# Small-area Measures of Income Poverty

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## Editorial note

This is the first of a series of papers arising from a programme of research called *Social Policy in a Cold Climate*. The programme is designed to examine the effects of the major economic and political changes in the UK since 2007, particularly their impact on the distribution of wealth, poverty, inequality and spatial difference. The analysis includes policies and spending decisions from the last period of the Labour government (2007-2010), including the beginning of the financial crisis, as well as those made by the Coalition government since May 2010. The programme is funded by the Joseph Rowntree Foundation and the Nuffield Foundation, with London-specific analysis funded by the Trust for London. The views expressed are those of the author and not necessarily those of the funders. The research is taking place from October 2011 to May 2015. More detail and other papers in the series can be found at: http://sticerd.lse.ac.uk/case/_new/research/Social_Policy_in_a_Cold_Climate.asp

## Abstract

This paper considers techniques for measuring the prevalence of income poverty within small areas, or "neighbourhoods", in Britain. The ultimate purpose is applying such statistics to investigating how the micro-spatial distribution of poverty within cities and regions changes over time as a consequence of political decisions and economic events. In the paper, some general criteria for small-area poverty measures are first set out, and two broad methods, poverty proxies and modelled income estimates, are identified. Empirical analyses of the validity and coverage of poverty proxies derived from UK administrative data, such as social security benefit claims, are presented. The concluding section assesses a new poverty proxy that will be used within a wider programme of analysis of the spatial-distributional effects of tax and welfare changes and of economic trends in Britain from 2000 to 2014. Particular attention is paid to the relationship between the proxy values and other local poverty measures in different kinds of places. These suggest that the proxy is an adequate, albeit imperfect, tool for investigating changes in intra-urban distributions of poverty.

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## Introduction

The *Social Policy in a Cold Climate* (SPCC) research programme, from which this work arises, is investigating the effects of the retrenchment of the welfare state and a halting economic recovery in the UK from 2007 to 2014. The premise of this specific paper is that the consequences of these changes for household incomes and poverty rates will vary from place to place. The study's purpose is thus to identify the methods by which spatial variation in the effects of economic and political change might best be described using "neighbourhood" income-poverty measures.

The paper first discusses some general principles and desirable properties of small-area income and poverty measures to be used for this research. A distinction is drawn between proxies, which are indirect and describe the prevalence of correlates of poverty, and estimates of actual local household incomes as conventionally understood in standard national statistics. In the second section, some potential proxy measures taken from current administrative data are tested as to how accurately and stably they approximate 'real' poverty rates. In the last part of the paper, UMBR, a proxy measure for tracking changes in poverty over time is introduced and described. Specific attention is given in this final section to assessing how this proxy is related statistically to conventional poverty measures in different types of place in Britain.

## Some general principles

Since the early 1970s, various parts of the government of the UK have produced a succession of official indices of material deprivation, and latterly, measures of the prevalence of income poverty and social exclusion for small areas. These continue a longer tradition in British sociology and geography of analysing the distribution of poverty within cities and the quantitative characterisation of neighbourhoods. In the public sphere, neighbourhood poverty measures have been used for a wide variety of purposes, from allocating public resources to discussing the dangers of inequality or segregation. In the 2000s official Indices of Multiple Deprivation (IMDs) have been separately produced by the four national administrations in the UK, and widely adopted in policy analysis and applied social research (Noble et al. 2004; Scottish Executive 2004; Northern Ireland Statistics & Research Agency 2005; Welsh Assembly Government 2005). Whether or not anointed with 'official' status, there is considerable variety in the construction and statistical properties of deprivation indices and small-area poverty measures. Throughout their history, there has been a tendency for statistics intended for one purpose (for example, allocating public resources) to be used for another (for example, describing how neighbourhoods change over time). Their political function as well as their analytic application is malleable. IMDs were developed as part of a centralised apparatus of policy intervention in high-poverty neighbourhoods, but now, under a different regime, their purpose is described as supporting the setting of 'local priorities' for the use of 'limited resources' (Lupton et al. 2012; McLennan et al. 2011, p.11; cf. Ozga 2009).

Our present interest in small-area poverty measures is different again: we seek to understand the micro-spatial distributional effects of reductions in public spending and provision, and of prolonged economic recession. The projected effects of 'austerity' and recession have been disaggregated in detail by type of household and by the position of households within the overall distribution of incomes (Browne & Levell 2010; Whittaker 2011; Whittaker 2012). These analyses show that certain households (those with children, the already-poor) are likely to suffer a proportionally larger decrease in their disposable incomes, as well as in the notional value of public services they receive (Horton & Reed 2010).

However, such analyses are largely aspatial; that is, they consider effects across the whole extent of the nation, with at most some discussion of regional variation. However, at the very least, the aggregate effects of changes to welfare policy on household incomes will vary from place to place simply because the composition of the household population varies over space. This is in itself of interest, as are questions which follow from such as the second-order effects of changes in local income, and the interaction with regional economic divergence. We might also wish to evaluate whether specific policies, such as in housing welfare, will themselves affect the spatial distribution of poverty within cities (Fenton 2011). All of this matters in so far as importance is attached to ideas such as 'spatial inequality', the 'concentration of poverty', or the 'segregation of classes'. It also matters because an explicit expectation of austerity policies is that private and voluntary collective welfare should substitute for state activity as it is curtailed. That the reduction of the resources of the local state varies from place to place, in a regressive manner, has been documented (Hastings et al. 2012), and central government has since 2010 largely disavowed the "neighbourhood" as a proper object of central government's political concern (House of Commons Communities and Local Government Committee 2011). This invites the question of whether and where private means will have the capacity to make up reductions in public provision.

*Dimensions of a small-area poverty measure*
Simpson comments that in the literature on deprivation indices, the fitness of measures for specific purposes is a matter too rarely discussed (1995, p.17). As well as stating the purpose for which a  measure is to be used, assessing fitness entails an appreciation of how one possible statistic is distinguished from another, and so better suited to one or another end. Four dimensions of spatial poverty measures are now introduced. The first two dimensions concern how a measure encompasses and covers space and time. The third is the epistemic and statistical properties of the measure as a number. The final dimension is the normative and theoretical coherence of a poverty measure. As the various UK IMDs are widely known and used, we will refer to them at several points in this discussion. It should be clear that the critique applies to the use of the summary measures of IMDs for investigating change over time, rather than the design of the IMDs themselves.

***The spatial dimension: scale, areas, coverage***

Elements of a small-area poverty measure are the territory it covers, and the set of geographic units for which it is calculated. It is likely that the areal units used will be a matter of expedience, and will come from geographic systems that already exist for the dissemination of Census data and other public statistics. The territory addressed in this paper is Great Britain, comprising three countries with more or less separate statistical services; the final scope of the SPCC programme also covers Northern Ireland. The standard small-area units in England and Wales are Lower-level Super Output Areas (LSOAs), and in Scotland, Datazones; altogether there are over 40,000 of these in Britain. LSOAs and Datazones are constructed from the smallest Census reporting units (Output Areas), but a range of non-Census data are now published for these geographies. Aside from the greater ease of working with pre-defined geographic units, they thus also enable linkage of aggregate data from different sources for which individual case data are not publicly available.There are existing deprivation indices for these units in each country that are not directly comparable (Payne & Abel 2012). LSOAs and Datazones are constructed from the smallest Census reporting units (Output Areas), but a range of non-Census data are now published for these geographies. Aside from the greater ease of working with pre-defined geographic units, they thus also enable linkage of aggregate data from different sources for which individual case data are not publicly available.

