Measures of Deprivation in Northern Ireland

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About this Report

The research team at Oxford University's Department of Social Policy and Social Work was contracted in July 2000 by the Northern Ireland Statistics and Research Agency (NISRA) to review deprivation measures in Northern Ireland.

This report presents the domains and indicators for the new Northern Ireland Measures of Deprivation. It also sets out the methodology for combining the indicators into Domain Deprivation Measures and for combining the domains into an overall ward level Multiple Deprivation Measure (MDM). This report also describes the results and presents maps of the domains and Multiple Deprivation Measure. The analysis is based on the Enumeration District, ward and Local Government District boundaries which were in place at the time of the 1991 Census. As far as has been possible, the indicators use data from 1999.

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Chapter 1: The Nature of Multiple Deprivation

Background

The need for information about the geographical distribution of relative deprivation in Northern Ireland has long been recognised. In response, each of the last three Censuses of Population in 1971, 1981 and 1991 has been examined to produce information on deprivation. The result of the 1991 analysis was a series of deprivation measures constructed by a team under the leadership of Professor Brian Robson of the University of Manchester. These measures have been used by a wide variety of programmes and projects to help target social and economic deprivation most effectively.

However, advances in the collection and use of other data sources, such as administrative data, have allowed analysis of deprivation at small area level in the inter-censal period. Such advances have also released the analysis from using proxy indicators from the Census in favour of using direct measures of deprivation, such as low income. In addition, recent work has developed the conceptualisation of multiple deprivation and its component parts, and this has been built in to the construction of the new Northern Ireland Measures of Deprivation[1].

Poverty and Multiple Deprivation

In his 1979 account of *Poverty in the United Kingdom* Townsend sets out the case for defining poverty in terms of relative deprivation. Thus his definition is: 'Individuals, families and groups can be said to be in poverty if they lack the resources to obtain the types of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged or approved in the societies to which they belong'[2]. Though 'poverty' and 'deprivation' have often been used interchangeably, many have argued that a clear distinction should be made between them. It could be argued 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 (1998) notes that in recent debates on 'Social Europe', the terms poverty and social exclusion have been used on occasions interchangeably, but defines poverty as a 'lack of money or material possessions'[3]. Townsend himself concurs. In his article 'Deprivation' Townsend argues that 'people can be said to be *deprived* if they lack the types of diet, clothing, housing, household facilities and fuel and environmental, educational, working and social conditions, activities and

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[1] Beatty, R., *et al*, (April 2001), *Targeting Areas of Social Need in Northern Ireland*, NISRA Occasional Paper 16.
[2] Townsend, P., *Poverty in the United Kingdom* (1979, Penguin), pp.31.
[3] A. B. Atkinson 'Social Exclusion, Poverty and Unemployment', in A. B. Atkinson and J. Hills (eds.) *Exclusion, Employment and Opportunity* (1998, London School of Economics Centre for Analysis of Social Exclusion), pp. 1-20.

facilities which are customary …' (our italics). People are in poverty if they lack the resources to escape deprivation[4].

In his 1987 article Townsend elaborates distinctions between social and material deprivation. The former - which he acknowledges as more difficult to measure - 'providing a useful means of generalising the condition of those who do not or cannot enter into ordinary forms of family or other relationships'. In this he is anticipating some aspects of what one might now call 'social exclusion'. The more easily measured material deprivation relates to diet, health, clothing, housing, household facilities, environment and work.[5] Townsend also lays down the foundation for articulating multiple deprivation as an accumulation of single deprivations - a concept which is developed further in the design of the new Northern Ireland Measures of Deprivation.

Though Townsend's work mainly (though not entirely) referred to individuals experiencing deprivations - single or multiple – the arguments can, in modified form, extend to area based measures. However, data availability inevitably means that some of the sophistication of his original concept is lost. At an area level it is very difficult to measure the percentage of the population experiencing one, two or more deprivations. It is possible to look at single deprivations at an area level and state that a certain proportion of the population experiences that deprivation, a proportion experiences some other form of deprivation etc. and at an area level describe the combination of single deprivations as area level multiple deprivation. This says little of the *individual* experience of *multiple* deprivation.

The 'Robson Measures' used the idea of 'domains' to classify elements of deprivation which contributed to the overall Measure of Deprivation. Thus there was an Environment domain under which variables relating to health, shelter and physical environment were grouped; a Skills/Socialisation domain comprising of education and family variables; and finally a Resource Base domain which included indicators relating to income and employment. The indicators were combined into a single Measure at Enumeration District (ED) level, ward level, and Local Government District (LGD) level. At the ward and LGD levels additional indicators were introduced meaning that the Measures at the different spatial levels were not directly comparable. The individual domains of deprivation played no role in the construction of the overall Measure of Deprivation and the indicators were not combined to form separate Domain Measures. This had the effect that domains of deprivation with a greater number of indicators received more weight in the single overall Measure of Deprivation.

The new research team has built on the earlier work in Northern Ireland and moved forward the measurement of multiple deprivation both conceptually and practically. The current approach is to conceptualise multiple deprivation as a composite of different dimensions or domains of deprivation. However, each dimension is measured independently using the best indicators available to generate a score or Domain Measure for each aspect of deprivation. These domain scores are then combined with explicit

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[4] P. Townsend, 'Deprivation', *Journal of Social Policy*, 1987, vol. 16, part 2, pp. 125-146, p. 131, p. 140.
[5] *Ibid*. p 136.

weighting to generate a Multiple Deprivation Measure which is an aggregate of the component domains. As will be discussed, the availability of new data has allowed these domains to be described with more precision, and in a more robust and consistent way than has been possible before.

The approach allows the separate measurement of different dimensions of deprivation, such as housing deprivation, education deprivation and health deprivation. There is a question as to whether there should be an additional domain for low income, or one that measures the lack of socially perceived necessities (e.g. adequate diet, consumer durables, ability to afford social activities etc.). To follow Townsend, within a Multiple Deprivation Measure only the deprivations flowing from a low income would be included so low income itself would not be a component, but socially perceived necessities would. However, there are no readily available small area data on the lack of socially perceived necessities and therefore low income is an important indicator for these aspects of material deprivation. Moreover, there are arguments that measures of consumption are themselves problematic as lack of certain items may be by choice rather than inability to pay for them. Therefore, it is appropriate to measure low income itself rather than the possession of certain items.

The research team recognise income deprivation in its own right but would not argue that it should be the only measure of area deprivation, and this has been supported throughout the consultations. Many dimensions of deprivation are measured in the Measures of Deprivation more directly than before. The other dimensions of deprivation contribute crucial further information about an area. However low income remains a central component of the definition of multiple deprivation for the Measures of Deprivation. As Townsend writes '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.'[6]

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 measurable. 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.

This perspective accommodates the reality of varying combinations of deprivation and disadvantage in different types of areas, which has been 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 addition of items to form a measure of 'multiple deprivation'. And if multiple deprivation cannot be *directly* quantified then there are problems in technically validating any overall Multiple Deprivation Measure as 'validation' requires something against which the Multiple Deprivation Measure can itself be measured. If this is correct, then the

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[6] Townsend, 'Deprivation', p. 131.

question of how components in the overall Multiple Deprivation Measure might be weighted rightly becomes a central question.

Individual, Household and Area Level Deprivation

Measuring different aspects of deprivation and combining these into an overall Multiple Deprivation Measure 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 composite measure are likely to be presented in the form of an aggregate score for that area. But this may combine deprivations experienced by many *different* groups within that area.

The research team's approach to measuring multiple deprivation

This brief debate on poverty and deprivation has underlined the importance of the financial component in any overall measurement of deprivation. This theme runs through the research team's approach to multiple deprivation and the basis for weighting the components in any overall multiple deprivation measure.

The debate also confirms the idea of separate 'domains' of deprivation, which any individual may experience singly or in combination. The intention has been to find ways of assessing the major forms of deprivation to create a robust deprivation measure for each domain - that is for income, unemployment, education etc. separately.

This approach implies rather more items in total than in earlier overall measures of deprivation. It also requires 'domain specific' items (and not what often happens when for example, 'educational deprivation' is measured by a mix of education, social and economic factors in combination). It also requires procedures for combining items *within* any Domain Deprivation Measure according to clear rules.

Particular Issues

During the consultation several issues were raised regarding the need for indicators to capture the deprivation experienced by people living in rural areas. Several features of the Measures of Deprivation address these concerns. Firstly, all indicators included in the Measures of Deprivation had to be applicable to the whole of Northern Ireland, so that fair scores and comparisons between areas could be made. This means that all of the indicators in the Measures of Deprivation are applicable to both rural and urban areas. For example, high rates of unemployment can in principle occur in both rural and urban wards, and would then be captured by the rate of people claiming the relevant benefits.

Second, indicators which have different 'meanings' depending on their location have not been included. Thus, car ownership, which has previously been used as a proxy for low income, has not been included, as in some areas people might choose to make other financial sacrifices because they need a car to get to work if there is limited public transport. Low income itself is measured directly in the Income Domain by the inclusion of counts of people claiming benefits. It is also appreciated that 'rural' areas do not necessarily share all the same characteristics, and that these differences will be revealed in the ward scores and ranks. This is of course also true of the differences between and within 'urban' areas.

Many people expressed concern during the consultations that the Measures of Deprivation should take some account of the toll the Troubles has taken on the lives of people living in Northern Ireland. Suggestions were made as to how particular aspects of this might be measured. However, very few sources of Northern Ireland wide data are available which are specifically related to the Troubles. Some other suggested indicators included unemployment counts, a measure of mental health, and poor access to services. Indicators which measure each of these have been included in the Measures of Deprivation. However, these indicators do not measure a causal link between the Troubles and, for example, high unemployment. Each indicator measures a deprivation in its own right, and not in relation to the Troubles, as it is not possible to distinguish in the Measures of Deprivation between a person who is unemployed as a direct result of the Troubles, and a person who is unemployed because of low economic growth in an area. Similarly it is hard to quantify the effect of segregated housing or schooling on the individuals living in an area. The strength of the Measures of Deprivation is that by combining many indicators into domains of deprivation which are in turn combined to create a Multiple Deprivation Measure, wards which face a number of problems, however complex the causality, will be identified, and the consequences of the Troubles will be incorporated.[7]

The question of deprivation experienced by women was raised by many people during the consultations. It is undoubtedly the case that many aspects of deprivation are gendered. One of the strengths of the Measures of Deprivation is that they do address some aspects of deprivation which affect women. For example, the Income Domain has a measure of Income Support which is paid to lone parents, the overwhelming majority of whom are women. The relatively disadvantaged position of older women, (and older people in general), is captured by the inclusion of Income Support in the Income Domain, and of Attendance Allowance in the Health Domain, as women will be disproportionately represented in these groups. However, there is still a data deficit in this area. This means that for example, the Employment Domain does not capture women who are involuntarily out of work, unless they are registered as unemployed in their own right, participant in the New Deal for Lone Parents or are claiming Incapacity Benefit or Severe Disablement Allowance. It is hoped that future versions of the Measures of Deprivation will continue to make progress in this regard.

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[7] See Fay, M.T., Morrissey, M., Smyth, M. and Wong, T. (1999) *The Cost of the Troubles Study* (Derry).

It is important to capture deprivation experienced by people whatever their ethnicity and regardless of any religious affiliation. The Measures of Deprivation are constructed in such a way that the indicators measure deprivation across all such categories. They measure inequality between small areas which provides important information about the spatial distribution of deprivation.

It can still be argued that certain groups experience additional types of deprivation that cannot as yet be measured in a more 'direct' way. An example is the additional types of deprivation experienced by some people from ethnic minorities or some people with a religious affiliation. It would be desirable to include measures of racism, discrimination and cultural isolation were they available. In the absence of these, however, it would be inappropriate to treat membership of an ethnic community or religious group as a deprivation in itself. Ethnic and religious groups are not homogenous, and many of the deprivations disproportionately experienced by some members have been captured in the relevant domains.

During the consultation there was discussion about particular socially excluded groups such as rough sleepers, travellers and young people aged 16 and 17 who are not in education or employment and are excluded from the benefits system. Unfortunately indicators for these groups have been difficult to obtain. They will each be discussed in the relevant domains.

Chapter 2: The Geographical Scale of the Measures of Deprivation

An ideal measure of area deprivation would be able to quantify deprivation at the level of 'neighbourhoods' or small areas with a homogeneity of characteristics and a standard population size. Such a measure would be able to offer to policy makers and funding programmes a robust method of describing the geographic distribution of deprivation to define areas for targeted intervention.

This raises several issues for a potential Multiple Deprivation Measure. First, the possible availability of data and population estimates for small areas; second, the problem of the variation in population size between areas and third, the heterogeneity of areas.

The availability of data for small areas in the inter-censal period had been considerably advanced by the increasing accessibility of benefits and other data at a sub-LGD level. In addition a new methodology for estimating populations at small area level at times other than the Census has been developed by the research team. This is discussed in detail in **Appendix B**.

In order to compare concentrations of deprivation between areas it is necessary to calculate rates in order to standardise for differences in the size of the population. Although wards vary in size, the problem of varying sizes is inherently much greater for LGDs. This raises the problem of the heterogeneity or homogeneity of an area, in terms of the intensity of deprivation. Rates for large areas, such as a whole city, may mask a great variation within it. This means that because of the heterogeneity within LGDs, as well as the variations in population size, comparisons of the intensity of deprivation at the LGD level are problematic. The ward level thus presents the most robust small area option for the Multiple Deprivation Measure. In addition the ED level Economic Deprivation Measure helps to pick up 'pockets' of deprivation.

Administrative boundaries in Northern Ireland have changed significantly since 1991; a review of local government boundaries in 1992 increased the number of wards from 566 to 582 and involved changes to most ward boundaries. The twenty-six LGDs were largely unchanged. There is particular interest in sub-ward (i.e. ED) level analysis. The EDs were functional units created to assist field work in the 1991 Census and nest within the 1991 wards but do not nest within the new 1992 wards. This analysis therefore used the ward and ED boundaries in place at the time of the 1991 Census.

Because of the availability of small area data, and the techniques advanced by the research team to harness other data sets, it was possible to construct the Multiple Deprivation Measure at ward level. The Measures of Deprivation are based on the 1984 ward geography which was in place at the time of the 1991 Census.

One of the disadvantages of using the geographical unit of wards is that smaller pockets of deprivation can be masked. An ED level multiple deprivation measure however poses

considerable challenges: the availability and robustness of non-census indicators at this level, and the construction of sub-ward population estimates. It has been possible to produce ED level population estimates for 1999, and because of the large number of cases in the data in the Employment and Income Domains, these have been constructed at ED level and were combined to form a measure of Economic Deprivation. This has not been possible for any other domains. However the Economic Deprivation ED level Measure present detailed information about the main drivers of deprivation in a dynamic and updateable form.

Chapter 3: Domains and Indicators

It follows from the conceptualisation of multiple deprivation outlined in **Chapter 1** that the new Northern Ireland Measures of Deprivation should comprise indicators which are combined to form domains of deprivation. This process produces a score for each of the domains - a Domain Deprivation Measure - which can be ranked across Northern Ireland to give a relative picture of each dimension of deprivation. The Domain Deprivation Measures were combined into an overall Multiple Deprivation Measure. This approach received widespread support during the initial consultations.

Domains

The domains in the Multiple Deprivation Measure are Income Deprivation, Employment Deprivation, Health Deprivation and Disability, Education, Skills and Training Deprivation, Geographical Access to Services, Housing Stress, and Social Environment. The Domains have each been presented as a separate Domain Deprivation Measure as each domain reflects a particular aspect of deprivation. Thus the Employment Domain captures exclusion from the world of work and conditions of work – *not* the low income that may flow from it, and the Income Domain can be used apart from the Multiple Deprivation Measure to examine low income alone. Similarly, the Education Domain does not include markers of income deprivation such as 'children in receipt of free school meals', as children living in low income families are measured within the Income Domain. This approach avoids the need to make any judgments about the complex links between different types of deprivation (for example the links between poor health and unemployment), and enables clear decisions to be made about the contribution that each domain should make to the overall Multiple Deprivation Measure.

While the domains represent distinct dimensions of deprivation, it is perfectly possible, indeed likely, that the same person could be captured in more than one domain. So, for example, if someone was claiming Income Support and was in poor health, they would be captured in both the Income and Health Domains. This is entirely appropriate because one individual can experience more than one type of deprivation at any given time.

The domains each represent a type of deprivation that is measured as directly as possible, rather than comprising a set of 'vulnerable groups' (i.e. groups of people that are more likely to be deprived than on average), as discussed in **Chapter 1, Particular Issues**.

The terminology used to describe the Measures of Deprivation changed between the project start and end, as a result of consultation. 'Domain Deprivation Measures', the 'Multiple Deprivation Measure' and 'Measures of Deprivation' were adopted in preference to 'Domain Indices', the 'Index of Multiple Deprivation' and the 'Indices of Deprivation' respectively.

Indicators

Each Domain Deprivation Measure contains a number of indicators. The criteria for these indicators were that they should be:-

- 'domain specific' and appropriate for the purpose (as direct as possible measures for that form of deprivation)
- measuring 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 Northern Ireland at a small area level in a consistent form

The intention was to include a parsimonious collection of indicators that comprehensively captured the deprivation for each domain, within the constraints of data availability. During the process of consultation some very interesting sources of data were suggested, such as Community Audits. Whilst some of these contain a wealth of useful information, they are not consistent across the whole of Northern Ireland. If Community Audits were standardized and made comprehensive in the future they would make a very valuable contribution to an updated version of the Measures of Deprivation. In the meantime Community Audits may have a role in describing the distribution of deprivation within the particular that they cover. At present however, it was not possible to include these data in the Measures of Deprivation. Other indicators were not included as they did not meet one or more of the criteria listed above or no data were available.

The indicators that were included in the Measures of Deprivation have been constructed using a range of techniques. Some of the data were obtained at individual level (with due regard to issues of confidentiality) and aggregated to ward/ED level; some were obtained at other levels (e.g. Labour Force Survey Local Authority (LFSLA) data) and then 'modelled down' to ward level. Postcoded data were assigned to 1984 wards using a Central Postcode Directory (CPD) furnished by the Northern Ireland Statistics and Research Agency (NISRA). The assumption had to be made that postcodes supplied were correct and accurate and they were therefore used as given. As far as possible, all the data included relate to mid-1999.

The small numbers problem and the shrinkage technique

One problem which had to be addressed at the outset of the construction of the Multiple Deprivation Measure was 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 were not all in the same units of measurement and if the raw data had been used the results would have largely been driven by the size of the population. For these reasons it was not possible to count the numbers of people experiencing each

deprivation and add them together. Instead where possible, rates, or some other standard form of measurement were used which allow areas of different sizes to be compared.

In some areas of Northern Ireland, particularly where populations at risk are small, data can be unreliable with particular wards getting unrepresentatively low or high scores on variables in certain domains. The extent of a score's 'unreliability' can be measured by calculating its standard error.

This problem emerged in the construction of other Indices or Measures of Deprivation in the past and this has prompted the use of the signed chi squared statistic.[8] However, this technique has been much criticised for its use in this context because it conflates population *size* with *levels* of deprivation.[9] Given the problems with the signed chi squared approach, another technique - 'shrinkage estimation' - has been used subsequently to deal with the problem.[10]

Shrinkage involves moving 'unreliable' ward scores (i.e. those with a high standard error) towards the mean score of the LGD within which the ward is located. This may be towards more deprivation or less deprivation. For the ED level Economic Deprivation Measure the component Income and Employment scores were 'shrunk' to the ward level Income and Employment scores respectively, within which the EDs were located, before being combined.

The actual mechanism of the procedure is to estimate deprivation in a particular ward using a weighted combination of (a) data from that ward and (b) data from another more robust source (for example the LGD mean). Using this method the estimate for any ward would then, for example, move towards the LGD mean by taking a weighted average of the ward and LGD values, thus reducing any ward-level 'noise' caused by small numbers. By this device the unreliability of the ward-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 avoids the problem of indicator values being linked to the size of the area (scale dependency).

