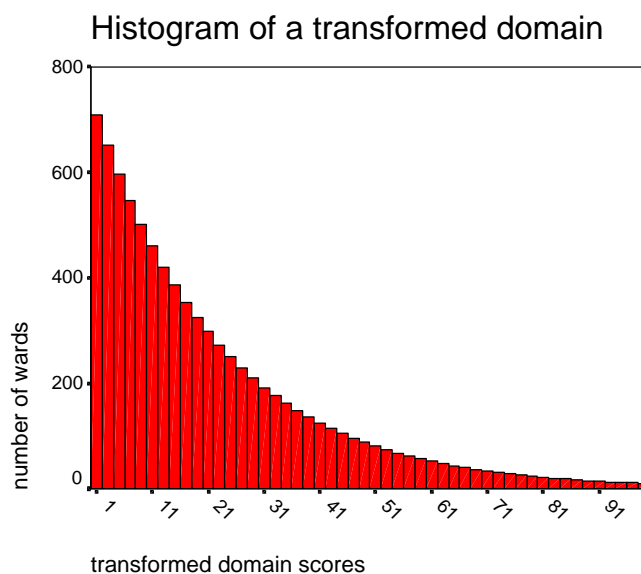
Appendix E: Exponential Transformation of the Domain Indices

D1 The precise transformation involved is as follows. For any EDiv, denote its rank on the domain, scaled to the range [0,1], by R (with $R=1/865$ for the least deprived, $R=865/865=1$ for the most deprived).

D2 The transformed domain, X say, is $X = -23 \cdot \log\{1 - R \cdot [1 - \exp(-100/23)]\}$

where \log denotes natural logarithm and \exp the exponential or antilog transformation, and $*$ denotes multiplication. This formula may at first sight seem complicated, but it is very straightforwardly calculated and is in fact simpler than the commonly-used transformation to a normal curve which necessitates the use of a look-up table. The resulting distribution is illustrated on the following page in a histogram.

D3 Each transformed domain has a range of 0 to 100, with a score of 100 for the most deprived EDiv. Ten percent of EDivs have a score higher than 50. When transformed scores from different domains are combined by averaging them, the skewness of the distribution reduces the extent to which deprivation on one domain can be cancelled by lack of deprivation on another. For example, if the transformed scores on two domains are simply averaged, with equal weights, a (hypothetical) EDiv that scored 100 on one domain and 0 on the other would have a combined score of 50 and would thus be ranked at the 90th percentile. (Averaging the untransformed ranks, or after transformation to a normal distribution, would result in such a EDiv being ranked instead at the 50th percentile: the high deprivation in one domain would have been fully cancelled by the low deprivation in the other.) Thus the extent to which deprivation in some domains can be cancelled by lack of deprivation in others is, by design, reduced.



Glossary of Abbreviations

AA	Attendance Allowance
A&E	Accident and Emergency
BCU	Beat Command Unit
BMA	British Medical Association
CB	Child Benefit
CESA	Inland Revenue's computer system dealing with self assessment
CMR	Comparative Mortality Ratio
CPD	Central Postcode Directory
COPS	Inland Revenue's computer system dealing with PAYE
CTB	Council Tax Benefit
DETR	Department of the Environment, Transport and the Regions
DfEE	Department for Education and Employment
DLA	Disability Living Allowance
DSS	Department of Social Security
DVLA	Driver and Vehicle Licensing Agency
DWA	Disability Working Allowance
ED	Enumeration District
EDiv	Electoral Division
ES	Employment Service
FC	Family Credit
FRS	Family Resources Survey
GCSE	General Certificate in Secondary Education
GIS	Geographical Information System
GMS	General Matching Service
GNVQ	General National Vocational Qualification
GP	General Practitioner
GPO	General Post Office
HB	Housing Benefit
HBAI	Households Below Average Income
HBMS	Housing Benefit Matching Service
HE	Higher Education
IB	Incapacity Benefit
ILO	International Labour Organisation
IMD	Index of Multiple Deprivation
IS	Income Support
JSA(IB)	Job Seeker's Allowance (Income Based)
JUVOS	Computerised individual level unemployment data held by ONS
KS2	Key Stage Two
LFS	Labour Force Survey
MA	Modern Apprenticeship
MIDAS	Matching Intelligence and Data Analysis Services
ML	Maximum Likelihood
NHS	National Health Service
NHSAR	National Health Service Administrative Registers
NIRS2	Computer system - Contributions Agency (soon to be Inland Revenue)
NOMIS	National On-line Manpower Information System
NVQ	National Vocational Qualification
ONS	Office for National Statistics

OPCS	Office of Population Censuses and Surveys
PAF	Post Code Address File
PCA	Principal Components Analysis
PF	Principal Factoring
QSE	Quarterly Statistical Enquiry
SDA	Severe Disablement Allowance
SEN	Special Education Needs
SEU	Social Exclusion Unit
SMR	Standardised Mortality Ratio
TDS	Trainee Database System
TEC	Training and Enterprise Council
UA	Unitary Authority
UCAS	University and Colleges Admissions Service
WHCS	Welsh House Condition Survey
WHS	Welsh Health Survey
WFTC	Working Families Tax Credit