Though the choice of units is largely determined by the source data, the use of such pre-defined units nonetheless bears on the interpretation of a small-area poverty measure. Both the size and the boundaries of the units are likely to affect the range of values derived: the so-called Modifiable Areal Unit Problem (MAUP). Schuurman and colleagues demonstrate the 'scaling' effects of the MAUP; that is, the use of larger spatial units is liable to obscure spatial differences in deprivation within those units (Schuurman et al. 2007). This is pertinent for a GB-wide poverty measure. LSOAs, in England and Wales have a higher mean population than the equivalent base unit in Scotland, Datazones (≈1,600 versus ≈800 in 2010). Thus, if England and Scotland had the same overall poverty rate and a similar distribution of poor households over space, we would still expect there to be more dispersion in the distribution of small-area poverty rates in Scotland. There would be more areas with very high and very low rates, but it would be mistaken to conclude from this that poverty was more concentrated in Scotland, or that Scotland had, compared to England, a higher proportion of extremely deprived areas.

In a study of income segregation in the US, Cohn and Jackman confirm the scaling effect of the MAUP, and show that a 'zoning' effect is also important (Cohn & Jackman 2011). Arbitrary divisions of space, such as those used in census or administrative boundaries, affect the results of analysis. Cohn and Jackman show that the use of arbitrarily bounded units understates the degree of income segregation compared to measures of segregation that look at each case (a household) relative to its unique locality. The algorithms used to compose LSOAs and Datazones from individual postcodes tried to take account of the edges of settlements, and to maintain social homogeneity within LSOAs/DZs, but did so in different ways. Hence, the

distribution of small-area poverty rates, even if estimated by a common method and from common sources, should not be directly compared between England and Scotland. More generally it indicates that when looking at a specific local area its poverty rate is an artifact of the boundaries of that area.

A final question is whether to use the smallest area units possible, or the superordinate geographies into which they are grouped, such as Intermediate Zones in Scotland. Since the units are defined algorithmically, it is hard to argue that those at one or other level are more likely to correspond to what is locally commonly recognised as named "neighbourhoods" or "places" – and, anyway, for all that existing small-area poverty measures are used to talk about poor 'communities', their definition and analysis have become almost wholly detached from a sociology of neighbourhoods, locality and dwelling. It is equally implausible that quantitative investigations of neighbourhood effects could provide an empirical answer as to the spatial scale that 'matters' for the instrumental interests of the welfare state - how bounded or extensive, for example, are so-called cultures of worklessness? The principal consideration that we are left with, then, is that estimation of poverty rates for smaller spatial units is inherently more uncertain than for larger ones, and this is discussed further in later sections of this paper.

### *The temporal dimension: timeliness and comparability*
Our particular purpose requires a measure of poverty that is timely and comparable over time. It needs to be timely as it is intended to contribute to public understanding and political debate as well as to scholarship. Hence it should be able to support debate about elements of public policy whilst those policies remain a matter of public interest. So, for example, whilst the Census conducted in April 2001 showed much about changes in the geography of poverty and wealth over the 1990s, the time taken to publish results meant that it had nothing to offer to the debates of the June 2001 election, nor to knowledge of what happened in the intervening years (Norman 2010, p.133). Comparability means that the poverty measure for one place at a point in time can be meaningfully compared to the value for that area at some prior point. Although the English Indices of Deprivation are accompanied by cautions about comparisons over time, they are nonetheless used in this way (e.g. Leeser 2011). Later in this paper we will investigate the stability of the relationship between poverty indicators and poverty rates over time.

### *The numerical nature of the measure*
Measures and indices of poverty and deprivation at least imply an ordinal interpretation. The various UK multiple deprivation indices show places to be more or less disadvantaged than one another. This ranked structure is distinctive of deprivation indices within the broader set of all typologies or classifications of places. For our current purpose, a small-area income-poverty measure is better constructed as a real rate, rather than simply an ordinal ranking. The rates should be what Verran calls "modern fact numbers", ones that have indexical rather than iconic properties (Verran 2010). That is, the rate is composed of counts of more-or-less tangible things (persons, households) with a characteristic (income poverty) relative to a unity (all people, all

households). A corollary of this is that one element of a good measure is a clear specification of the unity that it covers, or what the English IMD refers to as the "at-risk population". Practically, this also means that a rate can be calculated for a larger spatial area by summing the numerator and denominator of its component small areas. Such a rate lends itself to different interpretations from ordinal measures, like the IMD, most commonly used to distinguish between the 'most deprived' neighbourhoods and the rest of the country on the basis of arbitrary cut-offs in the ranking, such as the 'worst' ten per cent. In the IMDs, underlying data are transformed in a way that is suited to a ranked multi-domain indicator: the ranks in individual domains, such as Health or Employment, are converted to exponentially distributed scores, with extremely deprived areas receiving very high per-domain scores (McLennan et al. 2011, p.122). The (sensible) intention is that extreme local deprivation in a single domain is not obscured when multi-domain scores and ranks are calculated. However, the procedure also has the consequence that, for example, a single incidence of unemployment may be accorded different values in different places. A constant change (for example, of one percentage point) in the proportion of people without work has a variable effect from place to place on an area's domain and overall deprivation score (cf Simpson 1995, p.17). Rankings can be ill-suited to describing change over time. For an 'average' area, a small change in poverty from one point in time to the next can lead to a large change in ranking, because there are many areas with similar rates. A larger change in rate for a high-poverty area might mean a smaller change in rank. There are variants of existing deprivation indices that are designed as real rates for measuring change over time; the Economic Deprivation Index (EDI) measures worklessness and poverty in England as real yearly rates for small areas (Noble et al. 2009). Within the constraints of the sources, the EDI describes the proportion of an area's whole population that is income-poor, and that of its working-age population that is involuntarily without work. The current edition covers England from 1999 to 2005, and an update to cover each year to 2009 is forthcoming (McLennan et al. forthcoming).

At a broader conceptual level, there is a tension between the virtues of real rates of a single concept, such as income poverty, and measures that seek to reflect a multi-dimensional understanding of deprivation. The latter require that some weights be attached to the several dimensions or domains of deprivation to produce a summary measure. Such weights matter, because decisions about them can change the rank ordering of areas and thus their perceived relative need (Mackenzie et al. 1998). Weightings are as much matters of political judgement as of empirical investigation. For example, research on the weights in the 2004 English IMD concluded from three quite different and separate methods that the *a priori* weighting currently applied to employment was too high, and that to health too low (Dibben et al. 2007, pp.16–17). In other words people (unsurprisingly) value being in good health more highly than having a job, when working itself is considered separately from the income it provides. However, the high weight attached to the employment domain in following editions of the IMD was unaltered. Dibben and colleagues note that changed weights would have little altered the overall rankings, and there was a demand from users for consistency over time. Still, this stressing of not-working as a dimension of

deprivation in official statistics also echoes Levitas' criticism of the conceptualisation of social exclusion as over-emphasising the inherent integrative value of work (Levitas 1996). Thus, this paper will only consider measures that are uni-dimensional and satisfy the real-number criterion of expressing a rate among a natural units such as people or households. Other types of measures, such as ranks, indices or classifications, are set aside.