Although all scores move a fraction, only 'unreliable' scores, that is those with a large standard error, move significantly. The amount of movement depends on both the size of the standard error and the amount of heterogeneity amongst the wards in an LGD (or ward, in the case of EDs being shrunk). The shrinkage procedure and formulae are presented in more detail in **Appendix C**.

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[8] See for example *Relative Deprivation in Northern Ireland* (1994, NISRA).
[9] 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.
[10] M. Noble, G. Smith, G. Wright, C. Dibben, M. Lloyd and B. Penhale *Welsh Index of Multiple Deprivation 2000* (The National Assembly for Wales, 2000); M. Noble, G. Smith, B. Penhale, G. Wright, C. Dibben, T. Owen and M. Lloyd *Measuring Multiple Deprivation at the Local Level: The Indices of Deprivation 2000* (DETR, 2000).

Combining the indicators into Domain Deprivation Measures

For each domain of deprivation (Income, Employment, etc.) the aim is 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 (i.e. the Income and Employment Domains) where the underlying metric is the same and where the indicators are non overlapping the indicators can be simply summed. Where there are several indicators within a single domain that have different underlying metrics and cannot therefore be straightforwardly combined (i.e. the Health, Education, and Social Environment Domains), a statistical procedure, factor analysis, can be used to identify weights for each indicator. 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**. The Access Domain's weights were not generated using factor analysis, as explained in **Chapter 8**. The Housing Domain is constructed using a point scoring method, as explained in **Chapter 10**.

Chapter 4: Income Deprivation

> **Income Deprivation: Indicators**
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> - Adults in Income Support households (DSD, August 1999)
> - Children in Income Support households (DSD, August 1999)
> - Adults in Income Based Job Seekers Allowance households (DSD, August 1999)
> - Children in Income Based Job Seekers Allowance households (DSD, August 1999)
> - Adults in Family Credit households (DSD, August 1999)
> - Children in Family Credit households (DSD, August 1999)
> - Adults in Disability Working Allowance households (DSD, August 1999)
> - Children in Disability Working Allowance households (DSD, August 1999)

Purpose of Domain

The purpose of this domain is to capture the extent of income deprivation in an area.

Background

An 'ideal' indicator of income deprivation might be to measure the proportion of households below a particular low-income threshold. International comparisons[11] frequently use the proportion of households living below fractions of median/mean income. Thus Eurostat has adopted a definition of income deprivation as those living in households below 60% of median income. National and regional estimates of households below fractions of median/mean income invariably derive from large scale surveys. However, such surveys, even those having a reasonably large sample size do not allow reliable small area 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.

The domain might be further extended. For example, some respondents to the consultations have suggested inclusion of variables relating to the economic 'health' of the area such as inward investment (and its corollary - failing businesses) or to try to capture spatial variations of the Gross National Product. After investigation it is clear that the data for such approaches are not currently available at small area level.

Despite the lack of comprehensive data on income distribution at a small area level, robust data on means tested social security benefits are available which give valuable insights into low income at very small spatial units. The indicators in this domain are in the form of non-overlapping counts of people in families in receipt of means tested

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[11] See for example Bradbury, B. and Jantti, N. *Child Poverty Across Industrialized Nations* (1999, Innocenti Occasional Papers, Economic and Social Policy Series no.71).

benefits. This domain has therefore been presented as the proportion of the population of a ward living in families in receipt of a means tested benefit.

The proportion of children under 16 living in families that claim the 'out-of-work' means tested benefits of Income Support and Job Seekers Allowance (Income Based), and the 'in-work' benefits of Family Credit and Disability Working Allowance has been separately presented as a supplementary Child Poverty Measure at ward level but it is not included in the overall Multiple Deprivation Measure as the children are already counted within the Income Domain.[12]

The means tested benefits are divided into 'out of work' and 'in work' benefits for mid 1999. Northern Ireland level data were obtained from the Department for Social Development (DSD) for these benefits. The data for all four benefits were for August 1999 and the population (claimant, any partner plus any dependent children) living in such families expressed as a percentage of the total population for the area in question.

In mid 1999 the 'out of work' benefits were Income Support (IS) and Income Based Job Seekers Allowance (JSA-IB) and the 'in work' benefits were Family Credit (FC) and Disability Working Allowance (DWA). JSA-IB is paid to those who are unemployed and whose income is insufficient to meet their needs. Income Support is payable to other groups such as pensioners and lone parents whose income is insufficient and who do not have to register as unemployed. Family Credit is paid to those in low paid work who have children (both lone and couple parents) as a top up to their earnings. DWA (a very rare benefit) is equivalent to FC but for disabled people. FC and DWA capture many of those in part-time as well as full time work as it is paid where the claimant works 16 or more hours a week.

In general, the in work and out of work benefits do not overlap. There is a very small contingent of IS/JSA-IB recipients who continue to receive Family Credit if they become unemployed during the currency of an FC award but these account for very few people and can reasonably be ignored.

The main groups on means tested benefits not captured are those not on IS/JSA-IB, FC or DWA who nevertheless claim Housing Benefit (HB)/Rate Rebate for help towards their rent and rates. The Northern Ireland Housing Executive (NIHE) administers rent and rate rebates and allowances for tenants whilst the Rating Collection Agency (RCA) administers rate rebates for owner occupiers. Whilst NIHE were able to supply data for tenants (though not for the time period requested), the RCA were not able to supply equivalent data for owner occupiers. This was due to the limitations of the software package currently used by them. Since to include data for tenants but not for owner occupiers would introduce a known but unquantifiable bias it was decided not to include

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[12] Unfortunately children under 16 living in JSA(IB) families could not be distinguished from all dependant children living in such families. In consequence the numbers of children under 16 living in JSA(IB) families were calculated as 90% of all dependant children living in such families. This proportion was derived from the ratio in Great Britain.

either of these data at this time. However, it is understood that operational changes at the RCA may make this possible in future versions of the Measures of Deprivation[13].

Combining the indicators

The indicators in this domain were summed in order to generate the percentage of the total population living in such families. The confidence interval of the proportion was such that 'shrinkage' was not necessary in this domain, and the Domain Deprivation Measure was the unadjusted rate.

Other Issues Considered

Those not on benefits but otherwise on a low income
During consultations those people on low incomes but not on benefits were discussed. In particular for example, this may have affected small farmers. It was suggested that the benefit structures might not easily accommodate those with irregular incomes from self employment. The key data sources that might help identify these groups would be tax or National Insurance contribution data from the Inland Revenue. Initial explorations in this area were not very fruitful. However, recently, through the interventions of NISRA, the Inland Revenue have indicated that they might be ready to provide data from the Contributions computer and might even be prepared to look at tax data provided the legislative framework in which they operate allows them to do so. Unfortunately these data were not be available for this version of the Measures of Deprivation but remain a distinct possibility for the future.

Income – benefit take-up
One of the acknowledged problems of producing a measure of income deprivation using benefits data is that of take-up. This was raised in several of the consultations. The data can easily be adjusted for non take-up provided reliable small area data on take-up are available. Take-up can vary by the type of benefit, the area, and the population group, such as pensioners. Some data on take-up are available for different claimant groups at Great Britain level. No equivalent data are available for Northern Ireland. Even if Northern Ireland data were available such data would need to be at a small area level to make meaningful adjustments to the Income Domain.

It was suggested that the Northern Ireland Citizens Advice Bureaux (CABx) may have such data. Certainly, e.g. Cookstown CAB have looked at this area locally but there is no Northern Ireland-wide data. It was therefore decided not to make any adjustments. This does not undermine the domain. It is still considerably more powerful than previous indices or measures which have used 'no access to a car' as a proxy for low income.

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[13] Checks with the Income Domains in both the English and Welsh Indices suggested that an Income Domain without HB correlated very highly with one which had the information (0.984 for England, 0.985 for Wales).

Free School Meals
The uptake of free school meals is sometimes used as a proxy for low income. Since eligibility for free school meals is passported for children of claimants in receipt of IS/JSA-IB and the IS/JSA-IB data are in this domain there is no need to include information about free school meals. In general, those attending the consultations welcomed the omission of this measure.

Debt and Credit
During consultation two related issues were raised. First whether a measure of debt could be included and second, a related issue on access to credit. It could be argued that to be on low income and in debt is to be more 'income deprived' than simply to be on a low income. Accordingly data were sought on debt at a small area level which might in some way be entered into this domain. Suggestions had been made that CABx might have this data. In fact the CABx do have data on debt. They have information on those coming to them with debt problems. However, this data might be skewed: to be a CAB 'statistic' might be dependant on how near you are to a CAB, whether that particular CAB has a good reputation, whether there are other sources of debt counselling etc. It was therefore decided not to include such data.

No data sources could be found on access to credit.

Chapter 5: Employment Deprivation

Employment Deprivation: Indicators

- Unemployment claimant counts of those aged under 60 (average of four quarterly extracts) (DETINI)
- Incapacity Benefit recipients aged under 60 (DSD, August 1999)
- Severe Disablement Allowance recipients aged under 60 (DSD, August 1999)
- New Deal participants not included in the unemployment claimant count (DHFETE, August 1999)

Purpose of Domain

This domain seeks to measure enforced exclusion from the world of work. The domain does not seek to capture income deprivation to which joblessness leads, since this is tackled in the Income Deprivation Domain. 'Employment deprived' are thus defined as those who want to work but are unable to do so through unemployment, sickness or disability.

Background

Conventionally employment deprivation is captured by the monthly claimant count. Whilst this is a good starting point it has become increasingly apparent that it does not tell the whole story.

There has been growing concern that measures based on the unemployed claimant count substantially under-estimate the numbers who would work if work were available. Such groups are referred to as the 'hidden unemployed'. They include those (particularly women) who are seeking work but not registered as unemployed. Some of these people may be captured at Northern Ireland level through the International Labour Organisation (ILO) definition of unemployment contained in the Labour Force Survey. There are also those people on various training schemes or New Deal options who do not appear on the count. There are also those people who have taken early retirement. Another group who might be considered are those people who are carers. One of the most significant groups are those people who have moved on to sickness and disability related benefits in the absence of any realistic prospect of finding work.[14]

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[14] Beatty, C., et al. *The Real Level of Unemployment* (1995, Centre for Regional Economic and Social Research, Sheffield Hallam University).

Data to tap into some aspects of 'hidden unemployment' such as those excluded from the claimant count but within the ILO definition have proved difficult to obtain at the ward level. However, significant breakthroughs have been possible in respect of those people incapable of work through sickness.

Unemployment counts at ward and ED level were obtained from the Department of Enterprise, Trade and Investment (DETINI). Taking the average of the claimant count figures for four quarters makes some allowance for seasonal variation. The indicator is therefore the average of the claimant count figures for the following quarters: February 1999, May 1999, August 1999, and November 1999.

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 these people all face exclusion from work, whether due to sickness alone or some combination of sickness and labour market conditions.

Because men over 60 who are unemployed can choose to receive Income Support rather than Income Based Job Seekers Allowance,[15] the claimant count for men aged 60-64 is an undercount. For this reason all indicators in the domain have been restricted to people aged 16-59. Furthermore because the domain is wider than simply those conventionally regarded as 'economically active' the denominator is all persons aged 16-59.

Participants in the various New Deal programmes and those in Job Skills training were also considered for this domain. After consultation with DHFETE it was decided that Job Skill training participants could not be considered 'employment deprived'. Of the New Deal participants, all those not in receipt of JSA (and therefore not included in the claimant count) were included.

Combining the indicators

As with income, the indicators in this domain constitute non overlapping counts of those excluded from the labour market through unemployment or ill health. Therefore a simple rate has been constructed - those unemployed or on certain schemes and those on Incapacity Benefit/Severe Disablement Allowance as a proportion of those aged 16-59.

The small size of confidence intervals across the domain did not suggest that the shrinkage technique needed to be applied and the Domain Deprivation Measure is the unadjusted rate.

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[15] 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.

Other Issues Considered

Lone parents
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.[16] This issue was aired at several of the consultations and the unanimous view which has been adopted is that lone parents on IS should not be included in this domain. Notwithstanding this general position, if a lone parent had opted to participate in the voluntary New Deal for Lone Parents, this signifies a desire to get back into the labour market and therefore this subset of lone parents was included in the domain.

Carers
Carers of people other than their own children might also be regarded as employment deprived within the definition of this domain. This arose as an issue in some of the consultation meetings. However, some have argued that it seems strange to include carers in the employment domain as they are not available for work and they are probably carers by choice. Others have argued that the concept of carers being 'voluntarily' not working probably does not hold up - it ignores the fact that if there is a need for care, someone has to provide it, paid or unpaid. Data sources that might give some 'counts' of this group include those receiving a 'carers premium' in connection with a means tested benefit and/or those in receipt of Invalid Care Allowance. Unfortunately such data were not available for inclusion in this domain at this stage. It may be possible to include such counts in later versions of the Measures of Deprivation, if it was decided that it was appropriate to include carers.

Status Zero Young People
The issue of how unemployed young people aged 16 and 17 who have left school and are not entitled to benefits might be captured in this (or other) domain(s) was raised in the consultation meetings. School leaver data were obtained from DE and the category identified as 'unknown' in the dataset may well include numbers of young people who are 'status zero'. These data have not been included though, as some of the young people in the 'unknown' category may simply be non-respondents to the questionnaire who would in fact be in some other category (such as employed), had they replied.

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[16] See E. Evason, G. Robinson and K. Thompson, (1998), *Mothers on Benefit*, (The Stationery Office, Northern Ireland).

Chapter 6: Health Deprivation and Disability

Health Deprivation and Disability: Indicators

- Standardised Mortality Ratios for men and women at ages under 75 (NISRA, 1995 to 1999)
- People receiving one or more of Attendance Allowance or Disability Living Allowance or Incapacity Benefit or Severe Disablement Allowance (DSD, August 1999)
- People registered as having cancer (excluding non-melanoma skin cancers). (Northern Ireland cancer registry, 1993 to 1996)
- Proportion of all 12 to 17 year olds with extractions and registered with a GDS dentist, and those not registered with a GDS dentist (CSA, September 2000)
- Drugs prescribed for depression or anxiety (CSA, August 2000)

Purpose of Domain

This domain identifies areas with people whose quality of life is impaired by poor health and/or disability or whose life is cut short by premature death.

Background

While ill health is closely intertwined with other aspects of deprivation, it is also an important aspect of deprivation in its own right. This domain is a measure of poor health and/or disability.

There is a long history of mapping deaths and the incidence of diseases. However, this work has tended to focus on mortality and acute illnesses. There has been far less work carried out on the small area mapping of chronic illnesses and disabilities. In this regard, the recording of limiting long-term illness within the UK in the 1991 Census was pioneering. The challenge was then to update this measure with current information by exploring various administrative databases such as those holding prescription or social security benefit information.

A number of techniques have been developed to deal with peculiar problems encountered when calculating indicators of health for geographical areas with varying demographies and populated by small numbers of people. These methods include age-sex standardisation and the shrinkage technique which is used for improving the estimate of a rate in an area with a small population.

Standardised Mortality Ratios (SMRs)
After examining the Standard Errors associated with Standard Mortality Ratios (SMR) for people aged under 65, under 70 and under 75, it was decided to use SMRs for the under 75s as the measure of premature death. Although SMRs for the under 65s showed the widest variation between areas in Northern Ireland, the Standard Errors associated with SMRs for the under 65s calculated at the ward level were in many instances large, indicating that the estimation of risk was unreliable. The variation in SMRs for the under 75s, between the areas in Northern Ireland was also wide but because of the greater number of deaths within this age group, the standard error of the SMR was smaller and therefore the estimate of the risk of premature death was more reliable. This indicator used the process of indirect standardisation.

Disability Living Allowance, Attendance Allowance, Incapacity Benefit and Severe Disablement Allowance
Disability Living Allowance (DLA) is a benefit for those severely disabled people under 65 needing help with personal care or with mobility needs. Attendance Allowance (AA) is an equivalent cash benefit for people aged 65 or over who need help with personal care but not for mobility needs. People over 65 can receive DLA for mobility needs providing that they were receiving it before they were aged 65. Incapacity Benefit (IB) is a non-means tested benefit paid to people who are unable to work due to ill health but 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. All of the variables are age standardised.

Any person receiving one or more of these four benefits is counted as someone suffering from morbidity or disability.

Cancer Incidence
It would be desirable to have measures of many serious illnesses which affect people in Northern Ireland, but unfortunately such data are not collected centrally. However, information is collected about all new cases of cancer, at the individual level by the Northern Ireland Cancer Registry. They provided the project with 4 years (1993 to 1996) of cancer incidence data at a ward level. These data excluded non-melanoma skin cancers cases. The rates of cancer were age standardised.

Dental Health
Capturing health inequalities in the young is difficult because they may not yet be exhibiting the health outcomes that will appear in later life. These health outcomes will contribute to their premature mortality and relative high levels of morbidity. For younger people health behaviours can be used as a predictor of future health outcomes. Smoking is an example of one health behaviour that might be used, but unfortunately data on smoking were not available. Another example of predictive health behaviour relates to aspects of dental health. After consultation with the DHSSPS, it was decided not to use dental caries as a measure of dental health because of the number of people who do not register with a dentist. Instead the number of 12-17 year olds who are not registered with a dentist or who are registered but have had permanent teeth extracted, were calculated as a proportion of all young people in a ward.

Anxiety and Depression

During the consultation there were many requests for indicators that related to mental health. It was possible to obtain a dataset, from the Central Services Agency, which contained a list of prescriptions for drugs that were prescribed by GPs during the month of August in 2000. From this, the research team were able to extract all prescriptions relating to anxiety and depression. The drugs counted include diazepam and chlordiazepoxide (for anxiety) and amitriptyline and seroxat (for depression). An average daily quantity (ADQ - a UK standard) for each drug was used to calculate, from the weight of the total prescriptions, an average count of people. The one month was treated as a sample from time. If, for example, a person was given a weeks prescription by their GP they should appear 4 times within the 1 month. Each prescription would therefore be counted as a quarter of a person. By summing the whole month one person would be counted.[17] The method of attributing prescription information to ward level involved attributing the individual prescription to a GP practice, and calculating a rate of drug prescription for the practice. This practice rate was then attributed to each person attached to the practice, who were then attributed to a ward by geocoding using the Central Health Index (CHI). The ward level score for this indicator was produced by aggregating the people attributed from a practice to a ward, and calculating the mean prescription drug rate for each ward.

This indicator was often requested during the consultations as it was felt to relate to the Troubles. While there is evidence to support this, it is not possible to establish any causal relationships here.[18] However, the research team found that if ward level rates of depression and anxiety, as measured in this domain, are compared with ward level rates of Troubles-related deaths (between 1969 and 1999 and as measured by the Cost of the Troubles project), expressed as a proportion of the *current* ward population, there is a statistically significant relationship between these two measures. This relationship remains significant when controlling for other socio-economic variables.

Combining the Indicators

Shrinkage estimation was applied in this domain. 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 and therefore applying factor analysis was appropriate. The indicators were transformed to a standard normal distribution and factor analysis was applied. Having taken into account the variance explained and the absence of a meaningful second factor for this domain, the indicators were combined using the weights generated by the factor analysis to produce a single domain score.

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[17] Prescribing Support Unit (2000) Average Daily Quantities and *97-PUs.
[18] See Fay, M.T., Morrissey, M., Smyth, M. and Wong, T. (1999) *The Cost of the Troubles Study* (Derry) for research linking experience of the Troubles with taking prescribed medication.

Other Issues Considered

Low Birth Weight
Low birth weight data were considered but after discussion with the DHSSPS it was decided that it is not currently appropriate to include it as a measure for this Domain in Northern Ireland. This was not because it does not measure an important aspect of health deprivation but because there are acute small number problems associated with measuring it at a ward level.