*Theoretical and normative grounding*
This matter of weighting in multi-dimensional measures of social exclusion exemplifies the more general problem of the theoretical and normative coherence of small-area deprivation measures. One might thus ask how a measure incorporates a theory of the subjective condition of poverty; whether it is sensitive to social and economic forces that are held to create this state; or whether any thresholds it employs have moral force and currency in political debate. In this regard, the UK Indices of Multiple Deprivation have a close coherence with theoretical understandings of 'social exclusion'. They explicitly understand deprivation as multi-dimensional. Exposure to crime and environmental hazards, limiting ill-health as well as income poverty are taken as distinct aspects of individual disadvantage, and operationalised, with varying success, from different data sources. IMDs are less concerned with *explanations* of poverty. One could imagine a poverty measure that sought to incorporate one or mechanisms of the production of poverty, such as the unequal distribution of the products of labour as wages and profits under capitalism, or the generosity of welfare-state income transfers to different groups (the unemployed, the elderly, families with children, the low-paid and so forth). The *Social Policy in a Cold Climate* programme intends to employ a schematic state/market framework for understanding changes in the distribution of income from 2007 to 2014, so the idea of, say, distinguishing changes in poverty attributable to changes in benefits from those attributable to changes in unemployment or earnings is appealing. Reconciling this with the requirement for a timely measure for small geographic units is rather more difficult.

As well as the theoretical foundations of a small-area poverty measure, there is the related matter of the normative grounding of any thresholds it incorporates. If it distinguishes the 'poor' from the 'non-poor', what moral force does the criterion have? Definitions of poverty and material deprivation are, of course, venerable topics in social science; whether poverty should be measured by income or expenditure is nearly as much so. The sanctification of specific poverty standards by the state is also central to political contests over how poverty should be ameliorated (Niemietz 2011). A common ideal for a poverty measure is that it be based on a minimally decent standard of consumption. The standard might (but need not be) founded empirically, by establishing a consensus on what people think are the things which no other citizen should go without (Davis et al. 2012). A threshold between poor and non-poor might also be set by common international practices, such as percentages of national median income. Or it could be set to a minimally guaranteed income that is legislatively prescribed, such as the 'Income Support' level in the UK. The level of income-replacement welfare benefits could be argued to be a weak form of consensual threshold, embodying, at several removes, popular will through elected government; it

should be better be seen as a bureaucratic residue of the uneven distribution of political power and technical understanding (Gaffney 2012).

Lastly, a binary poor/non-poor distinction can of course only indicate the *extent* of poverty within a geographic unit. A useful refinement might be a measure that also addresses *intensity*: extreme or persistent low income, or the coincidence of multiple aspects of deprivation within households. Whilst the income components of IMDs are binary measures, and assume an additive rather than multiplicative effect of deprivation within households (Dibben et al. 2007, p.6), other small-area studies of poverty do address intensity, such as the distinction between 'breadline' and 'core' poor in the work of Dorling and colleagues (Dorling et al. 2007). A further strength of the latter study is that treats the geographic distribution of wealth and poverty together, against the prevailing tendency of policy-oriented studies to examine poverty in isolation.


## Proxies and modelled estimates of poverty

Whatever the definition, there are in Britain no direct observations of poverty amongst all people from which rates for small areas could be directly derived. Existing small-area poverty statistics employ one of two broad approaches to dealing with this absence of direct measures: *proxies* and *modelled estimates*. These both satisfy the *real-number* criteria, in that they are proportions of a total of all natural units (for example households) within an area. Often, both approaches use the same sources, such as Census tables or administrative data. They differ in the methods by which they derive a statistic for each geographic unit, and in how that statistic should be interpreted. Proxies use household or personal characteristics associated with poverty to indicate its relative spatial distribution, without purporting to be an exact statement of the rate in each area. Modelled estimates combine national social surveys and local administrative or Census data to state the probable local prevalence of poverty according to definitions used in the social survey.

We look at each method in turn, and consider them against the dimensions set out in the preceding section. Broadly, there is a trade-off between timeliness and relative simplicity, favouring proxies, and theoretical and normative coherence, favouring modelled or simulated estimates.

### Proxies for poverty
With a proxy, one uses an observed characteristic to stand for another that is not observed but which is in fact of interest. There must be some logical or empirical association between the observed proxy and the characteristic of final interest. This might be one of necessity: all people who claim unemployment benefits (the proxy) must be unemployed (the matter of interest), and all who claim means-tested benefits must have incomes below the test level. Note that in both cases, the reverse is not true: not all unemployed people claim unemployment benefits. Alternatively, one might know the prevalence of deprivation of one basic good (for example, of overcrowded

housing), use this as a proxy for material deprivation of other basic goods, and assume this together to imply insufficient income. Or, one might start from an empirical correlation between a proxy and a characteristic of interest: for example, lone parents or members of some ethnic groups are more frequently income-poor, so observations of household composition or ethnicity are used in a proxy. All of these types of proxy-relationship have been used in small-area poverty research, although empirical investigation of the underlying relationships is rather rarer (Davies et al. 1997). The value – and dangers – of a proxy depend partly on the relationship, and partly on the source data.

Proxies have a long history. The deprivation indices developed in the 1970s and 1980s were all proxy measures, but until the mid-1990s, the Census was the only source used for small-area poverty analysis (Green 1994, p.9). With the further computerisation of government functions such as taxation and welfare, more timely and more varied poverty proxies became possible. The first UK deprivation index to incorporate official administrative data appears to be the 1996 Index of Local Conditions, which included vacant land statistics and counts of Income Support claimants. In 2012, publicly available administrative series include counts of means-tested benefit claimants and recipients of tax credits, and registers of property values and sales prices. Such data are published on an annual, quarterly or monthly basis for small geographic areas, often only a few months in arrears. In contrast, the detailed data from some government social surveys is  made available to academic researchers several years after the fieldwork was completed. For example, the *Family Resources Survey* is the principal official source of information on the incomes of UK households. As of September 2012, the most recent detailed case-level dataset available to academic researchers through the UK Data Archive covers the financial year 2009/10. There have of course been economic developments and changes in tax and welfare policy of great consequence to poverty research since that time.

So, administrative statistics are appealing as proxies for small-area poverty rates because they are timely, and because they are normally censuses counting all cases within their field. Their shortcomings are in part technical – problems of definitions, coverage and validity – and partly matters of meaning and interpretation. For definitions, poverty is normally conceived of as a characteristic of families or households; though most children have no income in their own right, they are not necessarily poor. Most administrative data, however, relate to either individuals (as taxpayers or benefit recipients) or to dwellings. How adults, children, families, households and dwellings are typically related varies enough from place to place to pose problems in specifying the units to which a small-area poverty rate pertains. The Income Domain of the English IMD addresses this by using detailed and linked administrative records of tax and benefits, but such detail is suppressed in the publicly available small-area data.

Administrative proxies also fail to account for people or families who are excluded by the rules that govern the system they record. Not all people are eligible for welfare benefits or tax credits, and not all those eligible claim them. Counts and rates of

benefits for people who are unemployed or not working through ill health fail to account for poverty arising from low pay. Statistics on tax credits to low-paid families help, but still only cover those who are eligible, primarily families with children. Furthermore, the take-up of means-tested benefits varies from place to place (Bradshaw & Richardson 2007), and factors other than 'need' are influential (Rosato & O'Reilly 2006). For example, Bramley found that in Scotland, the take-up of means-tested benefits by eligible poor households is higher in neighbourhoods with a higher overall rate of poverty, and lower for elderly households in rural areas (Bramley et al. 2000). Thus no straightforward statistical relationship, such as direct proportionality, can be assumed to exist between administrative proxies and underlying poverty.

As well as consistency over space, proxies bring problems of comparability over time. The valuation of dwellings for the levying of Council Tax have been used as deprivation indicators (e.g. Beale & Taylor 2005), but in England, those valuations are set to a 1990 reference point. Conversely, whilst there are strong political disincentives to change Council Tax valuations, governments find it hard to resist altering welfare regimes for low-income households. These changes can affect the coverage of those benefits as a proxy for poverty (because some poor households become eligible, or are no longer so), or the validity of those benefits (because changes in the income supplied by the benefit move households above or below a poverty threshold). Over the 2000s, there were major changes of this sort to, among others, the rules on Income Support to lone parents, the minimum income for pensioners, and the benefits offered to working-age people with disabilities. There have been further changes since 2010. Thus, for example, the introduction of more stringent rules on claiming benefits might reduce the number of claimants in an area, and so reduce the proxy poverty rate, without implying any increase in material welfare – in fact, quite probably the opposite. Further, comparing counts of out-of-work benefits over time says nothing about the changes in the relationship between low-pay waged incomes and living costs, even though that relationship may be central to changes in the structure and spatial distribution of poverty.

These are questions of the validity and coverage of proxies for poverty, and of their consistency over time and space. Arguably, the use of proxies can also lead to errors of interpretation and inference. Benefit claims, say, are used as a *proxy for* poverty, and poverty becomes understood as foremost a *problem of* benefits. Misinterpreting the meaning of social security administrative data is easily done, be that wilfully or by accident (Gaffney 2011). For the purpose of this paper, the answer is to maintain a clear distinction in use and interpretation between proxies and direct estimates of small-area poverty rates, to which we turn next.

### *Modelled and simulated estimates*
Given the shortcomings of poverty proxies, an alternative is to estimate the actual prevalence of income poverty in small areas by combining information from surveys and administrative data. The definitions of income and poverty are those used in surveys. 'Small area estimation' (SAE) is a general term in empirical economics for

estimating statistics for groups within a sampled population where the numbers of each group sampled by a survey are too small to provide acceptably accurate direct estimates. In our case, the groups of interest are the populations of small areas. The Family Resources Survey now samples around 20,000 households per year (25,000 a year until 2011). There are around 40,000 small areas (Datazones or LSOAs) in Great Britain. Thus, even setting aside the FRS's clustered sampling, we would expect that in at least half the small areas, no household would be sampled, and in that most others, far too few would be sampled for reliable estimates of, say, mean income, to be made.

For small-area estimates of income and poverty in the UK, two types of method have been used: econometric modelling and micro-simulation. Both start by identifying within a survey a set of variables which are correlated with income, and for which small-area data are available from other sources, such as the Census or administrative data. They differ in the methods used to link the survey and small-area information to derive estimates of income or poverty. In the econometric approach, a regression model is fitted that predicts the income of a household in the survey from the data available for small areas. The model's fit is evaluated by the usual criteria. Once a satisfactory model is obtained, its parameters are applied to the small-area data to give predicted income values for all areas of interest. The specific form of regression model is important as it determines what income statistic is estimated. Several different types of model, and thus types of estimate, are described in the literature.

A simple approach is to fit a linear model by Ordinary Least Squares (OLS), which estimates household income, typically log-transformed. The estimates that come from such a model are the mean averages of the incomes of households within each. Such a log-linear approach has been used by the Office for National Statistics (ONS) to produce estimates of average income for Wards, in 1997/98 and 2001/02, and latterly Middle-level Super Output Areas (MSOAs), in 2004/05 and 2007/08 (Bond & Campos 2010). However, these have the usual limitations of mean averages of income as indicators of poverty. A mean average for an area modestly above an arbitrary poverty line could reflect either an area where no-one was in poverty (a uniformly modest-low income area) or an area where a large majority of the population was in poverty and a small minority of high-earners pulled up the arithmetic mean. An alternative approach is to use quantile rather than OLS linear regression to estimate parts of the income distribution within local areas (Tzavidis et al. 2008). However, there are no published examples of the application of quantile regression to poverty estimation in the UK.

Rather than estimating values within a continuous distribution, like income, other small-area models estimate the probability of a household's income being above or below a threshold of interest, such as a poverty line. Using such a model, each small area is given an estimated proportion of households below an income threshold, based on a set of area and/or household predictor variables. Bramley uses a combination of OLS and logistic models to predict the probability of households in different local authority districts having incomes in a variety of bands (Wilcox & Bramley 2010). Of

note is his use of multiple sample survey sources, such as ASHE and the LFS within the estimation process. For smaller areas, the ONS has published estimates of household poverty rates for MSOAs in 2007/08 using this kind of binary response model (Methodology Directorate & Centre for Regional and Local Statistics 2010; Fry 2011). The poverty rates that are estimated for each MSOA with this area have the same meaning as national published income poverty rates, including concepts like housing costs and equivalisation. By implication, methods for estimating low incomes are also potentially capable of estimating high incomes or wealth, whereas there are scant public data proxies for these, house prices, taxable incomes and owner-occupation being the obvious ones.

Regression models are not the only means to make direct estimates of local incomes and poverty rates. In the UK literature, the most developed alternative is microsimulation, to which Ballas et al. (2005) provide an accessible introduction and which Anderson works through more fully in relation to LSOA incomes in England, Northern Ireland and Wales (Anderson 2007; 2008; 2011). The method consists of generating new grossing weights for survey data in each area of interest, by iteratively constraining predictor variables to totals known for each area. Put simply, one adjusts the weights in the survey so that the whole survey resembles the population of each LSOA in terms of occupational class, employment, household composition and so on. Using each area's weights, one can calculate whatever income statistics, including poverty rates, are desired for each area. One attraction is thus being able to derive more complex statistics for local areas, such as indices of income inequality, or the prevalence of poverty within sub-groups such as children. A further intriguing possibility is being able to run micro-simulations of tax or benefit policies, and see how changes might affect different small areas (Tanton et al. 2011, p.932).

Both modelled and simulated estimates, then, offer some substantial advantages over proxy rates. The most important of these for the current purpose are their coverage of the whole household population, their validity as regards standard definitions of poverty, their sensitivity to changes in both policy and economic conditions, and the possibility of measuring intensity as well as extent of poverty. So, they cover both in-work and out-of-work poverty, and should reflect the real effects of changes in both wages and social security. However, there are difficulties. Fitting a good regression model is not easy. The ONS comment that it "is the worst scenario an analyst could encounter, a database full of covariates, all conveying the same information about the response variable [income], but none of them presenting a well-defined relationship with the variable of interest". (Methodology Directorate & Centre for Regional and Local Statistics 2010, p.15). There are similarly difficulties in selecting good constraints for the reweighting procedure in microsimulation; the set of variables common in definition and level of measurement between the survey and small areas is quite small, and for the areas, often limited to the decennial Census. This is potentially a serious shortcoming, if the data required to produce an acceptable general model of poverty are collected only once a decade. It might be partly ameliorated by using hierarchical iterative fitting (Müller & Axhausen 2011) of household surveys to

individual-level poverty predictors (like benefit claims) at small-area level, but such fitting is relatively novel and not yet applied to income estimation.

There are also multiple sources of uncertainty in modelled and simulated estimates, and the uncertainty of the estimates is not easily quantified: "[i]n view of the complex multi-stage nature of the estimation process, and the lack of an authoritative 'right answer' at the local level, it is not possible to provide a formal statistical confidence interval on the final figures" (Wilcox & Bramley 2010, p.37). The estimation of error in micro-simulated estimates is a matter of current methodological research (e.g. Whitworth 2012). The ONS's MSOA modelled poverty estimates do come with 95% confidence intervals; these are in the region of +/- 10% for the poverty rate in more deprived neighbourhoods. The uncertainty of such estimates makes them, according to the ONS, ill-suited to measuring short-term changes over time, and thus although the ONS MSOA income estimates for England have been designated *National Statistics*, they will not be updated annually (UK Statistics Authority 2011, para.2.4, 3.3).