Firstly, at a ward level the numbers of births are very low. In 286 of the 566 wards in Northern Ireland there were 100 or less births between 1997 and 1999. Secondly, the proportion of the births that are 'low weight' is low: the average ward proportion is 4%. Thirdly, there is not very much difference in the rate between wards. The standard deviation of the rate is only 2.3 percentage points. Together this means that the low birth weight rate is very unstable: just one or two low weight births will have a very great impact on the relative position of a ward. It was therefore decided that this measure did not meet the criteria for inclusion in the Measures of Deprivation.

Survey Data
It had been hoped to include further measures of mental health, and to include smoking as an indicator of future ill health. The proposal was to model such data from the Continuous Household Survey and the Health and Well-being Survey, however these data were not made available within the timescale of the project.

Chapter 7: Education, Skills and Training Deprivation

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Education, Skills and Training Deprivation: Indicators

- Working age adults with no qualifications (1996-1999 aggregated LFSLA data at LGD level modelled to wards)
- Proportions of those leaving school aged 16 and not entering Further Education (School Leavers Survey, 1996/7 - 1998/9, DE)
- Proportions of 17-20 year olds who have not successfully applied for Higher Education (1997-9, UCAS)
- GCSE/GNVQ performance data points score and no qualifications (School Leavers Survey, 1996/7 - 1998/9, DE)
- Absenteeism at secondary level (all absences) (School Performance Survey, 1998-1999, DE)
- Proportions of Years 11 and 12 pupils not in a grammar school (1999 School Census, DE)

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Purpose of domain

The central purpose of the Education Domain is to measure in as consistent a way as possible the key *educational* characteristics of the local area that might contribute to the overall level of deprivation and disadvantage. Many previous attempts to measure educational deprivation at this level have tended to include both social and educational measures, typically using indicators such as free school meals as a proxy for income deprivation. On the basis of the approach that has been adopted by the research team, 'free school meals' is not needed, as the Income Domain captures children in families receiving Income Support (IS) or Income-Based Job Seekers Allowance (JSA-IB) (the eligibility criteria for receiving free school meals). Low income is certainly a correlate and probably, in part, a cause of educational deprivation but it is not a *direct* measure of such deprivation itself.

Background

Measures of educational deprivation have tended to focus on the increasing volume of school-based data. Yet children at school represent only one section of the population which might contribute to the overall deprivation of the area. Results from school examinations cover only one particular age cohort, many of whom may well move out of the area once they become adults. For this reason the aim was to extend the scope to include the adult population.

Many of the items that were considered for the Education Domain dealt 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).

Inevitably the final choice of indicators is partly constrained by what is currently measured and assessed. As well as the educational system and among measurement specialists, the job market and wider society places explicit value on these measures of educational attainment.

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

Data from schools can be divided into information that is held at school level and data that are held on individual pupils. Data from all but thirteen secondary and grammar schools were obtained in confidential and anonymous individual form, with the kind permission of the schools. The data on the remaining thirteen schools were analysed by the DE research staff and the aggregate results combined with the main data set at ward level.

Indicators

Working age adults with no qualifications
Four separate years of the Labour Force Survey (1996-1999) were drawn on to produce a ward level estimate of the numbers and proportions aged 25-59 with no qualifications. The LFSLA contains a measure of qualifications which is reduced to a three point scale – 'no qualifications', 'middle level qualifications', 'high level qualifications' (NVQ level 4 and above). This measure was modelled to ward level to give an estimate of the proportion of adults (25-59) with no qualifications, using 1991 Census analogue variables.

Proportions of those leaving full-time school aged 16 and not entering Further Education
Proportions of those leaving school at Year 12 and not continuing to Further Education were calculated from the School Leavers Survey from 1996/7, 1997/8 and 1998/9.

Proportions of 17-20 year olds who have not successfully applied for Higher Education
The research team obtained an individual level extract of applicants to Higher Education (HE) for years 1997, 1998 and 1999 from the UCAS system. Ward aggregates were produced for 'under 21' year olds who had successfully applied through UCAS for HE in Northern Ireland and Great Britain over the three year period from a postcoded domestic Northern Ireland address. UCAS data also includes successful applicants who apply direct to the HE institution, but are then back-coded to the UCAS system by the HE

institution. Data from the Department of Higher and Further Education, Training and Employment showed approximately 240 first year Northern Ireland domiciled students on a first degree in the Republic of Ireland. In view of the relatively small numbers (there are more than 10,000 first year Northern Ireland domiciled students on first degrees at Northern Ireland and Great Britain universities), and the limited information on the area they came from, this group had to be left out of the analysis.

GCSE/GNVQ performance data
Data were obtained for 1996/7, 1997/8, 1998/9 from the Department of Education (DE) for all but thirteen secondary and grammar schools in Northern Ireland in individual anonymous form, with the permission of the schools. This contains information on all pupils leaving school with full details of qualifications obtained, and destinations. It was decided to focus on qualifications at 16 and to use GCSE/GNVQ. A points score was calculated for GCSE and GNVQ Part 1 (Intermediate and Foundation levels), using the standard points equivalent. By focusing on the qualification level at 16 it was possible to include all three years of data and therefore have a significant numbers of cases. Results were then aggregated to ward level and a score produced for each ward. Data for the thirteen schools were put through the same analysis by DE and the results combined into the full score for all wards.

Absenteeism at secondary level
Each school records information on the number of attendances in the school year and the maximum possible number of attendances. However this was only available as a 'school level' variable. The School Census information on individual pupils in all grant aided schools from Year 8 to Year 12 was used as a way of spreading this data across Northern Ireland wards. These were aggregated to wards and the school average figure for attendance attributed to each pupil.

Proportions of Years 11 and 12 pupils not in a grammar school
The recent 'Gallagher Report' estimated that 'all other things being equal, being in a grammar school will add almost 16 GCSE points…at 16 years'[19]. The implication is that attending a grammar school adds significantly to educational prospects. Data on all Year 11 and Year 12 pupils were obtained. These school years were used because of potential problems of using all pupils from Year 8 and above in areas where selection may be delayed until a later stage (e.g. Craigavon). School level data were used to identify whether the school was selective or not. These results were then allocated to ward and the data which were analysed in parallel by the DE team on the 13 schools were added.

Combining the Indicators into a Domain Score

'Shrinkage estimation' was applied to all indicators in the Education Domain. The indicators have varying distributions so they were ranked and then transformed to a standard normal distribution. The indicators were transformed to a standard normal distribution and factor analysis was applied. Having taken into account the variance

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[19] T. Gallagher, *et al, The Effects of the Selective System of Secondary Education in Northern Ireland*, Department of Education Research Briefing, RB 4/2000, (September 2000), paragraph 17.

explained and the absence of a meaningful second factor for this domain, the indicators were combined using the weights generated by the factor analysis to produce a single domain score.

Other Issues Considered

Special Educational Needs
Use of measures of special educational needs (SEN) was considered and data obtained on all secondary age pupils indicating whether or not they had Statements of special educational needs. Only about 1.4% of secondary age pupils have a full Statement of special educational needs. This varies by school from effectively zero to nearly one in five (22%). However there is no clear association with other educational outcomes such as performance at school level (school performance tables published by the Department of Education exclude pupils with statements), suggesting that while SEN clearly flags an *individual* educational need, there may be some variation in the way this is decided from area to area and also that it may not be a very good proxy for more general educational disadvantage. This indicator therefore did not meet the criteria for inclusion in the domain.

Travellers Children
It was also suggested that children of travellers might be another group to identify as an indicator of educational disadvantage. However there are only approximately 160 or so traveller children recorded at secondary level (approximately 0.1% of the age group). This group, however disadvantaged, would not be large enough to meet the indicator criteria of a condition that affects a significant proportion of the population.

Free School Meals
This again was a measure that was available from the School Census data for all secondary age pupils. However as stated above, the criteria for free school meals eligibility is receipt by the parent of IS or JSA-IB and that is measured in the Income Domain.

Exclusion data
This indicator was considered for the domain but fortunately there are low numbers of pupils permanently excluded from schools, and the numbers may be influenced by school policy. Therefore, this indicator was not included.

KS2 Data
The inclusion of Key Stage 2 performance data was suggested during the consultation process. However in view of the fact that data on GCSE and GNVQ were available at pupil level, and that KS2 results were based on teacher assessment and only available at school level, it was decided to focus on the GCSE/GNVQ results to measure educational attainment at school.

Chapter 8: Geographical Access to Services

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Geographical Access to Services: Indicators

- Access to a post office (General Post Office Counters, August 2000)
- Access to a GP Surgery (CSA, June 1999)
- Access to an Accident and Emergency hospital (CSA, March 1997)
- Access to a dentist (CSA, June 1999)
- Access to an optician (CSA, June 1999)
- Access to a pharmacist (CSA, June 1999)
- Access to a library (Education and Library Boards, November 2000)
- Access to a museum (Northern Ireland Museums Council, February 2001)
- Access to a Social Security Office or a Training and Employment Agency (DHFETE, 2001)

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Purpose of Domain

The purpose of this domain is to measure the extent to which people have poor geographical access to certain key services.

Background

This domain of deprivation is a relative newcomer in terms of the conceptualisation of multiple deprivation, and was welcomed by many people during consultation on the project. This domain - as for all the other domains - measures an aspect of multiple deprivation that is relevant to people wherever they live in Northern Ireland, as poor access to services can be experienced in urban as well as rural areas.

Indicators

Access to post offices
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 cheque and savings accounts. They also serve as a focal point in many remoter communities – they can be a site for publicising local information, as well as a place for developing more informal community networks. All post offices which were open in August 2000 have been included.

Access to GP Surgeries, Dentists, A & E Hospitals, Pharmacists and Opticians
It is very important that people have easy access to doctors surgeries, dentists, opticians, pharmacists and hospitals with accident and emergency facilities. The location data for these sites in Northern Ireland were supplied by CSA.

Access to Libraries
During the consultation some people requested that access to a library should be included. Not only are libraries an important resource for information, as well as for books for reading for pleasure, but they also provide a forum for information about the area and a focus for a local community. The research team obtained the postcodes of all libraries in Northern Ireland for all areas covered by the five Education and Library Boards.

All library premises that were open in November 2000 have been included. However, there are two important other types of provision which could not be taken into account. Firstly, in addition to the premises included in this indicator, books are also delivered by the Library Boards to schools, hospitals, prisons and 'out centres' holding library stocks across Northern Ireland as required. However, it would not necessarily be appropriate to take many of these sites into account, as libraries within schools for example, would probably not be open to the general public. But more importantly, mobile libraries which are fairly common in Northern Ireland and are more heavily depended upon in rural areas have not been taken into account as such libraries are by definition not attributable to a particular site. The indicator therefore measures peoples' geographical access to static library premises that are open to the general public.

Access to Museums
Also during the consultation, some people requested that access to a museum should be included. It was possible to obtain a list of all museums in Northern Ireland that were registered in February 2001 with Resource: the Council for Museums, Archives and Libraries. This information was supplied by the Northern Ireland Museums Council. A museum is defined for this purpose as follows: 'Museums enable people to explore collections for inspiration, learning and enjoyment and they are institutions that collect, safe guard and make accessible artefacts and specimens which they hold in trust for society' (Museums Association). Registration is a voluntary scheme which was introduced in 1988 and is open to museums of all sizes, from large museums to a small village museum run by volunteers, (as well as heritage centres and visitor centres that have collections though these are not included in this indicator). The research team were advised that very few museums in Northern Ireland have not registered.

Access to a Social Security Office or a Training and Employment Agency
In view of the impending roll-out of the ONE programme, inviting claimants of social security benefits to attend interviews at SSOs/T&EAs to help with job seeking, it is appropriate to include a measure of access to these offices.

Distance Measurement

The DHSSPS made a matrix available to the research team which had been constructed by the Geography Department of Lancaster University. This matrix measures road distances from Enumeration District level nodes to the nearest service in question, for the whole of Northern Ireland.

Combining the Indicators

Using the post office indicator as an example, the road distance from each ED node to the nearest post office was computed, using the grid references of the ED node centroids and all post offices. The road distances for all ED nodes were then aggregated by ward and divided by the number of ED nodes in the ward to create an average ward level road distance for each indicator.

A ward level score of the average road distance that people have to travel in that ward to the nearest of each of the services was calculated.

The shrinkage technique was found not to be necessary in this domain. The indicator scores were transformed to a normal distribution, and then combined using selected weights to create a single domain score. GP surgeries, A&E hospitals and pharmacies were each given a double weight and the remaining indicators were each assigned a single weight.

Other Issues Considered

There are many ways in which the domain could be further refined. For example, it would be useful to examine cross-border access. The remaining issues are addressed in three categories: transport availability, increasing the number of indicators, and broadening the definition of the domain to take other access-related issues into account.

Transport
The research team considered whether to take the availability of transport into account in this domain. It might ideally be possible to measure peoples' access to a car and to public transport – buses and trains in particular - and to use this as a mechanism for weighting the distances from the key services.

The Department of the Environment possesses recent car ownership data at small area level. The data allow, for example, the identification of individual cars and a calculation of the average number of cars per person in a ward could in principle be made.

The Department of the Environment (Roads Service Transportation Unit) has commissioned the consultancy group MVA to develop the Northern Ireland Strategic Transport Model (NISTRIM) which is a strategic *inter-urban* model and currently contains information about Belfast bus services, as well as inter-urban buses and rail provision for the whole of Northern Ireland. If this was adapted to take into account not just inter-urban travel, for example by incorporating the smaller bus companies, it would provide a very useful small area level measure of people's access to public transport throughout Northern Ireland. Also, the Department of Regional Development has some data on public transport provision for villages in Northern Ireland which could be incorporated in some way in the future.

However, there are many issues that would need to be taken into account before including transport weights in this domain. First, could one source of data be taken into account if the other source is not available? Second, what do the data mean? For example, how should an area with high car ownership but few buses compare with an area with low car ownership but regular and frequent buses? How does one take into account the fact that relatively high car ownership rates in poorer rural areas may mainly comprise older and therefore more unreliable vehicles? The research team concluded that it was not possible to answer all these empirical questions within the time frame of the project, but it is strongly recommended that access to transport is considered for future versions of the Measures of Deprivation.

Further Indicators
During the consultation many new possibilities for indicators were suggested. For example, there was a request for measures of access to leisure, play and sports facilities, e-mail, schools, higher education, job centres, adult education and affordable and good quality childcare provision; police and ambulance response times; and access to affordable good quality housing in the area of choice and access to public water supplies. All of these suggestions link in to very important issues, but many of them are more associated with subsets of the population than those included in the domain. For example, access to good quality childcare, while an issue of principle for many people, is only an issue of geographical access for people who have children. It was hoped that an indicator about access to large food shops would be included but this was not possible.

Broadening the definition of Access
Access is a very complicated issue, as demonstrated in relation to available transport where it is desirable to take into account the availability, cost and frequency of public and private transport. It would also be interesting to take into account cost and quality of services. The Department of the Environment's survey of public attitudes to public services could be considered for example, though this currently only covers about 400 households per LGD. It would be desirable to measure access for people with disabilities. Also, for minority ethnic and religious groups it would be desirable to measure cultural or language barriers, and the possible effect of community interfaces.

Chapter 9: Social Environment

Social Environment: Indicators

Recorded offences relating to:
- Burglary in a dwelling
- Violence against the person (excluding assaults)
- Common assaults
- Serious assaults
- Theft of a vehicle
- Theft from a vehicle
- Criminal damage
- Burglary in a building other than a dwelling
- Drug offences
(All data from RUC, 1998/1999 and 1999/2000)

- Local Area Problem Score generated from data on:
Graffiti, Scruffy/neglected buildings, Scruffy gardens/landscaping,
Litter/rubbish/dumping and Vandalism (1996 Northern Ireland House Condition Survey)

Purpose of the Domain

This domain seeks to measure deprivation in the social environment. Indicators about crime and local area problems have been combined to measure local conditions that reduce the quality of life. There is a significant volume of (mainly US) research that links these dimensions together at the neighbourhood level.[20]

Background

Ideally this domain would include a range of indicators at ward level quantifying incidents of crime and disorder at the local level. This could include the main offences experienced by residents, including domestic burglaries, vehicle–related thefts, offences involving violence against the person or vandalism to property. It might also include data on offenders in an area, and other data on social disorder. People's perception of the risk of crime, and the impact this has on their lives is also important. If possible therefore, the domain could include a measure of the fear of crime and disorder. It could also seek to measure (the lack of) neighbourhood attachment and civic participation. However many of these aspects are difficult to measure at any level, let alone that of the local area. They

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[20] Barnes, J. 1997, 'Methods of measuring community characteristics', *Child Psychology and Psychiatry Review* 2 (4) 163-169.

extend into the type of more subjective measures of deprivation pioneered by the 'geography of misery' team at York (see Burrows and Rhodes, 1998 for full details[21]).

In practice there are large numbers of problems associated with recorded crime data. First only a proportion of crimes is actually reported to the police. Crimes involving insured property (e.g. burglaries and car related crime) are more likely to be much better reported. In some areas householders are much less likely to carry house contents insurance. Under-reporting applies particularly to crimes against the person. Events such as domestic violence may both be poorly reported and also may not be recorded as a 'crime' following police involvement. There may also be selective reporting of crime by type of neighbourhood, social class and community. However the Community Attitudes Survey carried out by the Central Survey Unit (Sixth Report[22]) found only limited differences between people who identified themselves as Catholic or Protestant regarding the propensity to report 'ordinary crime', though there were differences in the main methods favoured for contacting the police, and considerable differences in satisfaction with the police (in terms of politeness, helpfulness, fairness and 'doing a good job'), with the people identifying themselves as Protestant generally expressing more favourable attitudes.

There are also several issues related to location. Crimes are recorded where they take place, and therefore certain offences are likely to be more numerous in areas where there are shopping centres, pubs, clubs and other facilities than may bring in a large population from outside the locality. There are also areas such as those of student accommodation and other bed-sits where recorded cases of domestic burglaries are high, in part because since 1998 a single break-in to such premises would be multiplied by the number of separate units burgled. The same recording change also affected single events with a substantial impact on large numbers of people, which are now recorded in terms of the overall numbers of offences.

While in principle some way of handling under- and non-reportage of crime and location might be possible – for example using the regular Crime Survey, which picks up a substantial amount of unrecorded crime, this would involve some form of manipulation or adjustment of the recorded crime data. The Crime Survey is based on only a sample of households and does not give any local estimates. While the research team was able to obtain crime data for Northern Ireland, it was decided not to attempt any manipulation or transformation of these data using other sources such as the Crime Survey, until more experience had been gained.

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[21] Burrows, R., and Rhodes, D., 1998 *Unpopular Places? Area disadvantage and the geography of misery in England* (Policy Press, Bristol).
[22] Central Survey Unit, 1999, *Community Attitudes Survey: Sixth Report* (NISRA Occasional Papers no. 10, NISRA).

Indicators Used

Recorded Crimes
Data were supplied at ward level by the RUC for 1998/1999 and 1999/2000 for the offences listed above. The categories for which data were supplied included those with large numbers of offences – common assault, serious assault plus a total count for violence against the person offences, burglary in a dwelling, burglary in a building other than a dwelling, theft from car, theft/taking away of a car, criminal damage and a total count of all offences. Drugs offences data were also included. These items comprise more than 70% of offences recorded, and are the most meaningful offences for inclusion in an area based measure of deprivation. The frequently recorded items omitted include offences such as fraud, shoplifting and 'other theft'.

Denominators employed included the number of residential units (for domestic burglaries); the numbers of non residential addresses (from the Post Office Address File – PAF) for burglaries other than in a dwelling; and numbers in the adult population (the research team's population estimates for those aged 16+) plus an estimate of the working population (taken from the 1999 Census of Employment) for other offences. It had originally been proposed to use the 1991 Census work-place data, but is was decided that these data are now too out of date. The 1999 Census of Employment is the most up to date source for the working population, though it does not distinguish between employees who are resident and those who are not normally resident, (unlike the 1991 Census). The inclusion of the working population takes some account of the greater population 'at risk' for crimes such as car crime, violence against the person etc. In principle it might be that city centre areas should be attributed even larger populations than those normally resident or working there, to deflate the effects of shoppers, visitors etc., but there is no obvious basis for doing this or for identifying such areas *a priori*, and there are other areas which may have a substantial population in transit (e.g. travelling through the area). It is the case that the events actually took place in the areas recorded. What is not always clear is whether they had any direct impact on the residents, or whether these effects should somehow be attributed in part to other areas. Again there was no realistic basis for any such attribution. The effect of including the working population substantially damps down some of the extreme cases (e.g. city centre areas with high number of workers).