*Proxies and estimates: in summary*
Both proxies and estimates are in principle capable of satisfying our requirements for small spatial units and real-number measures. Modelled or simulated estimates have compelling strengths with regard to our criteria of normative and theoretical coherence with understandings of poverty. However, practical considerations relating to official social surveys mean that proxies are the method for looking at small-area poverty rates that is taken forward in the remainder of this paper. For a long period, small-area identifiers in the authoritative source on income in the UK, the *Family Resources Survey*, have been unavailable to researchers, and there are no clear indications as to when this will change. Alternative sources, such as *Understanding Society*, do not have the same detail in the recording of incomes as they are general social surveys. For example, Council Tax, a direct tax, is not deducted in *Understanding Society's* calculation of net income, and there is insufficient detail to calculate a net housing cost to give income after housing costs. Even were those overcome, it is likely that in 2014, small-area poverty estimates would have to be made using 2011/12 data. This is a problem because others report instability in the modelled relationship between poverty and its predictors (Methodology Directorate & Centre for Regional and Local Statistics 2010, pp.14–15). Further, some of the coalition's changes to social security – the introduction of Universal Credit, and further changes to Housing Benefit – would not be reflected in survey data from 2011/12, nor would the effects of the second period of economic recession which started in late 2011. These together tend to obviate many of the advantages of direct estimates.


# The selection of a proxy for poverty

This section assesses empirically the suitability of several potential proxies for income poverty. The aim is to identify oserved characteristics that are good candidates for inclusion in a small-area poverty measure. The assessment addresses the *validity*,

*coverage* and *stability* of a range of characteristics about which data are currently publicly available for small areas (LSOAs or Datazones) in the UK. The majority of these are statistics on claimants of social security benefits, but a number of dwelling characteristics, such as tax banding, are also included. Further details of the data sources are given in Table 3, in the appendices to this paper.

### *Validity, coverage and error in 2009/10*

The main measures of validity, coverage and error are given in Table 1, which is derived from the *Family Resources Survey* and *Households Below Average Income* (2009/10). The percentages refer to the population of benefit units, a narrow definition of a "family" used in the administration of social security and in UK poverty research[1]. Each row of Table 1 covers one potential proxy for a benefit unit's poverty status, such as its including an adult member who claims a benefit, like Job-Seeker's Allowance (JSA), or its living in a low-value band dwelling. Income poverty is defined as a threshold relative to UK median equivalised household income, after housing costs. Three thresholds are used: below 50% of median income ("very low incomes"), below 60% (the standard poverty line) and below 70% ("low incomes"). Three specific measures of each proxy's validity are shown for each of these levels of poverty. The **validity** of a proxy is the proportion of benefit units identified by it which are, in fact, income-poor. For example, the validity of JSA is 67% at the standard poverty line threshold of 60% of median income. This means that two-thirds of benefit units in which an adult claims JSA are income-poor. This can be compared against the "base" validity, which is the proportion of *all* benefit units that are income-poor at the relevant threshold – 22% for the standard poverty line. The **coverage** of a proxy is the proportion of all income-poor benefit units that are identified by that proxy. The coverage of JSA at the standard poverty line is 12%; this means that 12% of all income-poor benefit units are identified by having someone who claims JSA. The other 88% of all poor benefit units do not include an adult claiming JSA, and so would be missed by using JSA as a proxy. For reasons discussed shortly, the coverage values for social security benefits are likely to considerably understate the true value, and should be taken as minima.

A perfect proxy would thus be one that has 100% coverage and 100% validity: it would identify all benefit units that are poor, and it would identify only poor benefit units. The **error** of a proxy as shown in the table is a summary measure of how far it falls short of this ideal. It accounts for two kind of errors in a proxy: implying that a benefit unit is poor when it is not, and vice-versa. The error is calculated as the root mean squared error (RMSE) of the proxy distribution against the observed distribution; this measure applies bigger penalties to bigger mistakes in either direction. The error for each proxy is scaled relative to a null proxy that assumes all benefit units are non-poor. A lower value is better, and a perfect proxy would have a

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1     A benefit unit consists of an adult, their co-resident spouse or partner (if any), and their co-resident dependent children. Some households therefore contain more than one benefit unit, in the cases of, for example, grown-up children living with parents or unrelated adults sharing a house or flat. The large majority of households contain only a single benefit unit.

value of zero. A proxy can have an error value greater than one. This occurs when the number of non-poor benefit units a proxy mis-identifies as poor is so large as to outweigh the incremental improvement it makes in identifying actually poor benefit units.

There are several important conclusions to be drawn from Table 1. The most obvious is that there is a contrast between single proxies that have good coverage and those that are very specific. JSA, for example, is a specific proxy with limited coverage. A majority of JSA claimants (56%) have very low incomes below 50% of median, but JSA only identifies 14% of all those living on such very low incomes. By contrast, the Council Tax Band of dwellings has wide coverage but poor validity. So, 35% of very low-income benefit units live in a dwelling in Council Tax Band A, but only 24% of benefit units in a Band A home have very low incomes. The most suitable single poverty proxy measure would seem to be receipt of Housing Benefit (HB), which has both high validity and high coverage at all three poverty thresholds. This should not be surprising, since HB is available to all people who rent, be they in employment or otherwise, on a narrow and strict means-tested basis. The Northern Ireland Deprivation Indices' Income Domain does in fact include HB. Unfortunately, there are no up-to-date housing benefit claims data for small-areas in England, at least. Also, HB can only be claimed by tenants and thus as a proxy it will be biased against neighbourhoods where many income-poor households are owner-occupiers. The final rows of the table consider a series of combined proxies, which identify benefit units where any one of several mutually exclusive income-replacement benefits is being claimed. The best of these combined indicators have validity and coverage that are comparable to HB, although they cover different benefit units.

A second observation is that the choice of poverty threshold matters. If the 70% threshold, covering a broader "breadline-poor" group of families is used, then housing characteristics are in fact better proxies than single benefits. Single income-replacement benefits are available to specific sections of the population, and some people eligible for means-tested benefits do not claim them (Barton & Riley 2012). Other benefits (such as Incapacity Benefits) are not means-tested, so people who claim them may benefit from a partner's income. Some benefits, notably JSA, can be either means-tested or paid on the basis of National Insurance contributions. The IMDs exclude the latter from their counts of income-deprived as they are not *necessarily* income-poor. However, the results suggest that the differences in actual poverty incidence between income-based and contribution-based JSA claimants are relatively small. Given the low value of working-age benefits like JSA relative to wages and living costs, it is not perhaps surprising that those who are eligible for and do claim contributory JSA are generally those with few other sources of income.

A broader conclusion to be drawn is that even the best proxy measures do not exclusively identify poor benefit units, and more importantly, identify only a minority of all the income-poor. However, there are reasons for thinking that in both respects things are not quite as bad as they seem. As to validity, some of the proxies have sub-groups in the corresponding administrative data who are systematically more likely to

be income-poor. Pension Credits, for example, have a 'Guarantee Element' which is means-tested on income, and a separate component which offers money to those with some savings (and potentially, a higher income). In-work Tax Credits have several income-related levels; some of these, such as claimants 'above the family element' contain only those who are very likely to be income-poor. Limitations in the FRS data prevent separate analysis of such sub-groups, but they would have higher validity and lower error than the whole.

As to coverage, the measures are calculated based on the receipt of benefits as *reported* by respondents to the FRS. Totals that come from surveys are consistently much lower than total receipt measured by administrative data. There are numerous explanations for these discrepancies, including differences in definitions and units of observation, and errors in administration. Most of the disparity is attributable to under-reporting to surveys, which occurs for a variety of reasons (Meyer et al. 2009). One study finds that, for Pension Credit, 31% of those eligible and in receipt did not report it in the Family Resources Survey (Bradshaw & Richardson 2007, p.3); another finds, for Housing Benefit for private tenants, the household totals derived from grossed-up survey results to be slightly less than half the number of claimants from administrative records for the equivalent period (Fenton 2010, p.13). Thus the coverage percentages for benefits reported in Table 1 should be regarded very much as minima that understate the real value. Nonetheless, the imperfect coverage underlines that these are proxies and not estimates: that is, they indicate, rather than measure, the extent of poverty. Their usefulness as small-area poverty measures depends on the spatial distribution of poor households *not* identified by the proxy being correlated with those whom the proxy does cover. This is tested shortly in the final main section of the paper.

*Stability over time*
A primary aim of the measure is to look at change, so we should consider how stable the proxies we have tested are as poverty indicators over time. We obviously cannot do this for the future, but we can look at the recent past. The validity and coverage of candidate proxies for income-poverty at 60% of median income are shown in Table 2 for the years 2001/02, 2005/06 and 2009/10. Since there were very substantial changes to the benefits regime for low-income pensioners, only benefit units with at least one working-age adult are included.

In most cases, the metrics for each proxy are very similar at all three points in time. The largest change is in Income Support, reflecting its replacement by Pension Credit for low-income pensioners, from 2003, and the transfer of lone parents with older children onto JSA, from 2008 onwards. The proportion of income-poor benefit units covered by social security benefits proxies fell. Importantly, the validity figures for the combined benefits indicator are more stable. The slight falls likely reflect stagnant median real wages during the 2000s during which benefit levels were uprated by the Rossi Index.

**Table 1: Coverage, validity and error in administrative data indicators of equivalised income poverty within benefit units, Great Britain, 2009/10**

| | Very low incomes < 50% median AHC income | | | Standard poverty line < 60% median AHC income | | | Low incomes < 70% median AHC income | | |
|---|---|---|---|---|---|---|---|---|---|
| | Validity | Coverage | Error | Validity | Coverage | Error | Validity | Coverage | Error |
| **Base (null proxy)** | **16** | **-** | **1.00** | **22** | **-** | **1.00** | **29** | **-** | **1.00** |
| *Out-of-work benefits for working-age adults* | | | | | | | | | |
| JSA | 56 | 14 | 0.87 | 67 | 12 | 0.89 | 76 | 10 | 0.90 |
| JSA (Income-based) | 58 | 12 | 0.89 | 69 | 10 | 0.90 | 78 | 8 | 0.92 |
| JSA (Contribution-based) | 48 | 2 | 0.98 | 57 | 2 | 0.98 | 68 | 2 | 0.98 |
| Income Support | 41 | 11 | 0.90 | 61 | 12 | 0.89 | 73 | 11 | 0.90 |
| Incapacity Benefit / SDA | 24 | 6 | 0.96 | 33 | 6 | 0.95 | 46 | 6 | 0.94 |
| ESA | 57 | 2 | 0.98 | 70 | 2 | 0.98 | 74 | 2 | 0.98 |
| *Other major means-tested benefits* | | | | | | | | | |
| Pension Credit | 8 | 3 | 1.03 | 20 | 5 | 0.97 | 43 | 8 | 0.92 |
| Housing Benefit | 40 | 30 | 0.83 | 54 | 29 | 0.75 | 70 | 28 | 0.73 |
| *Tax Credits* | | | | | | | | | |
| Working Tax Credit | 18 | 7 | 0.98 | 31 | 8 | 0.94 | 46 | 9 | 0.92 |
| Child Tax Credit | 20 | 19 | 1.10 | 32 | 21 | 0.91 | 42 | 21 | 0.84 |
| *Dwelling characteristics* | | | | | | | | | |
| Council Tax Band A | 24 | 35 | 1.30 | 34 | 36 | 0.95 | 45 | 36 | 0.78 |
| Council Tax Band B | 16 | 20 | 1.32 | 23 | 20 | 1.05 | 32 | 21 | 0.91 |
| Flat or Maisonette | 28 | 31 | 1.06 | 35 | 28 | 0.88 | 44 | 26 | 0.81 |
| *Combined means-tested benefit indicators* | | | | | | | | | |
| MT: Working-age benefits | 49 | 27 | 0.78 | 64 | 25 | 0.76 | 75 | 22 | 0.78 |
| MT: WAB + Pension Credits | 33 | 30 | 0.93 | 47 | 30 | 0.78 | 62 | 30 | 0.72 |
| MT: WAB + PC + Tax Credits | 24 | 42 | 1.44 | 36 | 44 | 0.97 | 48 | 45 | 0.73 |

*Source: Households Below Average Income, Family Resources Survey; OECD equivalisation scale used.*

**Table 2: Validity, coverage and error in proxy indicators of equivalised income poverty over time, 2000/01, 2005/06 and 2009/10. Only benefit units with working-age adult members**

| | Validity % < 60% AHC median | | | Coverage % < 60% AHC median | | | Error < 60% AHC median | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000/01 | 2005/06 | 2009/10 | 2000/01 | 2005/06 | 2009/10 | 2000/01 | 2005/06 | 2009/10 |
| **Base (null proxy)** | 21 | 22 | 24 | - | - | - | **1.00** | **1.00** | **1.00** |
| *Income-replacement benefits* | | | | | | | | | |
| JSA | 72 | 72 | 67 | 11 | 9 | 14 | 0.89 | 0.91 | 0.86 |
| JSA (Income-based) | 75 | 74 | 69 | 10 | 8 | 12 | 0.90 | 0.92 | 0.88 |
| JSA (Contribution-based) | 51 | 61 | 58 | 1 | 1 | 2 | 0.99 | 0.99 | 0.98 |
| Income Support | 67 | 63 | 61 | 28 | 19 | 14 | 0.73 | 0.82 | 0.86 |
| Incapacity Benefit / SDA | 32 | 37 | 35 | 10 | 10 | 7 | 0.92 | 0.92 | 0.94 |
| *Other major means-tested benefits* | | | | | | | | | |
| Housing Benefit | 74 | 70 | 70 | 38 | 30 | 31 | 0.63 | 0.71 | 0.70 |
| *Dwelling characteristics* | | | | | | | | | |
| Council Tax Band A | 35 | 36 | 38 | 38 | 37 | 37 | 0.94 | 0.91 | 0.87 |
| Council Tax Band B | 23 | 23 | 24 | 22 | 21 | 20 | 1.07 | 1.06 | 1.02 |
| Flat or Maisonette | 36 | 35 | 39 | 28 | 26 | 29 | 0.88 | 0.88 | 0.84 |
| *Combined means-tested benefit indicators* | | | | | | | | | |
| MT: Working-age benefits | 68 | 66 | 64 | 39 | 28 | 30 | 0.63 | 0.74 | 0.72 |
| MT: WAB + Pension Credits | 68 | 64 | 62 | 39 | 29 | 32 | 0.63 | 0.73 | 0.71 |

*Source: Households Below Average Income, Family Resources Survey; OECD equivalisation scale used*

*UMBR – the construction of a poverty proxy*

At this point, the national analyses give us a basis for a provisional poverty proxy whose spatial properties can then be investigated. For the proxy, means-tested benefits are preferred to dwelling characteristics as having a direct logical connection to household income. The choice of specific benefits starts from those which have high validity and coverage (Table 1) and are reasonably stable over time in this (Table 2): Jobseeker's Allowance (JSA), Employment Support Allowance (ESA) and Income Support (IS). Pension Credit (PC) has much lower validity at the standard poverty line, primarily because it is more generous than comparable benefits for working-age people. Using it marginally worsens the overall error of the combined means-tested proxy, from 0.76 to 0.78. It is, however, included in the provisional proxy for a number of reasons. Firstly, it is the only current indicator that covers people over working age. Secondly, within the administrative data we can identify a subset of PC claimants with lower incomes. Thirdly, both ONS's modelling using the FRS and our own using Understanding Society find the small-area rate of PC (Guarantee Element) claims among retirement-age households to be a very strong predictor of the income poverty rate among all households in that area (Methodology Directorate & Centre for Regional and Local Statistics 2010, pp.20, 21). It is not unexpected that the prevalence of retired people who have small pensions as a result of low-paid or irregular work in the past should be a good predictor of the prevalence of low pay among working-age adults in the same area.