Local Area Problem Score
The Northern Ireland House Conditions Survey 1996 (Housing Executive, 1998) contains a number of environmental rating scales for the area surrounding each house assessed in the survey. Five items were selected from this scale, covering 'graffiti', 'vandalism', 'scruffy gardens/landscaping', 'scruffy neglected buildings', and 'litter rubbish dumping'. The items were scored on a five point scale in the original study. The five items were summed at ward level to give a ward score.

Combining the Indicators

The shrinkage technique was applied to all of the indicators. The indicators were transformed to a standard normal distribution and factor analysis was applied. Having

taken into account the variance explained and the absence of a meaningful second factor for this domain, the indicators were combined using the weights generated by the factor analysis to produce a single domain score.

Other Indicators Considered

Electoral Turnout and Population Turnover
Electoral turnout was not used, as the consultation consistently suggested that it might vary for quite other reasons than voter apathy or lack of community attachment. No other measures of such attachment or alternatively community dislocation presented themselves, except in small survey format.

Population turnover was also not used as it may mean different things in different settings.

Vacant Housing
Data were obtained from DSD for vacant housing stock and total housing stock at ward level for 1995 to 1999. This indicator was not included because it did not relate to other items in the domain and where there was a small association the direction was generally negative. That is, areas with higher levels of vacant houses appeared to have lower rates on other measures such as criminal damage.

Chapter 10: Housing Stress

Housing Stress: Indicators

- Housing in disrepair (1996 Northern Ireland House Condition Survey)
- Houses without central heating (1996 Northern Ireland House Condition Survey)
- Houses lacking insulation (1996 Northern Ireland House Condition Survey)

Purpose of this domain

This domain seeks to identify areas of unsatisfactory housing by using indicators of 'housing stress'. This conceptualisation of the Housing Domain considers the condition of the housing itself, rather than the status of the occupants. It would be possible to construct a domain from indicators relating to vulnerability in the housing market, access to suitable housing, and the special needs of certain groups to have safe and appropriate housing (children and disabled people for example). However, even if up to date data to address these issues were available at ward level for the whole of Northern Ireland (requirements which need to be met but which are at present largely not possible), it is not evident that all of these indicators would represent the same kind of 'deprivation', or that they could be conceptually linked to people living in poor standard accommodation, who are otherwise not deprived.

By showing that a ward contains housing with a low 'Housing Stress' score, there is no implication that this ward (and individuals within the ward) is not deprived in other ways, or that the ward is privileged.

Background

The 'Robson Measures' used a mixture of indicators which related to housing deprivation, although they were not combined into a domain. These indicators were mostly drawn from the 1991 Census and included the lack of amenities, the lack of central heating for pensioners, children living in flats or non-permanent accommodation, and overcrowding (measured as an average of more than one person per room in the house). It was agreed throughout the consultations for the new Measures of Deprivation that the 1991 Census is now out of date and the use of the 1991 Census was avoided in the construction of the Housing Domain. The Domain uses information from the Northern Ireland House Condition Survey (NIHCS) of 1996. This is the most up to date data which covers the whole of Northern Ireland and has relevant information about the condition of housing across all of the housing types and tenures. The survey carried out a physical inspection and in a large proportion of cases a household interview. The NIHCS data are a weighted sample, by which any particular household or case can 'count for'

several other properties.[23] The survey is widely reported at LGD level and provides a comprehensive overview of the housing stock for LGDs and the whole of Northern Ireland. Using the survey at ward level is an innovative technique, and one which contributes towards the understanding of multiple deprivation at a small area level.

Indicators

Number of Houses in disrepair
Housing quality is a critical issue. Much relevant data on housing quality is collected in the NIHCS. The first indicator was constructed by taking into account major faults to the physical structure of the house. These were faults to the roof structure, the roof covering and faults in the walls and windows.

Houses without central heating or insulation
The inability to properly heat a house is considered to be a good measure of poor housing. The lack of central heating and the lack of insulation (a combined measure of double glazing and wall insulation – which are applicable to all types of accommodation) indicate poorly maintained accommodation which will be difficult to heat or keep warm and dry. These two variables were also created from the House Condition Survey.

Combining the indicators

Ward level scores were created by combining the three indicators at a household level. 'Points' were given to the indicators by using the lack of central heating (two points), or the presence of disrepair (up to four points) and the absence of insulation (up to two points) to create a score. These points were then summed and these case scores were then aggregated to ward level and expressed as a proportion of the maximum possible score. Shrinkage estimation was applied to this score to create the final domain score.

Other issues considered

All of the issues discussed below relate to the condition of household members or the conditions of property availability, rather than to the condition of the properties in which people live. Because the aim of this domain is to capture the disadvantage of living in accommodation in poor condition and with poor heating and insulation, these avenues of inquiry have been explored, but are not included in the domain.

Overcrowding
During the consultations, concerns were raised that household overcrowding be taken into account in the Housing Domain. Rates of overcrowding can vary significantly between areas, reflecting the varying need for housing capital investment to tackle the problem. But two issues arise in relation to this indicator. Firstly, household overcrowding potentially reflects property prices in an area and not only the conditions of

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[23] For full details of the sampling technique see *The Northern Ireland House Condition Survey 1996* (NIHE, 1998).

the household *per se*. Second, although this is an important issue, the only comprehensive data available are from the 1991 Census, which it is acknowledged is now out of date.

Homelessness
This question was raised during the consultations in relation to rough sleepers, young people, children, women and people homeless or resettled as a result of the Troubles. Although data are held on homelessness in various categories by the Northern Ireland Housing Executive, these data are not readily available below LGD level for the whole of Northern Ireland.

Affordability
Many people are rightly concerned about the availability of affordable housing. The lack of affordable housing can contribute to household overcrowding and restrict the choices of people to live near work or near their family. 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[24]. Using a definition of affordable housing costs as a fraction of income may be useful, but relies on knowing the income of households across Northern Ireland. At present such a measure is not possible.

Unsuitable Housing
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, it was agreed by all that the Census data should be avoided because it is now ten years old.

Housing Benefit
Being in receipt of Housing Benefit is a mark of having a low income and is discussed in the Income Domain.

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[24] See the very useful work undertaken by the Centre for Research in Property and Planning, at Ulster University, in constructing a quarterly House Price Index and associated research, at www.engj.ulst.ac.uk/RPP

Chapter 11: Constructing the ward level Multiple Deprivation Measure

Standardising and Transforming the Domain Deprivation Measures

Having obtained a set of Domain Deprivation Measures these needed to be combined into an 'overall' Multiple Deprivation Measure. In order to combine Domain Deprivation Measures 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. A form of standardisation and transformation was required that met the following criteria. First it must ensure that each domain has a common distribution; second, it must not be scale dependent (i.e. confuse size with level of deprivation); third, it must have an appropriate degree of 'cancellation' built into it (discussed below); and fourth, it must facilitate the easy identification of the most deprived wards. Having considered other options, the exponential transformation of the ranks best met these criteria.

Other procedures were considered, such as z-scores or untransformed ranks. Using the ranks for each domain would solve some problems but would introduce others. Ranks would certainly 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 information of the data is lost. The symmetrical nature of ranks, and 'z scores' of normally distributed data, 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.

The exponential distribution has a number of properties. First it transforms each domain so that they each have a common distribution, the same range and identical maximum/ minimum value, so that when the domains are weighted and combined into a single Multiple Deprivation Measure, the impact of the weights is absolutely clear and explicit. Second, it is not affected by the size of the ward's population. Third, it effectively spreads out that part of distribution in which there is most interest - that is the 'tail' which contains the most deprived wards in each domain. Fourth, it enables one to determine the desired cancellation properties.

The exponential transformation involves ranking the scores in each domain. The ranking standardises the domain scores (between 566 for the most deprived and 1 for the least deprived for the purposes of the calculation). These ranks are then transformed to an exponential distribution, using the formula presented in **Appendix E**. This has the effect of transforming the ranked domain scores to a value between 0 (least deprived) and 100 (most deprived), on an exponential basis, that is larger (more deprived) scores are given greater emphasis.

The exponential transformation stretches out the distribution so that greater levels of deprivation score more highly. The most deprived 10% of wards have values between 50 and 100 after exponential transformation.

This issue of cancellation is clearly important for understanding 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.)

As has been noted in **Chapter 1**, the approach in the Measures of Deprivation is to conceptualise the various deprivations as measured by each domain as separate and distinct, though they may have cumulative effects in an area (or for any individual). Thus to be poor *and* in ill-health is clearly a worse state than experiencing just one of these deprivations on their own. It would be conceptually inappropriate for someone who is poor but healthy to have their income deprivation ignored because they are fortunate enough to be in good health.

The significant advantage of the exponential transformation is that it gives *control* over the extent to which lack of deprivation in one domain cancels or compensates for deprivation in another domain. In particular, it allows precise regulation (though not the elimination) of these cancellation effects. The exponential transformation has been used in a way that reflects a level of cancellation appropriate to this approach to multiple deprivation.

The exponential transformation formula selected gives approximately 10% cancellation. This means that in the extreme case, a ward which was ranked top on one domain but bottom on another would overall be ranked at the 90th percentile in terms of deprivation (if the two domains were equally weighted). This compares with the 50th percentile if the untransformed ranks or a normal distribution had been used instead. For example a ward that came top in terms of Income deprivation (i.e. the most deprived) but was bottom on the Housing Domain (i.e. the least deprived) would still be at the 90th percentile (top 10%) if these two domains were combined with equal weights. In fact income deprivation is weighted more highly, which would further reduce the impact of the non-deprived result for the Housing Domain.

In the previous 'Robson Measures' the signed chi-square approach was used both to address the problem of unreliable small numbers, and as a form of standardising the different indicators. As has been indicated, the more robust 'shrinkage' approach has been used to deal with the small numbers problem in the new Measures of Deprivation. The signed chi-square approach was rejected as a method to standardise the indicators in the Measures of Deprivation because there are many problems associated with this method. These are, briefly, its scale-dependency (that is it conflates the size of the area or population with seriousness of the problem in a non-linear way) and its lack of transparency. There has been widespread criticism of the technique from academic

quarters (e.g. Chisholm and Connolly, 1999). For example, the implication of the scale dependency of the signed chi-square technique is that other things being equal a larger ward would get a higher deprivation score even if it had the same or even a lower level of deprivation as a smaller ward.

Weighting the domains

Weighting *always* takes place when elements are combined together. Thus if the domains are summed together to create a Multiple Deprivation Measure this means they are given *equal weight*. It would be incorrect to assume that items can be combined without weighting.

The Domain Deprivation Measures must be combined in such a way that their weights are explicit. The exponential transformation procedure, as has been noted, ensures that the domains can be combined without 'hidden' weights. It would be inappropriate simply to sum the standardised Domain Deprivation Measures because this would give each Domain equal weight.

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

- The importance of their contribution to an overall concept of multiple deprivation
- Robustness of the indicators comprising the domain

The Income and Employment Domains were regarded as the most important contributors to the concept of multiple deprivation and the indicators comprising the domains were very robust. Hence it was decided that they should carry more weight than the other domains. The weightings of the domains is supported by the research team's work, the consultation process and, where available, the wider academic literature.

On the second criterion it is important to stress that only indicators which are sufficiently robust have been included within the Multiple Deprivation Measure. 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 Northern Ireland at a small area level) have been selected.

Based on these criteria the following weights have been used (weights must total 100%):

Income deprivation	25%
Employment deprivation	25%
Health deprivation and disability	15%
Education, skills and training deprivation	15%
Geographical access to services	10%
Social environment	5%
Housing stress	5%

Each domain score is ranked and exponentially transformed, to standardise the distribution. The six transformed domain scores for each ward are then summed, using the weights in the table above. Thus, a ward's overall score is:
(0.25 x Income) + (0.25 x Employment) + (0.15 x Education) + (0.15 x Health) + (0.1 x Access) + (0.05 x Social Environment) + (0.05 x Housing).

Chapter 12: Presenting the Results, Interpretation and Guidance

Results have been released at ward level for each of the Domain Deprivation Measures, the overall Multiple Deprivation Measure and the supplementary Child Poverty Measure as well as LGD level summaries of the ward level Multiple Deprivation Measure. In addition, the Income and Employment Domains have been released at ED level. An Economic Deprivation Measure has been constructed at ED level from the Income and Employment Domains with two summaries at ward level.

Section 1: Ward level presentations

At the ward level there are nine Measures for each ward in Northern Ireland: seven Domain Deprivation Measures (which are combined to make the overall Multiple Deprivation Measure); an overall Multiple Deprivation Measure and a supplementary Child Poverty Measure. In addition there are two ward level summaries of the ED level Economic Deprivation Measure, see **Section 4**. The Deprivation Measures are each assigned a rank. There are 566 wards in Northern Ireland. The most deprived ward for each Measure is given a rank of 1, and the least deprived ward is given a rank of 566. The ranks show how a ward compares to all the other wards in Northern Ireland and are easily interpretable. However, the scores indicate the distances between each rank position, as these will vary.

The seven Domain Deprivation Measures and their Ranks
Each Domain Deprivation Measure consists of the combined indicators in that domain. These are then ranked. These Domain Deprivation Measures can be used to describe each type of deprivation in an area. This is important as it allows users of the Measures of Deprivation to focus on particular types of deprivation, and to compare this across wards. There may be great variation within an LGD, and the ward level Domain Deprivation Measures allow for a sophisticated analysis of deprivation information.

The scores for the Income and Employment Deprivation Measures are rates. So for example if a ward scores 35.1 in the Income Domain, this means that 35.1% of the ward's population are Income deprived. The same applies to the Employment Domain. The scores for the remaining five domains are not rates. Within a domain, the higher the score, the more deprived the ward. 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 Multiple Deprivation Measure at ward level
The overall Multiple Deprivation Measure describes the ward by combining information from all seven domains: Income, Employment, Health, Education, Access, Social Environment and Housing. 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 ward level Multiple Deprivation Measure is ranked in the same way as the Domain Deprivation Measures.

The Multiple Deprivation Measure score is the combined sum of the weighted, exponentially transformed domain rank of the domain score. Again, the bigger the Multiple Deprivation Measure score, the more deprived the ward. However, because of the exponential distribution, it is not possible to say, for example, that a ward with a score of 40 is twice as deprived as a ward with a score of 20.

The most deprived ward according to the Multiple Deprivation Measure is assigned a rank of 1, and the least deprived ward, a rank of 566.

The supplementary Child Poverty Measure
The Child Poverty Measure is a subset of the Income Domain Deprivation Measure, and shows the percentage of children in each ward that live in families that claim the 'out-of-work' means tested benefits of Income Support and Job Seekers Allowance (Income Based), and the 'in-work' benefits of Family Credit and Disability Working Allowance. The Child Poverty Measure is not combined with the other domains into the overall Multiple Deprivation Measure as the children are already captured in the Income Domain. A Child Poverty Measure score of e.g. 24.6 means that 24.6% of 0-15 year olds in that ward are living in families claiming means tested benefits.

Maps
Maps have been produced to show the spatial distribution of the Domain Deprivation Measures and the overall Multiple Deprivation Measure at ward level. The wards have been deciled (divided into ten equal groups) according to the deprivation scores in each domain or on the Multiple Deprivation Measure. Each decile contains 56/57 wards (see **Chapter 13**).

Section 2: ED level presentations

ED level Domain Deprivation Measures have been constructed for the Income and Employment Domains. In addition, an Economic Deprivation Measure has been created by combining the Income and Employment Domains at ED level. This was achieved by exponentially transforming the ranks of the Income and Employment ED level Domain Measures and combining them with equal weights, each ED score having first been shrunk to the ward score of their respective domains. The Economic Deprivation Measure has been summarized at ward level (see **Section 4**).

Section 3: LGD level presentations of the ward level Multiple Deprivation Measure

The Multiple Deprivation Measure produced is at ward level. However, six measures at LGD level have been devised to summarise the ward information.

LGDs are complex to describe as a whole or to compare for several reasons. First, LGDs can vary in population size. Further, some LGDs may have a less homogenous population, containing more variation in deprivation and in some places deprivation may be concentrated in severe pockets rather than being evenly spread. This makes an 'overall picture' more difficult to establish. All areas experiencing high levels of deprivation will be identified by one or more of these six measures, as they are designed to capture deprivation in areas of different sizes with different levels of heterogeneity.

Six measures have been devised to take account of these issues. They all describe the LGD in different ways: looking at the most deprived populations, the most deprived wards, as well as the average of the wards, to get six meaningful descriptions of deprivation at LGD level. Given the different patterns of deprivation within LGDs, it is important to have a variety of measures to capture this variation. All of the summary measures need to be considered together to give a full description of an area's deprivation. More subtle descriptions of deprivation across an LGD can be established by a close analysis of the wards within that LGD, as the ward level Multiple Deprivation Measure contains the most detailed account of local deprivation. At the ward level much more information is retained than in the LGD level summaries. The ED level Income and Employment Domains and the Economic Deprivation Measure present further detail about small area deprivation.

There are 26 LGDs in Northern Ireland. For each measure each LGD is given a rank and score (with the exception of Extent, as explained below). For presentation, a rank of 1 indicates that the LGD is the most deprived according to the measure, and 26 is the least deprived. The meaning of the scores for each of the measures is detailed below.

The measures are population weighted by the ward populations for the LGD (except for the two Scale measures which are in the form of a simple count).

Local Concentration

> The population weighted average of the ranks of an LGD's most 'multiply' deprived wards that contain exactly 10% of the LGD's population.

Local Concentration is an important way of identifying LGDs' 'hot spots' of deprivation. It highlights the most deprived wards in an LGD. These need not be contiguous but may comprise pockets of deprivation which can be seen from the ranks of the ward level Multiple Deprivation Measure.

The Local Concentration measure defines the 'hot spots' by reference to a percentage of the LGD's population. The average of the population weighted ranks of an LGD's most deprived wards that capture *exactly* 10% of the LGD's population was selected. In many cases this was not always a whole number of wards. The population weights were calculated by determining the proportion that each of these selected wards contributed to the 10% (of the LGD's total population). For the purpose of calculating this score the wards are ranked such that the most deprived ward is given the rank of 566.

Worked example
An example might be an LGD containing 10,000 people. Ten percent of this population is 1,000 people. The Local Concentration measure would calculate the score of the most deprived wards containing exactly 1,000 people. Having sorted the wards in descending order of deprivation, the most deprived ward contains 800 people and has a rank of 300 (out of 566, where 566 is the most deprived ward for this calculation). The next most deprived ward contains 600 people and has a rank of 100. 200 people from the second ward are required to reach the total of 1,000 people (which is 10% of the LGD's population). The Local Concentration score for this LGD would be:
$((800/1000) \times 300) + ((200/1000) \times 100)$
$= (0.8 \times 300) + (0.2 \times 100)$
$= 260$.

The larger the Local Concentration score, the more deprived the LGD, on this measure. The most deprived LGD on this measure is given a rank of 1, for presentation.

Extent

Proportion of an LGD's population living in wards which rank within the most 'multiply' deprived 10% of wards in Northern Ireland.

The aim of this measure is to portray how widespread *high levels* of deprivation are in an LGD. It only includes LGDs which contain wards which fall within the top ten percent of the most deprived wards in Northern Ireland. Therefore some LGDs will not have an overall score for this measure and will be given an equal 'least deprived' rank. The Extent measure is the proportion of an LGD's population living in the wards which rank within the most deprived 10% of wards on the Multiple Deprivation Measure in Northern Ireland.

Worked example
An example might be an LGD with 10 wards. Five of the wards are within the most deprived 10% of wards in Northern Ireland on the Multiple Deprivation Measure. The populations of the five highly deprived wards are aggregated and divided by the LGD's total population and presented as a percentage. So, the populations of these highly deprived five wards are 1,000 2,000 3,000 2,000 and 1,500 and the total LGD population is 15,000.
Extent $= (1,000 + 2,000 + 3,000 + 2,000 + 1,500)/15,000 \quad \times \quad 100 \quad = 63.3\%$

The LGD scores are ranked in descending order, so the LGD with the highest percentage is given a rank of '1'.

Scale (two measures)

> Income Scale is the number of people who are income deprived; Employment Scale is the number of people who are employment deprived

These two measures show the sheer numbers of people experiencing income deprivation and employment deprivation at LGD level.

Income Scale is a count of the number of people in each LGD who are included in the Income Domain i.e. the sum of the ward level numerators. This captures all people dependent on IS, JSA-IB, FC and DWA.

Employment Scale is a count of the number of people in each LGD who are included in the Employment Domain i.e. the sum of the ward level numerators. This captures the unemployment claimants, IB or SDA recipients aged 16-59 and New Deal participants not included in the unemployment claimant count.

The Multiple Deprivation Measure itself has been created in such a way as to be independent of population size. However, this measure will inevitably identify LGDs with large numbers of people experiencing these deprivations. It is important to note that the scale measures do not pick up large populations, but large *deprived* populations. If two LGDs have the same percentage of income deprived people, the larger LGD will be ranked as more deprived in the Income Scale measure because more people are experiencing the deprivation.

Worked example
LGD X has five wards. The number of people in low income families in each ward (i.e. the numerator in the Income Domain) are 1344, 4221, 847, 3737 and 329.
The Income Scale score is therefore = 1344 + 4221 + 847 + 3737 + 329
$$= 10,478$$

The Employment Scale score is generated in the same way, using the numerator of the Employment Domain.

In both cases, the LGD scores are ranked in descending order, so the LGDs with the largest number of Income or Employment deprived people are ranked '1'.

Average of ward ranks

Population weighted average of the combined Multiple Deprivation Measure ranks for the wards in an LGD

This measures the LGD as a whole, including both deprived and less deprived wards. All the wards in an LGD need to be included to obtain an average, as each ward contributes to the character of that LGD. In this measure, the deprived and less deprived ward ranks will 'average out'. For the purpose of calculating this score the wards are ranked such that the most deprived ward is given the rank of 566. The ward ranks are population weighted within an LGD to take account of the fact that ward size can vary significantly within LGDs.

Worked example
An LGD has five wards, with populations of 1,000 1,500 2,000 3,000 and 2,500. These wards rank 100, 278, 500, 489 and 27 respectively (for the purposes of the calculation the ranks are such that 1=least deprived). The total LGD population is 10,000. In order to calculate the score, each ward rank is multiplied by the proportion of the LGD's population that falls in that ward. These are summed to make the LGD score. Thus, the average ward rank for this LGD is:
((1,000 / 10,000) x 100) + ((1,500/10,000) x 278) + ((2,000/10,000) x 500) + (3,000/10,000) x 489) + ((2,500/10,000) x 27)
=305.15

The LGD scores are ranked in descending order, and the most deprived LGD (which has the largest score) is given a rank of '1' for presentation.

Average of ward scores

Population weighted average of the combined Multiple Deprivation Measure scores for the wards in an LGD

This measure also describes the LGD as a whole, taking into account the full range of ward scores across an LGD. **The advantage of the Average of Ward Score measure is that it describes the wards by retaining the fact that the more deprived wards may have more 'extreme' scores, which are not revealed to the same extent if the ranks are used. This means that the more deprived ward scores will not be moderated to the same extent by the less deprived ward scores as they are for the Average of ward ranks measure.** This measure is calculated by averaging the ward scores in each LGD after they have been population weighted. This measure, and the average of ward ranks, are equally valid ways of presenting the average deprivation of an LGD's wards.

Worked example
This is calculated in exactly the same way as the Average of Ward Ranks, except that the Multiple Deprivation Measure ward score is used instead of the ward rank.

Section 4: Ward Level Presentations of the ED level Economic Deprivation Measure

The Economic Deprivation Measure has been summarized at ward level.

Economic Deprivation Extent

> Proportion of a ward's population living in EDs which rank within the most Economically deprived 10% of EDs in Northern Ireland.

The aim of this measure is to portray how widespread *high levels* of economic deprivation are in a ward. It only includes wards which contain EDs which fall within the top ten percent of the most Economically deprived EDs in Northern Ireland. Therefore some wards may not have a score for this measure and are given an equal 'least deprived' rank. The Extent measure is the proportion of a ward's population living in the EDs which rank within the most deprived 10% of EDs on the Economic Deprivation Measure in Northern Ireland. The ward level summary of the ED level Economic Deprivation Measure is calculated in the same way as the LGD level summary of the ward level Multiple Deprivation Measure, with the ED level populations used instead of the ward population. For this measure a rank of 1 was given to the ward which was the most deprived.

Local Concentration for the ED level Economic Deprivation Measure

> The population weighted average of the ranks of a ward's most Economically deprived EDs that contain 10% of the ward's population (or the whole most deprived ED if this contains more than 10% of the ward's population).

Local Concentration is an important way of identifying a ward's 'hot spots' of deprivation. It highlights the most deprived EDs in a ward. These need not be contiguous but may comprise pockets of deprivation which can be seen from the ranks of the ED level Economic Deprivation Measure. It is calculated in the same way as the LGD Local Concentration summary measure.

For this measure a rank of 1 was given to the ward which was the most deprived.

Section 5: Guidance

The Multiple Deprivation Measure is a new source of valuable information about spatial patterns of deprivation in Northern Ireland. Seven Domain Deprivation Measures have been constructed at ward level; a ward level overall Multiple Deprivation Measure; a supplementary Child Poverty Measure at ward level; two ED level Income and Employment Domain Deprivation Measures; an ED level Economic Deprivation Measure; six LGD level summaries of the ward level Multiple Deprivation Measure, and two ward level summaries of the ED level Economic Deprivation Measure. These can all be used to help focus policy and intervention on deprived areas and particular types of deprivation.

Using Scores and Ranks
As outlined in the **'Presentation of Results and Interpretation'** section, it is valid to compare wards *within* a domain using either the score or the rank. For example, it is valid to say that Ward A has a score of 29.92 and Ward B a score of 6.87 in the Income Domain, ranking 152 and 538 respectively, and that Ward A is more deprived than Ward B.

However, when comparing a ward *between* domains, ranks should be used. It is not appropriate to compare Ward A's score of 29.92 in the Income Domain and its score of 1.16 in the Health Domain. This is the case for all of the domains because the range and the minimum and maximum scores vary.

For the overall Multiple Deprivation Measure, wards can be compared using either the scores or ranks. But again, for any given ward, the Multiple Deprivation Measure cannot be compared to other domains using the score: only the rank should be used.

Because the Income and Employment Domain scores are rates, it is possible to say that Ward X with a score of 40% is twice as deprived as Ward Y with a score of 20%. In the Access Domain the score represents the weighted average distance to selected services. Thus one can also say that the weighted mean distance to services in Ward A is, for example, twice that of Ward B. However, in the four other Domains, it is **not** possible to do this, as the scores are not rates. The domain ranks cannot be described in this manner either and it is not possible to say that Ward X with a rank of 100 is twice as deprived as Ward Y with a rank of 200.

Using individual Domain Deprivation Measures and the overall Multiple Deprivation Measure
Individual Domain Deprivation Measures can be used to identify particular types of deprivation. For example, it is possible to describe an LGD's wards solely in terms of its Health deprivation. The ward level Multiple Deprivation Measure's main purpose is to describe the overall picture of multiple deprivation, based on the combined Income, Employment, Health, Education, Geographical Access to Services, Social Environment and Housing Domain Deprivation Measures.

Comparing different wards using individual Domain Deprivation Measure ranks and Multiple Deprivation Measure ranks
The individual Domain Deprivation Measures can be used to make comparisons between wards across Northern Ireland. For example, it is possible to say that 11 wards in LGD A are ranked in the most deprived 100 in the Income Domain compared with 0 wards in LGD B in the Income Domain. The ward level Multiple Deprivation Measure can be aggregated up to different spatial levels, as long as these can be constructed from 1984 wards.

Comparing the Domain Deprivation Measures in a single ward
It is valid to describe a ward in terms of more than one domain, and this will usually be entirely appropriate. For example, Ward A has a rank of 41 for the Income Domain and a rank of 23 for the Health Domain. However, these two pieces of information cannot be combined to make a single score or rank: the only acceptable combination of the Domain Deprivation Measures is the ward level Multiple Deprivation Measure which incorporates all seven Domain Deprivation Measures. This is because combining the Domain Deprivation Measures selectively does not take into account the compensation between domains, and the domain weights which were carefully selected and consulted upon during the construction of the Multiple Deprivation Measure.

Re-ranking within an LGD
The ward ranks within an LGD for the Domain Deprivation Measures and the overall Multiple Deprivation Measure are the Northern Ireland ranks. LGDs may wish to extract wards within their own area from the released data and re-rank for local purposes e.g. an LGD with 21 wards might find it easier to use the measures by ranking their own wards 1 through 21. This is perfectly acceptable.

Adding new data to the Domain Deprivation Measures and the overall Multiple Deprivation Measure
Supplementary information cannot be incorporated into the Domain Deprivation Measures and the Multiple Deprivation Measure as they are constructed using agreed data sources from fixed points in time. However, additional information e.g. data from Community Audits, can of course be presented alongside the results to reach targeting or other decisions. It should be stressed that this point relates to the current Measures. Any future changes or updating of the Measures will need to explore whether further information, for example on new domains, can be incorporated.

Summarising the overall Multiple Deprivation Measure at LGD and other levels
The Multiple Deprivation Measure can be summarised at LGD level (see above). As noted above, it can also be summarised for other area units, so long as they are made up of whole 1984 wards.

Domain Deprivation Measures and Domain Weights
The domain weights have been agreed through a process of consultation. Combining the Domain Deprivation Measures using alternative weights should not be undertaken. Similarly, none of the Domain Deprivation Measures should be removed from the

Multiple Deprivation Measure. Multiple deprivation must take account of the substantial range of domains included in the Multiple Deprivation Measure. The Domain Deprivation Measures can also be summarised at LGD level.

Chapter 13: The Geography of Deprivation in Northern Ireland

Section 1: The Multiple Deprivation Measure

The map of the ward level Multiple Deprivation Measure (MDM) shows that there is considerable variation in multiple deprivation levels across Northern Ireland. The most deprived 10% of wards, shaded in dark blue, are spread throughout Northern Ireland. They are particularly concentrated in Belfast, Londonderry, Craigavon and Newry and Mourne. It is striking that the least deprived 20% of wards are concentrated in the eastern half of Northern Ireland. The map shows that some LGDs have wards across the whole deprivation spectrum, whereas the LGDs outside Belfast, Outer Belfast and the East of Northern Ireland areas show relatively less variation in the range of multiple deprivation.
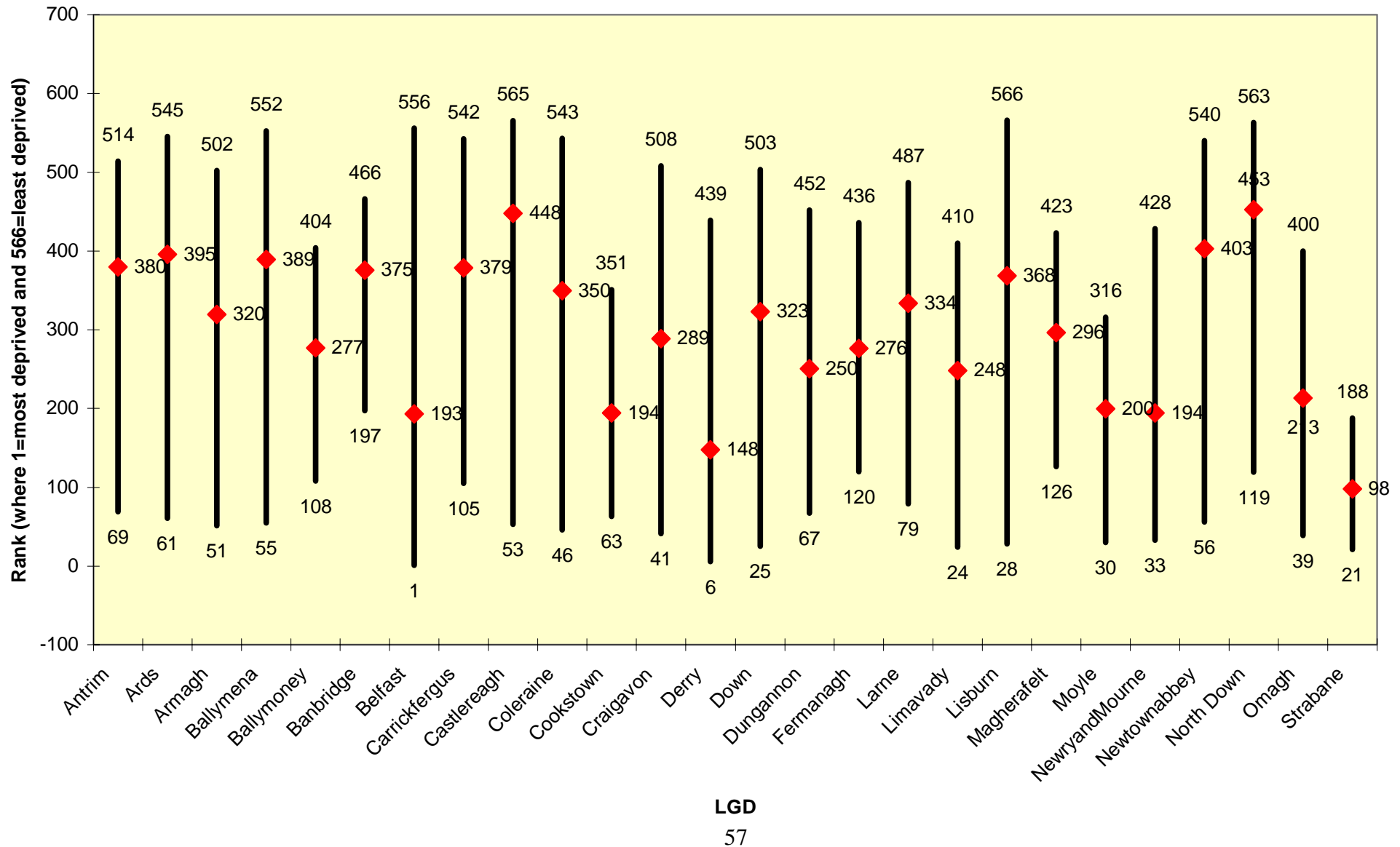
Chart 13.1 shows the most deprived rank, least deprived rank and population weighted mean rank for each LGD in Northern Ireland. So for example, Antrim's most multiply deprived ward has a rank of 69 (where 1 is the most deprived), and its least deprived ward has a rank of 514 (where 566 is the least deprived). Its population weighted mean rank which is depicted by a diamond, is 380.

Of the wards that fall within the most multiply deprived 10% of all wards in Northern Ireland, the following can be said:
- 96% (i.e. 54 wards) fall within the most deprived 10% on two or more of the seven domains.
- 50% (i.e. 28 wards) fall within the most deprived 10% on four or more of the seven domains.
- No wards fall in the most deprived 10% of all of the seven domains.

Just over 206,900 people live in the most multiply deprived 10% of wards in Northern Ireland, which is 12.2% of Northern Ireland's population. At the other end of the spectrum just over 211,200 people live in the least deprived 10% of wards in Northern Ireland, which is 12.5% of Northern Ireland's population.

Chart 13.1   Multiple Deprivation Measure: Range of Ranks by Local Government District

Section 2: Ward level Domains of Deprivation

Each domain of deprivation has been mapped at ward level. In addition a chart has been produced for each domain measure showing the most deprived rank, least deprived rank and population weighted mean rank for each LGD in Northern Ireland.

The map of Income Deprivation shows that there is considerable variation in income deprivation levels across Northern Ireland. The most deprived 10% of wards, shaded in dark blue, are spread throughout Northern Ireland. They are particularly concentrated in Belfast, Londonderry, Strabane, Omagh, Cookstown and the west of Newry and Mourne. The distribution is similar to that shown in the map of Multiple Deprivation. **Chart 13.2** shows the most deprived rank, least deprived rank and population weighted mean rank for each LGD in Northern Ireland on the Income Domain. So for example, Omagh's most income deprived ward has a rank of 73 (where 1 is the most deprived), and its least deprived ward has a rank of 448 (where 566 is the least deprived). Its population weighted mean rank which is depicted by a diamond, is 214.

The pattern of the Employment Domain map is very similar to that of the Income Domain, with the exception of the centre of Belfast which has slightly more wards in the most employment deprived decile. **Chart 13.3** shows that Employment deprivation varies dramatically by LGD, as well as within LGDs. Thus for example, Belfast has a range of ward ranks that go between 2 and 563 (with a mean rank of 196), while Strabane has a much more limited range of between 31 and 219, with a mean rank of just 88.

The Health Deprivation and Disability Domain map shows rather more clustering of high levels of deprivation than with the MDM, with concentrations of highly deprived wards in Derry, Newry and Mourne, Craigavon and particularly in Belfast. **Chart 13.4** shows the discrepancy in ranges between LGDs. So for example, Banbridge's rank between 160 and 514. with a mean rank of 362 (where 566 is the least deprived), whereas Derry's wards rank between 11 and 278, with a mean rank of 112.

The Education, Skills and Training Deprivation Domain map shows a wide variation within the LGDs in Northern Ireland. Belfast, Derry, Ballymena, Newtownabbey and Castlereagh which each contain several wards in the most education deprived quintile. **Chart 13.5** shows that even in LGDs with very low levels of education deprivation on average, there are some education deprived wards. For example, North Down contains the least deprived ward, ranked at 566, and has an average rank of 406 (the least deprived mean rank in Northern Ireland for this domain), but it also contains a ward that ranks 64, just outside the most deprived decile.

The Geographical Access to Services Domain map shows a very different picture, but one that captures an important dimension of multiple deprivation. **Chart 13.6** shows that Moyle LGD has the most access deprived mean rank (124) in Northern Ireland. Other highly access deprived LGDs include Fermanagh, Limavady, Larne and Strabane. Belfast is the least deprived LGD in this domain, and has a much more limited range of ward ranks of between 312 and 566 (where 566 is the least deprived).

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The Social Environment Domain map shows concentrations of deprivation in Belfast, Derry and Craigavon. However, as **Chart 13.7** shows, most of the LGDs show a wide range of deprivation ranks for this domain. Belfast has the most deprived ward (ranked 1), and a ward in the least deprived decile, at 529. However, its mean rank is very deprived, at 120. Derry has the second most deprived mean rank on this domain, at 193, and the second most deprived ward in Northern Ireland, however its least deprived ward only has a rank of 378.

The Housing Stress Domain map shows a great variation of deprivation levels between LGDs as well as within LGDs. **Chart 13.8** shows that Fermanagh and Ballymoney have the most deprived mean ranks (109 and 104 respectively), and limited rank ranges. In contrast, Castlereagh, while also having a limited range of ward ranks in this domain, only has wards which fall in the least deprived 50%, and it has a mean rank of 501 (where 566 is the least deprived).

Section 3: The ward level Child Poverty Measure

The map of child poverty shows the proportion of children living in families in receipt of IS, JSA-IB, FC or DWA. Wards that fall in the most deprived decile are largely concentrated in Belfast, Derry, Lisburn, Craigavon and Coleraine. Some LGDs such as Armagh show a great variation in ward rates of child poverty. **Chart 13.9** confirms this point. However, some LGDs have much less variation in the child poverty ward ranks. For example, Strabane and Cookstown, which have ranges of 18 to 266 and 80 to 339 respectively (where 1 is the most deprived). Strabane has the most deprived mean ward rank of 133, while North Down has the least deprived mean rank of 425.