To produce a measure, the quarterly counts of each benefit (JSA, IS, PC Guarantee Element and ESA) are averaged across a calendar year, and the four annual averages are then summed. This sum of benefit claimants is used as the numerator for a poverty proxy rate, called UMBR: the Unadjusted Means-tested Benefits Rate. UMBR is conceived of as a proxy for the rate of poverty among an area's households, and so its denominator is the estimated count of households in an area in the corresponding year. Inter-censal estimates of household numbers for small areas are derived from official small-area population estimates. UMBR is thus the average number of means-tested benefit claimants in a given area and year, divided by the total households. It is 'unadjusted' in the sense that the raw rate is used without shrinkage and with the assumption that spatial variations in validity and coverage are unknown and so should not be compensated for at this point. UMBR has similarities to the Income Domains of various UK deprivation indices already discussed in this paper, such as the IMDs and the Economic Deprivation Index. A fuller description of the calculation of UMBR, and a comparison to IMDs is given in the Annexe.


## Spatial variation in a proxy for poverty

The literature reviewed and the findings on the validity and coverage indicate that we need to test how a proxy like UMBR is related to the underlying construct (income poverty) in different types of place. The first matter is to identify bias: that is, whether the proxy systematically leads us to believe that the poverty rate in specific kinds of place is higher or lower than it is in fact. A second aim is understanding the numerical

relationship between UMBR and the underlying poverty rate; can we assume, for example, that UMBR identifies a constant proportion of all income poverty?

As we know, there are in the UK no actual direct observations of small-area poverty rates to which to compare the proxy measure. UMBR also cannot be tested against either IMD Income Domains or ONS's MSOA income poverty estimates, since they all share underlying welfare benefits data. The strategy adopted here is thus to test UMBR against income poverty as measured in two large sample surveys, HBAI and *Understanding Society*. The tests compare aggregated UMBR rates for groups of small areas, such as all those in a geographic region or all those with similar compositional characteristics, to the survey poverty estimates for all households living in those same areas.

### *Regional variation*

Rates of income poverty vary widely between regions in the UK, and it is plausible that not all the reasons for this variation will be captured by UMBR as a proxy. For one, UMBR is comprised only of means-tested benefits paid to people not in work. Thus regional differences in rates of in-work poverty – where waged income is normatively inadequate to support the people in the household who must live off it – are not reflected. For another, UMBR does not reflect regional differences in housing costs and their effects on poverty when, as is commonly preferred, it is measured against income net of housing costs. The difference this makes can be substantial. According to HBAI, London in 2009/10 had a poverty rate before housing costs of 17%, the UK average, but a rate of 28% after housing costs, the highest of any region (Department for Work and Pensions 2011b, sec.3.5). UMBR also will not reflect systematic differences between regions in either eligibility for or take-up of the means-tested benefits used as the numerator of the rate.

In Figure 1 the UMBR household rate – the number of means-tested benefit claimants, divided by the estimated households in that region – is shown against single-year survey estimates of income poverty, considering income *before* housing costs (BHC). The same comparison is made in Figure 2, but now considering income poverty measured in HBAI *after* housing costs (AHC). Each region in each year is shown by a circle centred on the UMBR rate (along the x-axis) and the survey estimate of income poverty from the HBAI (on the y-axis), and labelled by region. The survey estimates are themselves subject to sampling error; the approximate[2] 95% confidence interval for the survey estimate is shown as grey tails above and below the circle. For each year, a best-fit line is shown that gives the implied relationship between regional UMBR and poverty rates as measured by HBAI. The best-fit line is a simple linear regression model of poverty rate upon UMBR, with the regions weighted according to their household population for the estimation.

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2       For ease of calculation, the intervals above and below are treated as symmetrical about the estimate and 1.96 times its standard error. Note that DWP's published HBAI poverty rates for regions are three-year moving averages, and so have smaller confidence intervals.

Looking at the two series of plots, there is, as we would hope, consistently positive correlation between regional UMBR and the survey estimates of income poverty. For the majority of regions and years, the range of the survey estimate crosses the best-fit line; this means that the underlying poverty rate implied by UMBR in the model is within the confidence interval of the observed survey value. The model fit is somewhat better for AHC poverty; the mean $R^2$ across the nine years is 0.63, and this is pulled down by one year, 2008, where the fit is very poor. However, the correlation between UMBR and survey-estimated income poverty is generally weaker in later years; note, for comparison, the relatively higher errors of the benefits poverty proxies in the later years in Table 2.

The most serious result from these charts is that there are some regions which are consistently above or below the best-fit line in successive years. London is below the line in many years for BHC poverty, and above it for AHC. This implies that UMBR would cause us to over-estimate the prevalence of BHC poverty, and under-estimate that of AHC poverty in London. This is consistent with the known regional pattern of wages and housing costs as causes of poverty that are not directly measured by UMBR. The lowest paid in London are paid on average slightly more than the lowest paid in other regions (so BHC poverty is lower), but these wages do not fully compensate for substantially higher housing costs. Two other regions also appear consistently away from the national pattern. UMBR appears to imply too low a rate of income poverty for the East Midlands, and too high a rate in Scotland. These results mean that UMBR should not be used to make statements about the relative prevalence of income poverty, as conventionally conceived, in places in different regions, or at least not in regions that are consistently outliers in the charts. The same UMBR in a small-area does not imply the same underlying rate of income poverty in London as it does in Scotland. It is very plausible that this also applies to districts within regions: that, for example, there are cities or sub-regions with high housing costs whose real poverty rate is under-estimated by UMBR. However, this cannot be tested using sample survey data.