Chart 13.2   Income Deprivation Measure: Range of Ranks by Local Government District

Rank (where 1=most deprived and 566=least deprived)

Chart 13.3 Employment Deprivation Measure: Range of Ranks by Local Government District

Rank (where 1=most deprived and 566=least deprived)

LGD	Low	Mid	High
Antrim	128	409	550
Ards	65	407	545
Armagh	43	274	466
Ballymena	71	402	544
Ballymoney	60	276	422
Banbridge	178	397	518
Belfast	2	196	563
Carrickfergus	44	383	523
Castlereagh	99	432	559
Coleraine	48	323	513
Cookstown	51	186	389
Craigavon	24	259	488
Derry	1	121	359
Down	9	326	515
Dungannon	110	263	403
Fermanagh	102	323	491
Larne	30	388	547
Limavady	6	289	440
Lisburn	26	396	566
Magherafelt	101	269	411
Moyle	17	190	312
NewryandMourne	29	206	457
Newtownabbey	49	413	557
North Down	74	436	565
Omagh	14	179	327
Strabane	31	88	219

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Chart 13.4   Health Deprivation and Disability Measure: Range of Ranks by Local Government District

Chart 13.5   Education, Skills and Training Deprivation Measure: Range of Ranks by Local Government District

Chart 13.6   Geographical Access to Service Deprivation Measure: Range of Ranks by Local Government District

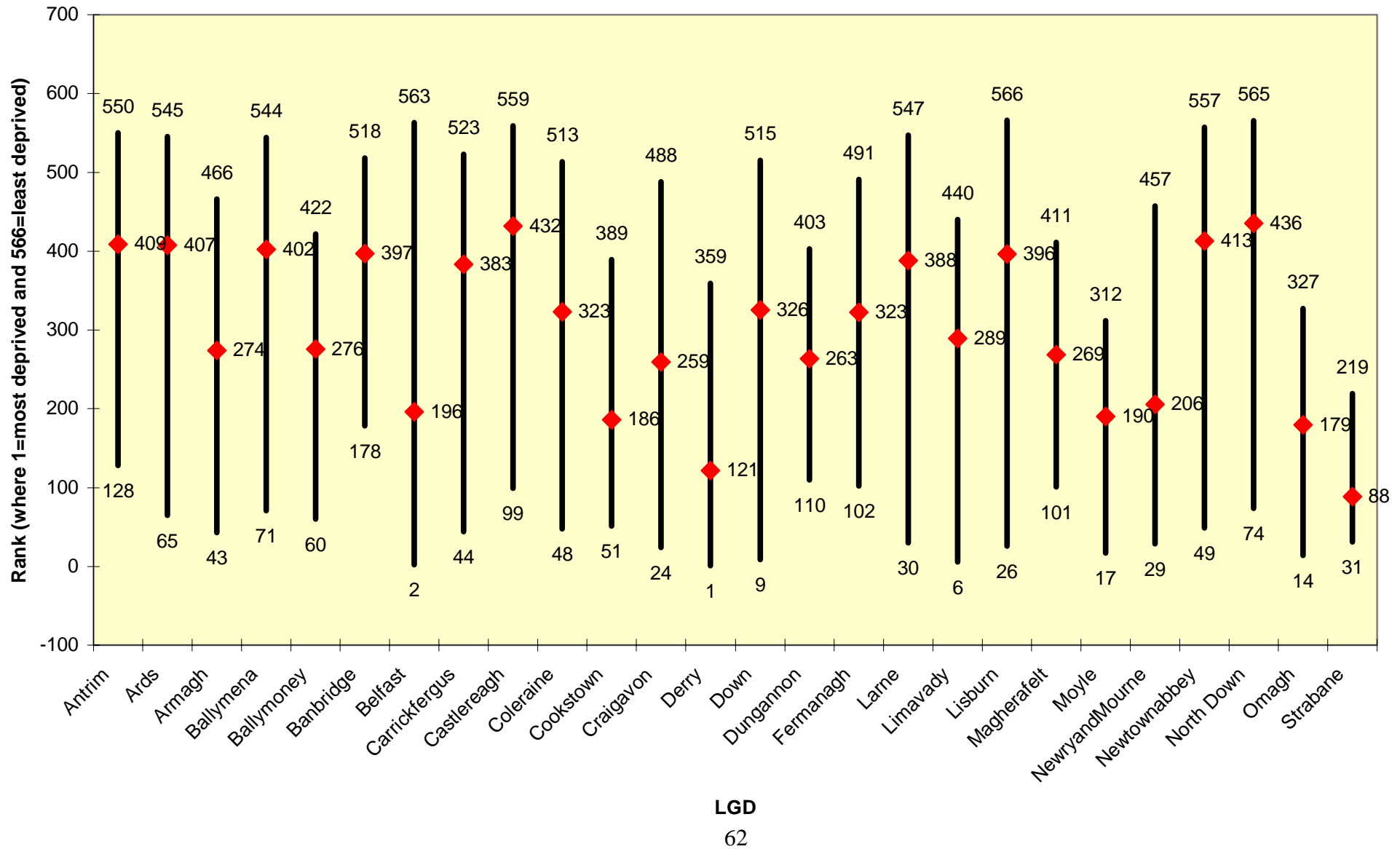**Chart 13.7   Social Environment Deprivation Measure: Range of Ranks by Local Government District**

Chart 13.8   Housing Stress Measure: Range of Ranks by Local Government District

Chart 13.9 Child Poverty Measure: Range of Ranks by Local Government District

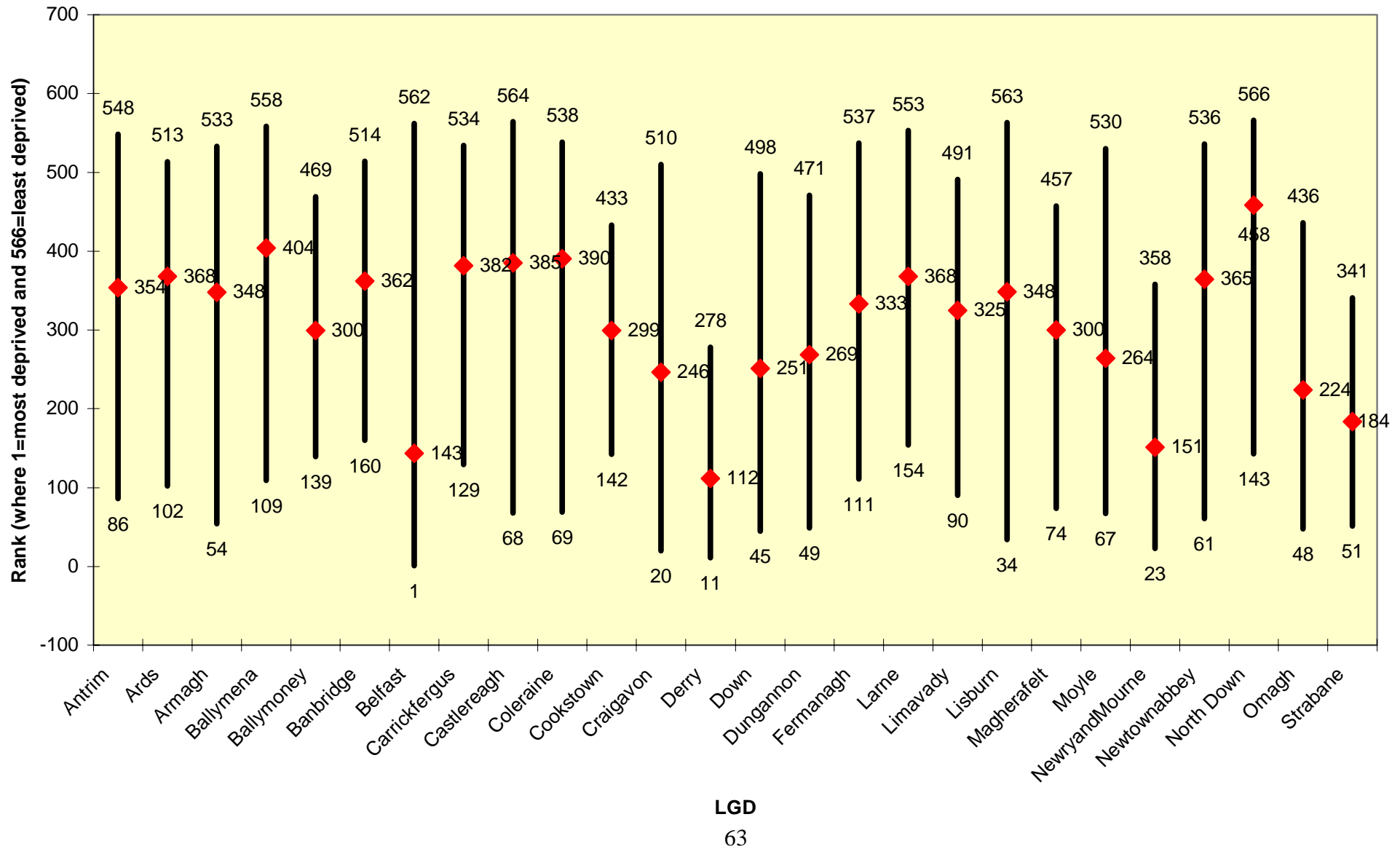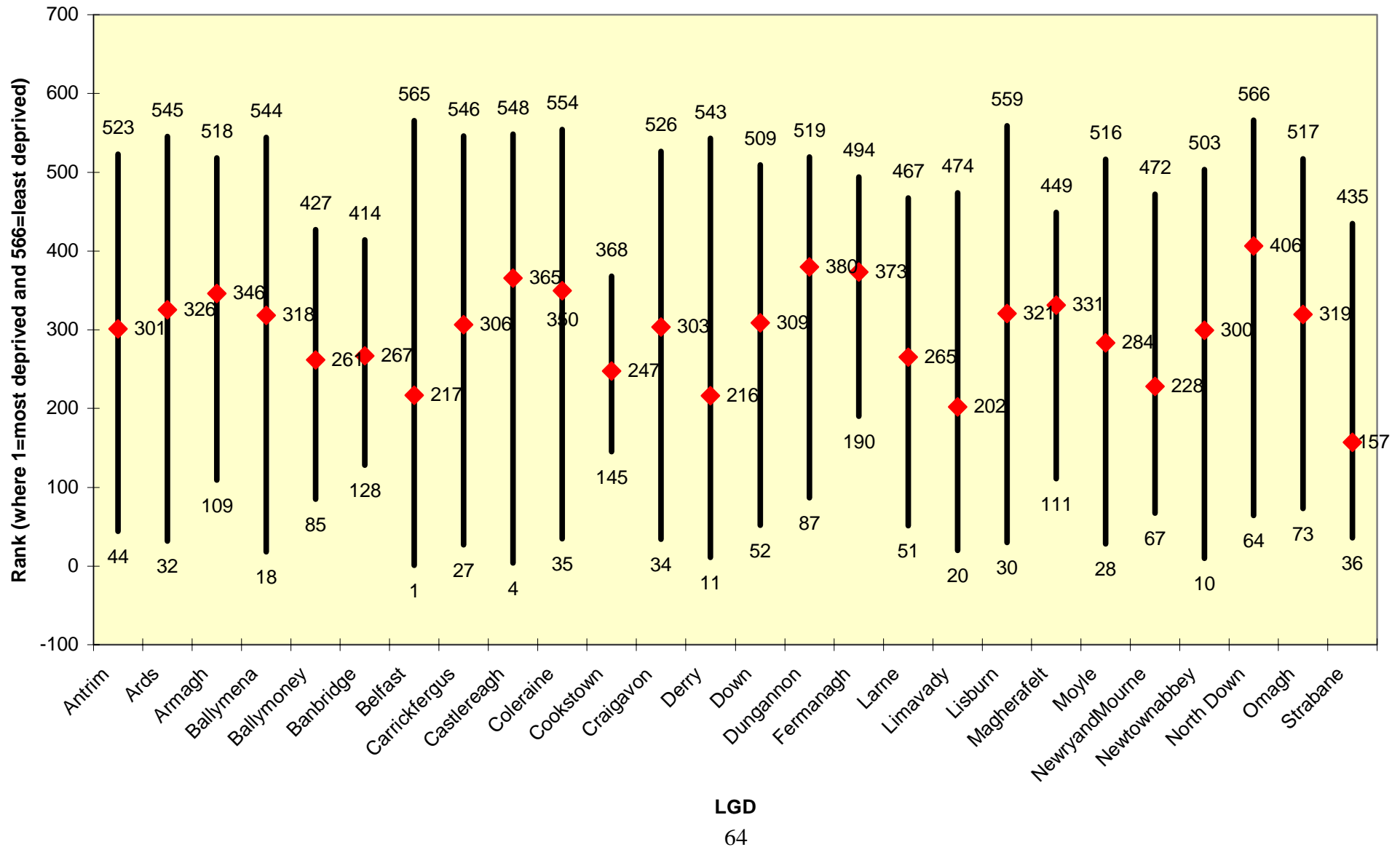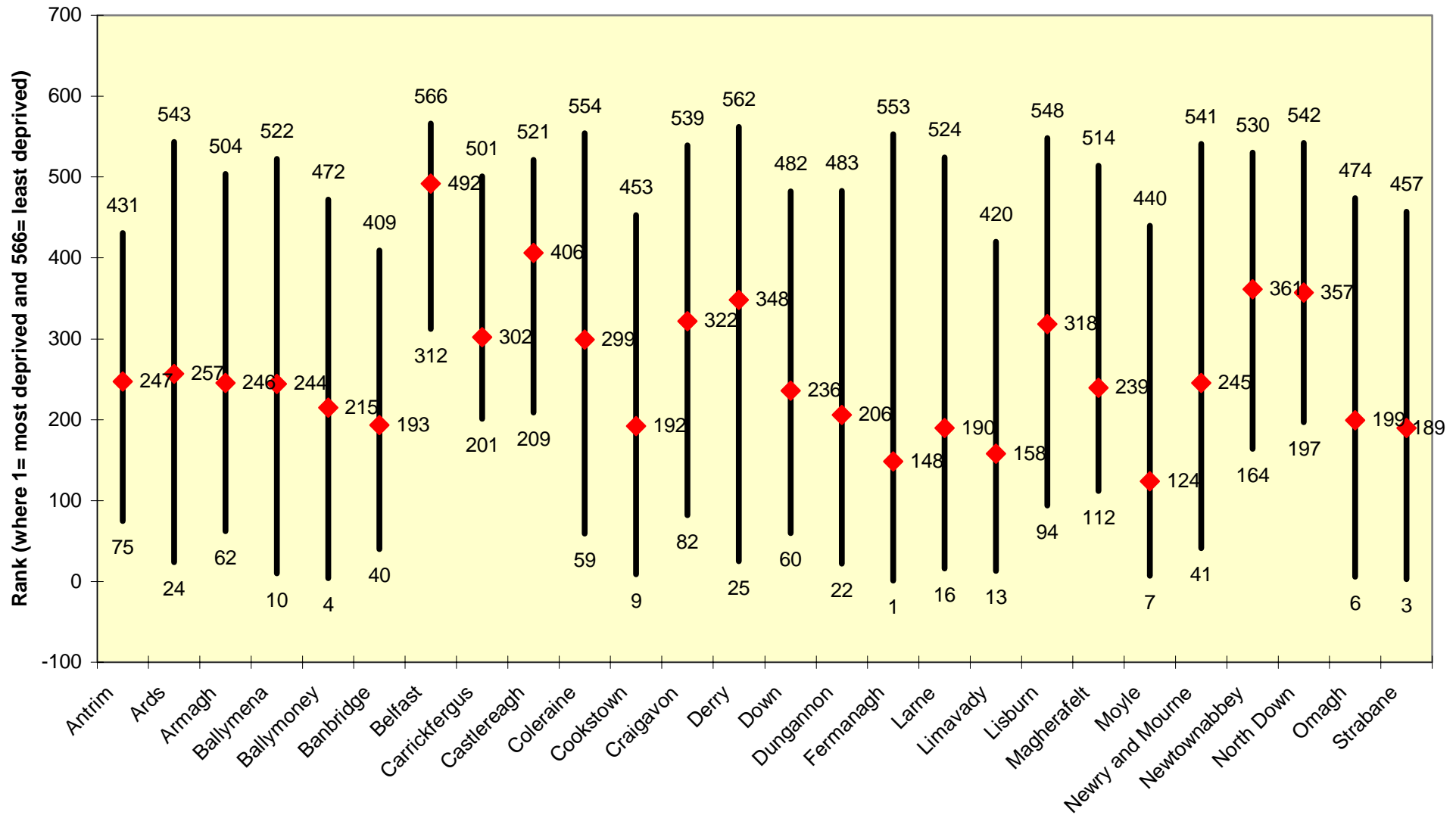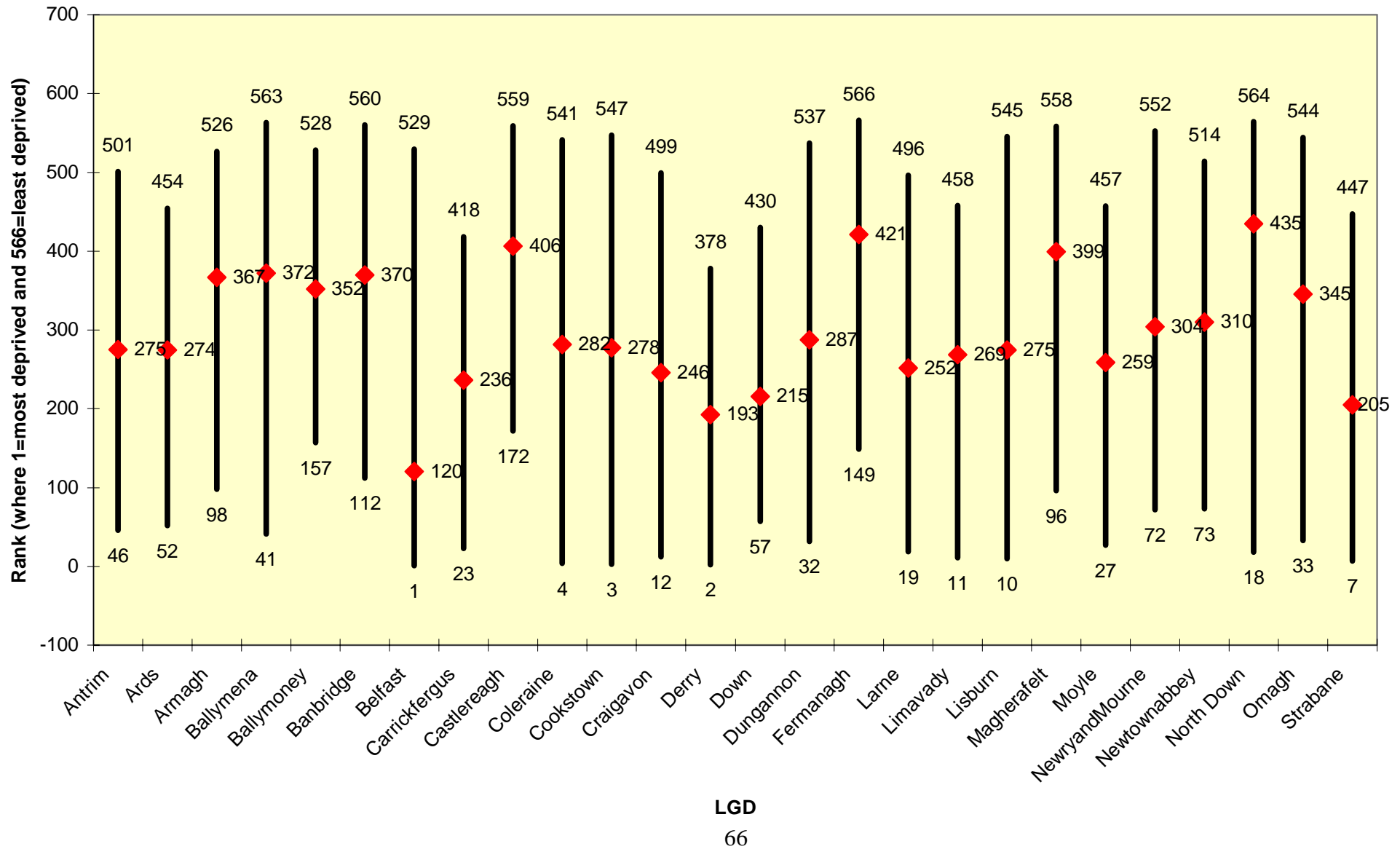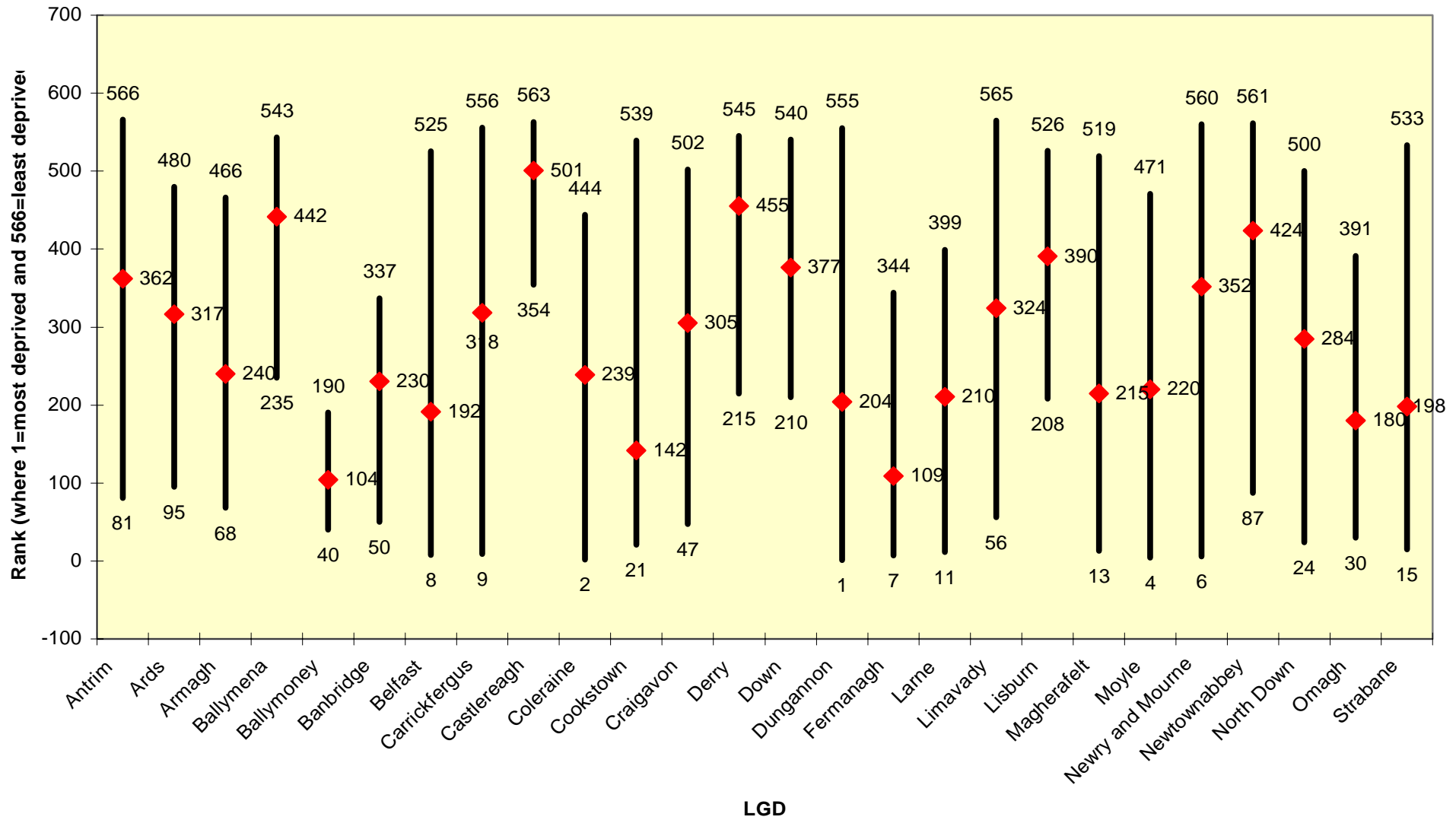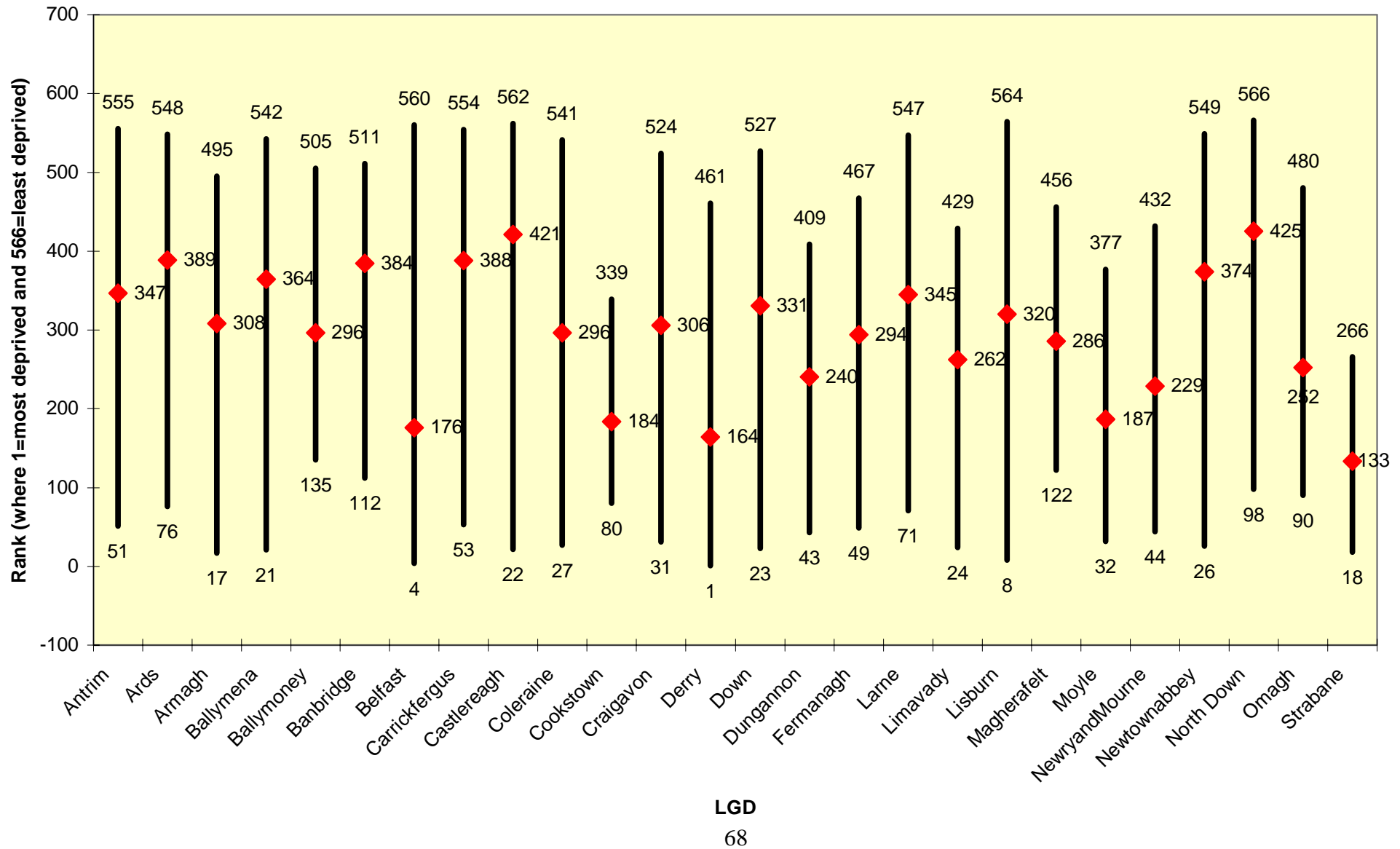# Section 4: ED Level Economic Deprivation Measure

Economic deprivation has been measured at Enumeration District level. It consists of the ED level Income and Employment Domains, combined with equal weights. The maps have been presented for different areas of Northern Ireland based on the NUTS 3 boundaries, although Belfast and Outer Belfast have been presented together. On these maps, the ED boundaries are depicted using a thin black line, the ward boundaries are depicted by a thicker black line, and the LGD boundaries are overlaid in red (thus covering the ED and ward boundaries).

These maps present economic deprivation at a sub-ward level, portraying the pockets of deprivation that can exist within wards. All LGDs contain a range of ED deciles. For example, Belfast has EDs in every decile, including 171 EDs in the most deprived decile (i.e. 30% of all EDs in Belfast), and 53 EDs (9.3%) in the least deprived decile. However, Strabane is particularly striking in that all but three of its EDs fall within the five most deprived deciles. In contrast, Banbridge has only two EDs in the two most deprived deciles.

Two ward level summaries of the ED level Economic Deprivation Measure have been generated: Local Concentration and Extent. The Extent measure shows the proportion of a ward's population living in EDs which rank within the most economically deprived 10% of EDs in Northern Ireland. Thirteen wards have 100% of their population living in EDs that fall within the most economically deprived 10% of EDs: 8 in Derry, 1 in Moyle and 4 in Belfast.

The Local Concentration measure is the population weighted average of the ranks of a ward's most Economically deprived EDs that contain 10% of the ward's population (or the whole most deprived ED if this contains more than 10% of the ward's population). Of the ten most deprived wards on this measure, 6 are in Belfast, 3 in Derry and 1 in Newry and Mourne.

Section 5: LGD Summaries of the ward level Multiple Deprivation Measure

Table 13.1 shows the rank of the LGDs for each of the summary measures. Explanations of these summaries can be found in **Chapter 12**. Thus, for example, Belfast ranks as the most deprived LGD on the Income Scale, Employment Scale, Local Concentration and Extent measures, while Strabane ranks as the most deprived LGD on the Average Score and Average Rank measures.

Table 13.1 LGD summaries of the ward level Multiple Deprivation Measure – sorted by rank

Rank	Income Scale	Employment Scale	Local Concentration	Extent	Average Score	Average Rank
1	Belfast	Belfast	Belfast	Belfast	Strabane	Strabane
2	Derry	Derry	Derry	Derry	Belfast	Derry
3	Newry and Mourne	Newry and Mourne	Strabane	Strabane	Derry	Belfast
4	Lisburn	Lisburn	Moyle	Lisburn	Newry and Mourne	Newry and Mourne
5	Craigavon	Craigavon	Lisburn	Moyle	Moyle	Cookstown
6	Fermanagh	Newtownabbey	Newry and Mourne	Craigavon	Cookstown	Moyle
7	Dungannon	Down	Craigavon	Newry and Mourne	Omagh	Omagh
8	Strabane	Omagh	Limavady	Omagh	Limavady	Limavady
9	Omagh	Ards	Omagh	Coleraine	Dungannon	Dungannon
10	Newtownabbey	Armagh	Coleraine	Limavady	Craigavon	Fermanagh
11	Down	Strabane	Cookstown	Armagh	Fermanagh	Ballymoney
12	Armagh	Coleraine	Ballymena	Ballymena	Ballymoney	Craigavon
13	Coleraine	Fermanagh	Newtownabbey	Castlereagh	Magherafelt	Magherafelt
14	Ards	North Down	Armagh	Down	Armagh	Armagh
15	Ballymena	Dungannon	Dungannon	Newtownabbey	Down	Down
16	Magherafelt	Ballymena	Larne	Antrim*	Larne	Larne
17	Cookstown	Castlereagh	Down	Ards*	Coleraine	Coleraine
18	North Down	Antrim	Castlereagh	Ballymoney*	Lisburn	Lisburn
19	Antrim	Magherafelt	Carrickfergus	Banbridge*	Carrickfergus	Banbridge
20	Limavady	Cookstown	Ballymoney	Carrickfergus*	Ballymena	Carrickfergus
21	Castlereagh	Limavady	Fermanagh	Cookstown*	Banbridge	Antrim
22	Banbridge	Banbridge	Magherafelt	Dungannon*	Antrim	Ballymena
23	Ballymoney	Carrickfergus	Ards	Fermanagh*	Newtownabbey	Ards
24	Carrickfergus	Ballymoney	Antrim	Larne*	Ards	Newtownabbey
25	Larne	Larne	North Down	Magherafelt*	Castlereagh	Castlereagh
26	Moyle	Moyle	Banbridge	North Down*	North Down	North Down

* LGDs marked with an asterix in the Extent column have a joint rank of 16.

Table 13.2 shows the scores and ranks of each of the LGD level summaries of the ward level MDM. The ranks are shown in bold. In the Extent measure, LGDs which do not have a score (because they have no wards which fall in the most deprived 10% of wards in Northern Ireland on the MDM) are given a joint rank of 16.

Table 13.2: Scores and ranks of the LGD level summaries of the ward level Multiple Deprivation Measure – sorted by LGD name

LA Name	Number of Income Deprived	Rank of Income Scale	Number of Emplt. Deprived	Rank of Emplt. Scale	Extent Score	Extent Rank	Local Conc. Score	Local Conc. Rank	Average of Ward Ranks	Rank of Average of Ward Ranks	Average of Ward Scores	Rank of Average of Ward Scores
Antrim	10252	**19**	2994	**18**	0.00	**16**	401.33	**24**	187.16	**21**	13.34	**22**
Ards	12986	**14**	4033	**9**	0.00	**16**	409.61	**23**	171.58	**23**	12.56	**24**
Armagh	14117	**12**	3904	**10**	4.19	**11**	485.32	**14**	247.48	**14**	17.50	**14**
Ballymena	11944	**15**	3297	**16**	3.65	**12**	497.56	**12**	177.64	**22**	13.64	**20**
Ballymoney	6805	**23**	1888	**24**	0.00	**16**	447.69	**20**	290.10	**11**	19.65	**12**
Banbridge	7229	**22**	2243	**22**	0.00	**16**	363.77	**26**	191.54	**19**	13.43	**21**
Belfast	102869	**1**	24451	**1**	39.12	**1**	563.45	**1**	374.02	**3**	35.87	**2**
Carrickfergus	6706	**24**	2242	**23**	0.00	**16**	459.41	**19**	188.29	**20**	13.99	**19**
Castlereagh	9580	**21**	3276	**17**	3.23	**13**	463.22	**18**	119.50	**25**	9.54	**25**
Coleraine	13687	**13**	3773	**12**	8.05	**9**	509.77	**10**	217.14	**17**	16.23	**17**
Cookstown	10944	**17**	2653	**20**	0.00	**16**	502.47	**11**	372.60	**5**	25.98	**6**
Craigavon	21188	**5**	6005	**5**	10.35	**6**	521.74	**7**	278.09	**12**	20.89	**10**
Derry	43911	**2**	10659	**2**	35.02	**2**	553.83	**2**	419.23	**2**	35.38	**3**
Down	15118	**11**	4241	**7**	3.16	**14**	466.09	**17**	243.92	**15**	17.37	**15**
Dungannon	16085	**7**	3538	**15**	0.00	**16**	476.37	**15**	316.83	**9**	21.65	**9**
Fermanagh	17030	**6**	3749	**13**	0.00	**16**	441.89	**21**	290.66	**10**	19.74	**11**
Larne	6286	**25**	1810	**25**	0.00	**16**	467.97	**16**	233.32	**16**	16.68	**16**
Limavady	9669	**20**	2366	**21**	4.60	**10**	520.79	**8**	318.94	**8**	22.52	**8**
Lisburn	25399	**4**	6057	**4**	12.69	**4**	531.29	**5**	198.53	**18**	16.10	**18**
Magherafelt	11390	**16**	2803	**19**	0.00	**16**	417.78	**22**	270.82	**13**	18.22	**13**
Moyle	4935	**26**	1287	**26**	11.25	**5**	534.50	**4**	367.39	**6**	26.78	**5**
Newry and Mourne	31645	**3**	7317	**3**	9.27	**7**	525.77	**6**	372.72	**4**	27.04	**4**
Newtownabbey	15212	**10**	4413	**6**	2.79	**15**	490.87	**13**	164.07	**24**	12.69	**23**
North Down	10901	**18**	3711	**14**	0.00	**16**	401.30	**25**	114.42	**26**	8.92	**26**
Omagh	15222	**9**	4119	**8**	8.48	**8**	520.79	**9**	353.87	**7**	25.37	**7**
Strabane	15362	**8**	3785	**11**	13.41	**3**	540.94	**3**	469.36	**1**	36.93	**1**

Section 6: Change since the previous Measures of Relative Deprivation

It will be observed that the geography of deprivation has changed in some respects since Robson's Measures of Deprivation which were published in 1994. Changes may be due to some or all of the reasons discussed below.

Further development of the conceptualisation of Multiple Deprivation

The research for the Northern Ireland Measures of Deprivation has built on the earlier work in Northern Ireland and moved forward the measurement of multiple deprivation both conceptually and practically. The approach used is to conceptualise multiple deprivation as a composite of different dimensions or domains of deprivation. However, each dimension is measured independently using the best indicators available to generate a score or Domain Measure for each aspect of deprivation. The 'Robson Measures' used the idea of 'domains' to classify elements of deprivation which contributed to the overall Measure of Deprivation, however the individual domains of deprivation played no role in the construction of the overall Measure of Deprivation and the indicators were not combined to form separate Domain Measures. This had the effect that domains of deprivation with a greater number of indicators received more weight in the single overall Measure of Deprivation.

New data allowing better measurement of the domains of deprivation

The Measures of Deprivation are based as far as has been possible on data from 1999. The Robson Measures were primarily based on 1991 Census data. The new Measures also avoid the use of proxy indicators in favour of more direct measures of deprivation. This has in part resulted from the advanced conceptualization of multiple deprivation and in part from the harnessing of new sources of data, such as administrative data to measure deprivation.

Methodological improvements

The statistical methods used to create the Measures of Deprivation have changed. Instead of using the signed chi-squared technique, which has been widely criticised in relation to this purpose, the new Measures use the shrinkage technique to deal with the small numbers problem, factor analysis to combine indicators in domains where the indicators are not on the same metric, and exponential transformation to transform the domains to a common distribution before being combined into the Multiple Deprivation Measure, with a controlled degree of cancellation. These methods are statistically robust, and are not scale dependent.

Real change in deprivation

As well as the reasons for change listed above, real change in the distribution of deprivation will have occurred. This will be reflected in the new geography of deprivation as seen in the Domain Measures and the Measure of Multiple Deprivation.

Appendix A: Consultation

Throughout the development of the new Northern Ireland Deprivation Measures, the research team have welcomed the very useful process of consultation which has been undertaken. This has taken several forms.

First, there has been a widespread consultation with statutory bodies, voluntary and community organisations through a series of seminars. Members of the research team and NISRA gave presentations in Belfast in July 2000, Lurgan in September 2000, Derry in October 2000, and Omagh in November 2000. These meetings were either with the statutory and voluntary sectors separately or a combined meeting of both sectors. These allowed interested groups, such as NICVA, the Housing Executive, and NIPSA, to have the opportunity to participate in early discussions regarding the conception and construction of the new Measures of Deprivation. The number attending these meetings has ranged between fifteen and sixty. The meeting in Derry was launched by the Minister of Finance and Personnel, Mr Mark Durkan MLA. These presentations were followed by small group discussions that responded to six set questions and reviewed possible measures. Their conclusions were then fed back to a plenary session. Notes were made of any suggestions. Members of the research team who attended found these sessions very helpful and constructive, and many of the difficult and challenging questions facing constructors of deprivation measures were raised, and many suggestions for possible deprivation indicators. One strong strand of concern that came through in all sessions was the importance of reflecting the human costs of the Troubles in some way in the new Measures of Deprivation.

Second, a website was set up for project. This described the project and held documents for downloading. In addition a dedicated email address was distributed, though which a number of suggestions and useful comments were received by the research team. Three newsletters were produced by the research team to inform interested groups about the review process. The first newsletter was issued in July 2000 and was distributed through NISRA and NICVA. This newsletter summarised the proposals for the new Measures of Deprivation and requested suggestions for deprivation Domains and Indicators. The second newsletter was issued in December 2000 and was disseminated through the project mailing list. This newsletter summarised many of the points made during the consultation seminars. The third newsletter summarised the final proposals for constructing the MDM. All three newsletters were made available on the website.

Third, NISRA gave several presentations about the project to a number of members of the Northern Ireland Executive, Departmental committees and political parties.

Fourth, methodological issues were explored at a meeting organized by the local group of the Royal Statistical Society in Belfast on 24th November 2000 following a presentation by the research team. Following the meeting a working paper on the proposed methodology was posted on the project website. This set out the research team's approach to combining the indicators into domains and combining the domains into an overall Multiple Deprivation Measure.

The research team has also been supported by a Steering Group containing experts from NISRA, central and local government, the voluntary sector and the Equality Commission. This group has reviewed the consultations, and advised on data collection, on the development of the deprivation indicators and on the completion of the final Multiple Deprivation Measure and report.

Appendix B: Population Estimates and Denominators

Introduction

Denominators are required at ward and ED level for the following three age groups: under 16s, 16 to 59s and 60s and over for mid 1999.

Currently no official sub-LGD population estimates are produced for Northern Ireland in the inter-censual period. However, NISRA produces mid year estimates for the LGDs. The starting point for this project was the Mid Year Estimates (MYE) produced by NISRA. The MYE represent a widely accepted set of population estimates produced for men and women for every year of age up to 85 with those above 85 placed into a single group. The objective was therefore to develop a methodology for 'moving' these estimates to the wards that make up a LGD. This would be achieved by generating a set of ward to LGD ratios that could be used to distribute the LGD figures amongst the wards that they contain.

In order to generate ED level population estimates, the ward level estimates were apportioned to EDs using unadjusted ratios generated from the Central Health Index (CHI).

Overview

A number of datasets were available at the ward level which were considered for generating the ward/ LGD ratios. They included:

- Child Benefit (CB) recipients (for August 1999)
- Central Health Index (CHI) (extracted in July 2000)
- 11-15 year olds in schools (excluding fee paying schools) (extracted in 2000)
- Older Persons Database constructed from Social Security benefits to which older people have entitlement (extracted in 2000)
- The Census (1991)
- Births 1st July 1998 to 30th June 1999

Of the above datasets only two span the entire age range. These are the CHI and the 1991 Census. The 1991 Census is both comprehensive and accurate. However, if it were used to create ratios to distribute the 1999 MYEs, the distribution of this figure to individual wards would be inaccurate if there had been a major change in population patterns between 1991 and 1999 within LGDs. The alternative possible ways of creating the ratios were:

1. To use birth data and Child Benefit data to create ratios for under 16s, use the Older Persons Database to distribute pensioners and use the CHI to distribute the working age population.
2. To use the CHI to distribute the entire population.
3. To create ratios using the CHI and modify these using the other datasets.

As will be described the preferred option was option 3.

An investigation was undertaken of the various datasets at LGD level, comparing them with the MYE. This revealed problems in some of the datasets.

The Child Benefit dataset though comprehensive up to the age of 16 appeared to have variable levels of geocoding in the LGD of Fermanagh. This was noticeable when the number of children aged 11 to 15 in

schools, CHI and Child Benefit datasets were compared with each other. This problem appeared to be localised and linked to the level of use of postcoding in Fermanagh, one of the last places in the UK to be allocated postcodes.

The schools data, as a measure of children of a specific age, depended on those children being in secondary school. This might not be the case if for example a child was a year behind (i.e. still in primary education), in a special school, being taught at home or in a private school. The choice of years 11-15 was designed to minimise inaccuracies at the upper and lower ends of the age band while also maximising the number of children counted.

The Older Persons Database relied upon people aged 65 and over taking up a state pension or other benefit.

The potential problems with the non-CHI datasets suggested that the CHI should be used to produce the main ratios with which to distribute the MYE and that the other datasets should be used to produce 'corrections' where the CHI was found to be inaccurate.

There were three main types of inaccuracy that might affect the CHI:
1. List inflation/deflation due to the problems of maintaining an accurate up to date population list based on registration.
2. Data maintenance issues – for example the absence of recognisable postcodes.
3. The undercount of permanent armed forces personnel because of the provision of forces' medical services.

List inflation/deflation is identifiable when comparing aggregated CHI figures with Mid Year Estimates as produced by NISRA. The pattern is variable over the age range within LGDs and has a different pattern between LGDs[25].

These types of inaccuracy will affect not only the ward in question but also the population estimates of other wards in the same LGD.
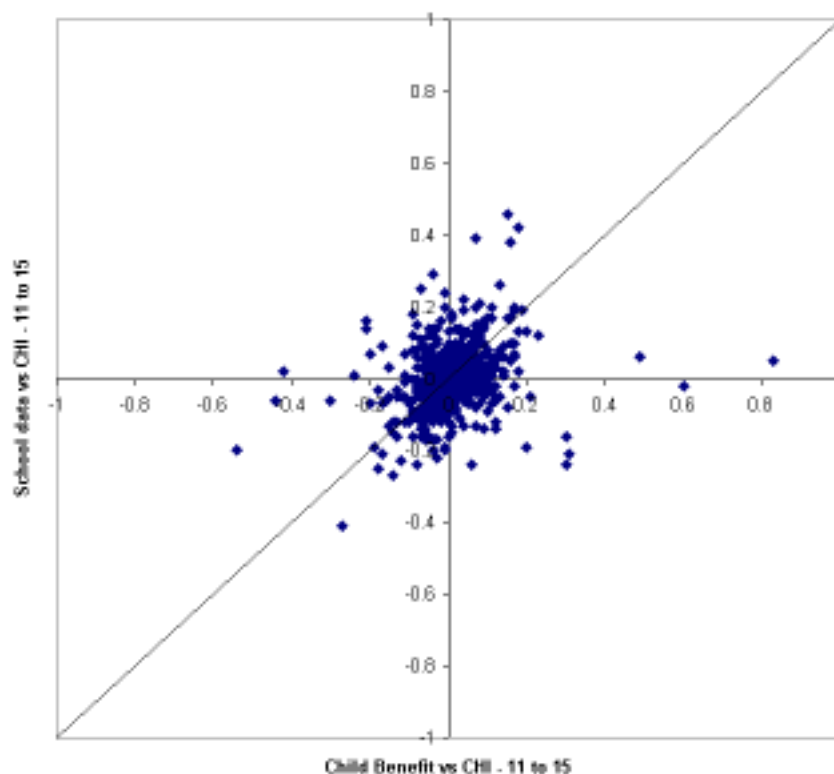
It is possible to identify where the CHI differs from other administrative datasets for both the 0-15 and the 65 and over age groups. However it is only for the 11 to 15 age group that contemporaneous datasets can be used to test whether this difference is not in fact due to an inaccuracy in the non-CHI dataset. It is possible to do this because of the existence of three datasets for this age group (the CHI, the schools dataset and the Child Benefit dataset). The number of 11 to 15 year olds in a ward can be expressed as a ratio of the aggregated LGD value for that dataset. If the CHI ratio is subtracted from each of the other datasets, and either resulting figure expressed as a percentage of the CHI, a measure of the amount of inaccuracy can be generated. If these two figures are then compared it is possible to assess the extent to which any difference between the CHI and another dataset is the result of a consistent inaccuracy in the CHI.

If the two 'difference' scores are plotted it is possible to see that there is some evidence of inaccuracy in the CHI (i.e. where a ward score lies on the diagonal leading from the bottom left hand corner of the plot up to the top right hand corner). The great majority of the wards lying in or near the line are in the centre of the plot. For these wards all three of the datasets largely agree. The significant wards are those lying away from the centre, on the main diagonal. Here there is evidence of difference from the CHI to a

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[25] See R. Beatty and M. Rodgers, (July 1999) *Mid-year population estimates in Northern Ireland: Validation and extension to Local Government Districts* (NISRA Occasional Paper no. 12).

similar degree and in a similar direction between the schools and Child Benefit datasets. In the case of these wards it would be possible to infer that the CHI is inaccurate and should be moved to a value closer to that of the schools or Child Benefit datasets.

Chart B1: Scatterplot showing the relationship between two 'difference' scores

The issue now becomes how to advance this methodology to the rest of the age structure. One assumption that could be made is that the first two of the inaccuracies identified earlier (i.e. list inflation/deflation and data maintenance issues) will affect the 11 to 15 age group as much, (or at least to a proportionate degree), as they do the other parts of the population. There is evidence for this when studying list inflation/deflation between the CHI and MYE at the LGD level, that although this phenomena typically affects the 25 to 50 age group to the greatest extent, the 11 to 15 age group is usually also affected but to a lesser degree. One solution would be to distribute the 'correction' factor identified within the 11 to 15 age group to the other age groups using the ratio of LGD level inflation/undercount as a guide. A check on whether this was appropriate for a particular ward would be if the 'correction' score was similar to the difference score generated when comparing the 11 to 15 age group 1991 Census ratio with the 11 to 15 CHI ratio.

A similar method could be used to create a correction factor for the remaining age groups: the under 11s and those aged 60 and over. In the case of the under 11s a ratio using the Child Benefit data could be compared with the CHI ratio for the same age group. The difference between these two ratios could then be compared with the correction factor generated for the 11 to 15 age group. If they were similar, then it would be appropriate to change the CHI figure. For the 60 and over group, the CHI ratio for those aged 65 and over could be compared with the equivalent ratio for those on the Older Persons Database to create a difference score. If this difference score was similar to that produced comparing the 1991 Census ratio with the CHI then it would be appropriate to correct the CHI using the pension data.

Many of the inaccuracies in the CHI would also be dealt with by this methodology. The armed forces personnel issue could be tackled by using MYE with armed forces personnel removed. The actual recorded ward number could then be added at the final stage, after the MYE had been distributed to all wards.

The methodology

The methodology has a number of steps:

1. Generate ward to LGD ratios for each year of age for both genders up to the age of 85 using the CHI. Create a single ratio for all those aged 85 and over.
2. Calculate correction factors.
3. Apply correction factors to the CHI single year ratios.
4. Distribute the resulting 'error' amongst all wards in the LGD within the appropriate age/gender boundary.
5. Distribute the LGD MYE (no armed forces personnel) to wards using the modified single year/ gender ratios.
6. Calculate the three required population denominators by summing the appropriate age groups.
7. Add the number of armed forces personnel to the ward level 16-59 age group.
8. Final adjustments.
9. Apportion ward level estimates to EDs.

Step 1: Creating ward to LGD ratios

For every ward, a ratio is calculated for each age group and each sex by dividing the ward CHI figure by the appropriate LGD total.

R=ward/LGD

In addition to the single year age/sex ratios, ratios for the following age groups were calculated:
- Ratio of 0-10 year olds living in families receiving Child Benefit
- Ratio of 11-15 year olds living in families receiving Child Benefit
- Ratio of 11-15 year olds in schools
- Ratio of 11-15 year olds on the Central Health Index
- Ratio of 16-59 year olds on the Central Health Index
- Ratio of 16-59 year olds in the 1991 Census
- Ratio of 65 and over on the Central Health Index
- Ratio of 65 and over receiving state pensions

Step 2: Calculation of correction factors

A. triangulation test
Two difference scores are created using the 11-15 ratios:

Diff1=(school ratio$_{11-15}$-CHI ratio$_{11-15}$)/CHI ratio$_{11-15}$
Diff2=(CB ratio$_{11-15}$-CHI ratio$_{11-15}$)/CHI ratio$_{11-15}$

These difference scores are then compared. If the differences lie within 40% of each other then a correction score is created which is the average of the two difference scores:

If Diff1 = +/-40% of Diff2   or Diff2 = +/-40% of Diff1
Then correction1 =(Diff1+Diff2)/2

This is the correction factor for the 11-15 age group.

B. correction factor for 0-11
A difference score is now created comparing the Child Benefit 0-11s with the CHI 0-11s:

$Diff3=(CB\ ratio_{0-11}-CHI\ ratio_{0-11})/CHI\ ratio_{0-11}$

The correction factor created above is then compared with this difference score:

If Diff3 = +/-40% of correction1   or correction1 = +/-40% of Diff3
Then correction2 = Diff3

This is the correction factor for the 0-11 year olds.

C. correction factor for 16-59
The correction factor created from the 11-15 triangulation is compared with a difference score created comparing the CHI and the 1991 Census for 16-59 year olds.

$Diff4=(Census\ ratio_{16-59}\ -CHI\ ratio_{16-59}\ )/CHI\ ratio_{16-59}$

If Diff4 = +/-50% of correction1   or correction1 = +/-50% of Diff4
Then correction3 = correction1

This is the correction factor for the 16-59 age group.

D. correction factor for 60 and over
Because the pensioner population is likely to remain more stable over eight years since the Census and the 11-15 group did not seem an appropriate comparable group, it was decided to use the Census as a check on the pensions data.

Two difference scores were generate:

$Diff5=(Census\ ratio_{60\ and\ over}\ -CHI\ ratio_{60\ and\ over}\ )/CHI\ ratio_{60\ and\ over}$
$Diff6=(Pensions\ ratio_{60\ and\ over}\ -CHI\ ratio_{60\ and\ over}\ )/CHI\ ratio_{60\ and\ over}$

If Diff5 = +/-40% of Diff6 or Diff6 = +/-40% of Diff5
Then correction4 = Diff6

Step 3: Apply correction factors to the CHI single year ratios
The three appropriate correction factors calculated are applied to each of the single years of age/ gender banded ratios for all those aged 0 to 15 and aged 60 and over.

new ratio = old ratio + (old ratio * correction factor)

For the age bands between 15 to 59 a modified correction was used. It was modified using knowledge of the LDG level CHI/ MYE relationship. So that for each one year age/gender band:

modifier = CHI total / MYE total

Then for each ward level one year age/ gender ratio:

If correction3 <0
Then new ratio = old ratio +(old ratio +(modifier*correction3))

If correction3 >0
Then new ratio = old ratio +(old ratio +((1+(1-modifier))*correction3))

Step 4: Distribute the resulting 'error' amongst all wards in the LGD within the appropriate age/gender boundary
The new single year age/gender ratios were then summed within an LGD and divided by the LGD level total. This ensured that the ratios summed to one at the LGD level. The changes brought about by the correction factors are distributed evenly amongst all the wards in a LGD.

For each one year age/gender band:

final ratio = new ratio/(LGD summed new ratio)

Step 5: Distribute the LGD MYE (no armed forces personnel) to wards using the modified single year/gender ratios
The LGD level MYE (with armed forces personnel excluded) are distributed using the ratios generated above.

For each one year age/gender band:

population = final ratio * MYE

Step 6: Calculate the three required population denominators by summing the appropriate age groups
The three required population groups are calculated by summing the appropriate age/gender bands.

Step 7: Add the number of armed forces personnel to the ward level 16-59 age group

Step 8: Final adjustments
The final population estimates were presented to experts within NISRA for consultation. As a result, the population estimates for a small number of wards were slightly modified, and the other wards in the 'parent LGDs' were adjusted accordingly so that the total LGD populations remained in line with the MYEs.

Step 9: ED level estimates
In order to generate ED level population estimates, the ward level estimates were apportioned to EDs using unadjusted ratios generated from the CHI.

Appendix C: The 'Shrinkage' Technique

The 'shrunken' estimate of a ward-level proportion (or ratio) is a weighted average of the two 'raw' proportions for the ward and for the corresponding LGD.[26] The weights used are determined by the relative magnitudes of within-ward and between-ward variability.

The 'shrunken' ward-level estimate is the weighted average

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

where z_j is the ward level proportion, z is the LGD level proportion, w_j is the weight given to the 'raw' ward-j data and $(1-w_j)$ the weight given to the overall proportion for the LGD. The formula used to determine w_j is

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

where s_j is the standard error of the ward level proportion, and t^2 is the inter-ward variance for the k wards in the LGD, calculated as

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

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[26] Where appropriate 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.

Appendix D: Factor Analysis

In the domains where individuals can be identified as being deprived or not in terms of the domain definition, the number of deprived people can simply be summed and divided by a suitable denominator to create an area rate. In other domains, deprivations tend to exist in different spatial and temporal forms so, for example, an area will be education deprived if the adults in the area have no qualifications or if the children do not obtain any GCSEs. These two situations co-exist in an area but relate to different individuals at any given point in time. 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 (e.g. failure to obtain GCSEs and failure to enter higher education). 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.

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 was used with a view to overcoming 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. Alternative statistical 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.

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 the 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 to estimate a factor score for each case (i.e. ward). 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.

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 will be 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 factor. If a meaningful second common factor is found it would suggest the need for a new domain or the removal of variables. Decisions over whether a meaningful second common factor exist are aided by standard tests and criteria.

Once a satisfactory solution is achieved a factor score can be estimated for each ward. That is, the combined indicators, using weights generated by the factor analysis process, are then used as the domain score. Thomson's method for estimating factor scores was used.

Appendix E: Exponential Transformation of the Domain Deprivation Measures

The precise transformation proposed is as follows. For any ward, denote its rank on the domain, scaled to the range [0,1], by R (with R=1/N for the least deprived, and R=N/N, i.e. R=1, for the most deprived, where N=566 which is the number of wards in Northern Ireland).

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

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.

Each transformed domain has a range of 0 to 100, with a score of 100 for the most deprived ward. The chosen exponential distribution is one of an infinite number of possible such distributions. The constant (23) determines that ten percent of wards 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) ward 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 ward 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

The following abbreviations have been used in the report.

AA	Attendance Allowance
A&E	Accident and Emergency
ADQ	Average Daily Quantity
CABx	Citizens Advice Bureaux
CB	Child Benefit
CHI	Central Health Index
CPD	Central Postcode Directory
CSA	Central Services Agency
DE	Department of Education
DETINI	Department of Enterprise, Trade and Investment
DHFETE	Department of Higher and Further Education, Training and Employment
DHSSPS	Department of Health, Social Services and Public Safety
DLA	Disability Living Allowance
DSD	Department of Social Development
DWA	Disability Working Allowance
ED	Enumeration District
FC	Family Credit
FE	Further Education
GCSE	General Certificate in Secondary Education
GDS	General Dental Service system
GNVQ	General National Vocational Qualification
GP	General Practitioner
HB	Housing Benefit
HE	Higher Education
IB	Incapacity Benefit
ILO	International Labour Organisation
IMD	The Index of Multiple Deprivation (2000) for England
IS	Income Support
JSA-IB	Job Seeker's Allowance (Income Based)
LFSLA	Labour Force Survey Local Authority
LGD	Local Government District
MD	Northern Ireland Measures of Deprivation
MDM	Northern Ireland Multiple Deprivation Measure
ML	Maximum Likelihood
MYE	Mid Year Estimates
NICVA	Northern Ireland Council for Voluntary Action
NIHCS	Northern Ireland House Condition Survey
NIHE	Northern Ireland Housing Executive
NISRA	Northern Ireland Statistics and Research Agency
NISTRIM	Northern Ireland Strategic Transport Model
NVQ	National Vocational Qualification
RCA	Rating Collection Agency
RUC	Royal Ulster Constabulary
SDA	Severe Disablement Allowance
SEN	Special Educational Needs
SDRC	Social Disadvantage Research Centre

SMR	Standardised Mortality Ratio
SSO	Social Services Office
T&EA	Training and Employment Agency
UCAS	University and Colleges Admissions Service
US	United States

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