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**Figure 1: Regional UMBR rates compared to income-poverty estimates from HBAI (before housing costs), 2001-2009**
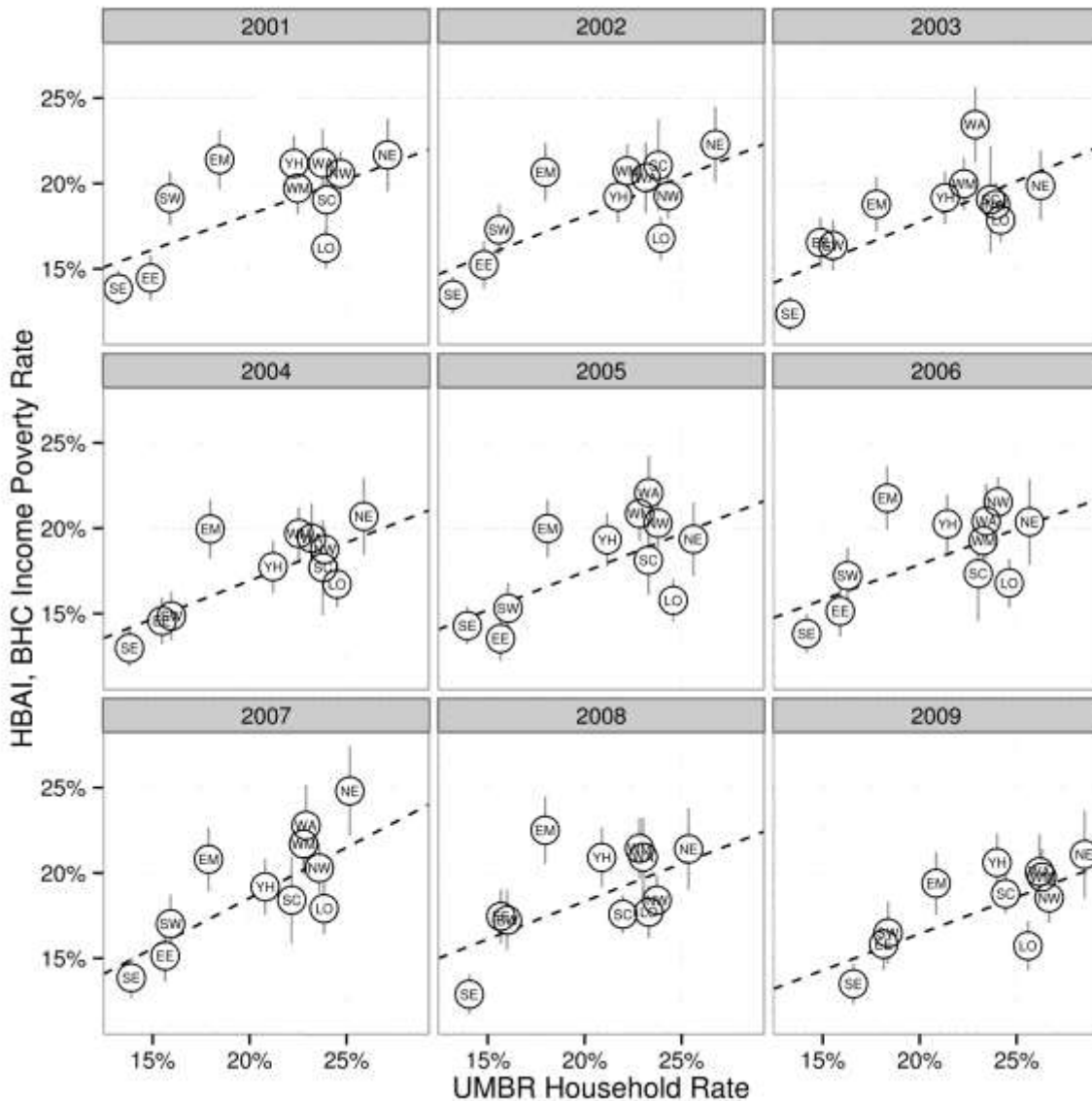


**Notes:** The poverty threshold used is below 60% of median income before housing costs, equivalised using the OECD scale. UMBR figures are for calendar years; HBAI estimates are the nearest corresponding financial year.

Regional labels: **EE**: East of England; **EM**: East Midlands; **LO**: London; **NE**: North East; **NW**: North West; **SC**: Scotland; **SE**: South East; **SW**: South West; **WA**: Wales; **WM**: West Midlands; **YH**: Yorkshire & Humber.

**Figure 2: Regional UMBR rates compared to income-poverty estimates from HBAI (after housing costs), 2001-2009**
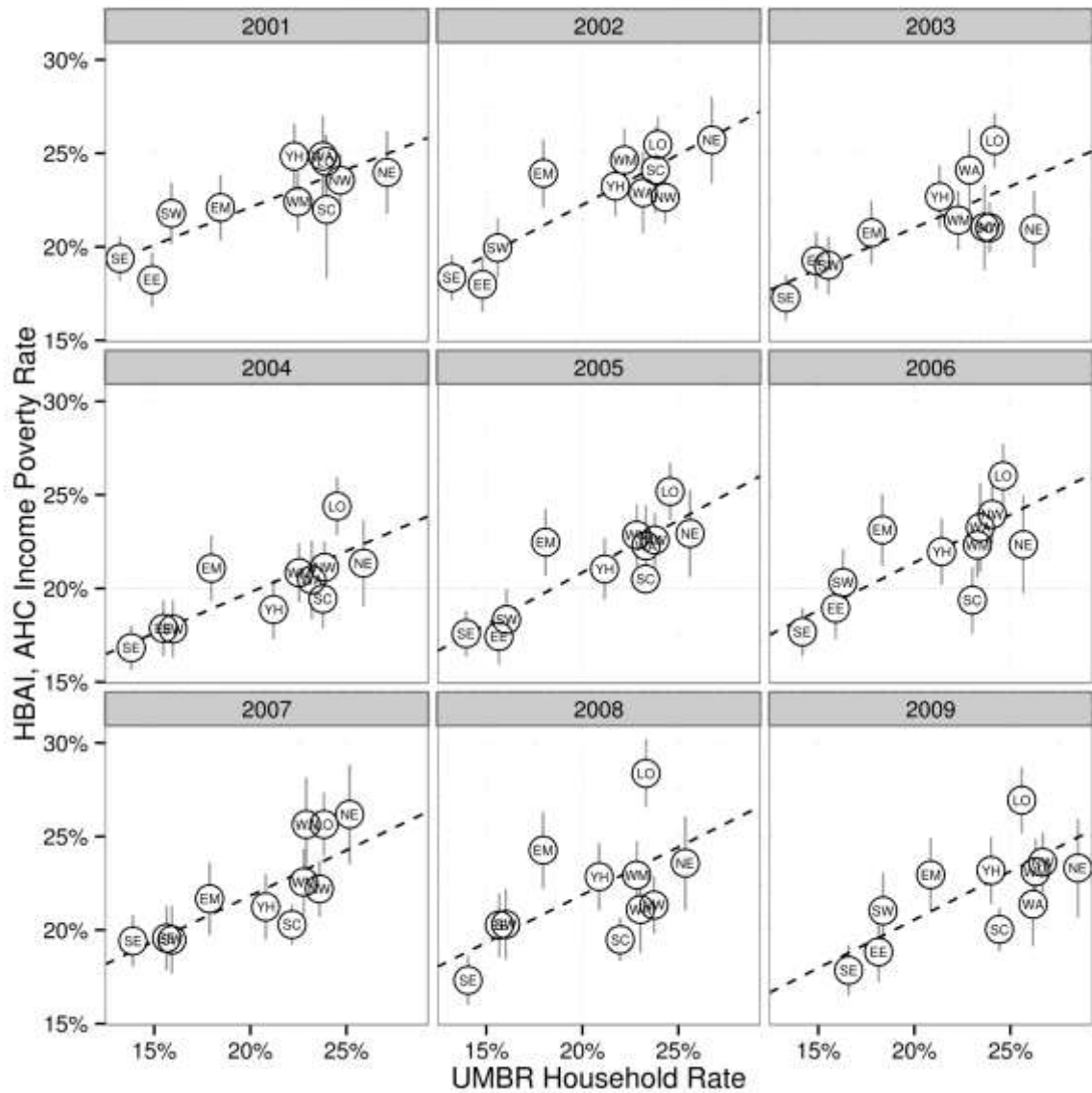


Notes: The poverty threshold used is below 60% of median income after housing costs, equivalised using the OECD scale. UMBR figures are for calendar years; HBAI estimates are the nearest corresponding financial year.
Regional labels: **EE**: East of England; **EM**: East Midlands; **LO**: London; **NE**: North East; **NW**: North West; **SC**: Scotland; **SE**: South East; **SW**: South West; **WA**: Wales; **WM**:

**Figure 3: UMBR household rate against Understanding Society BHC poverty, by OAC neighbourhood type, England and Wales, 2010**
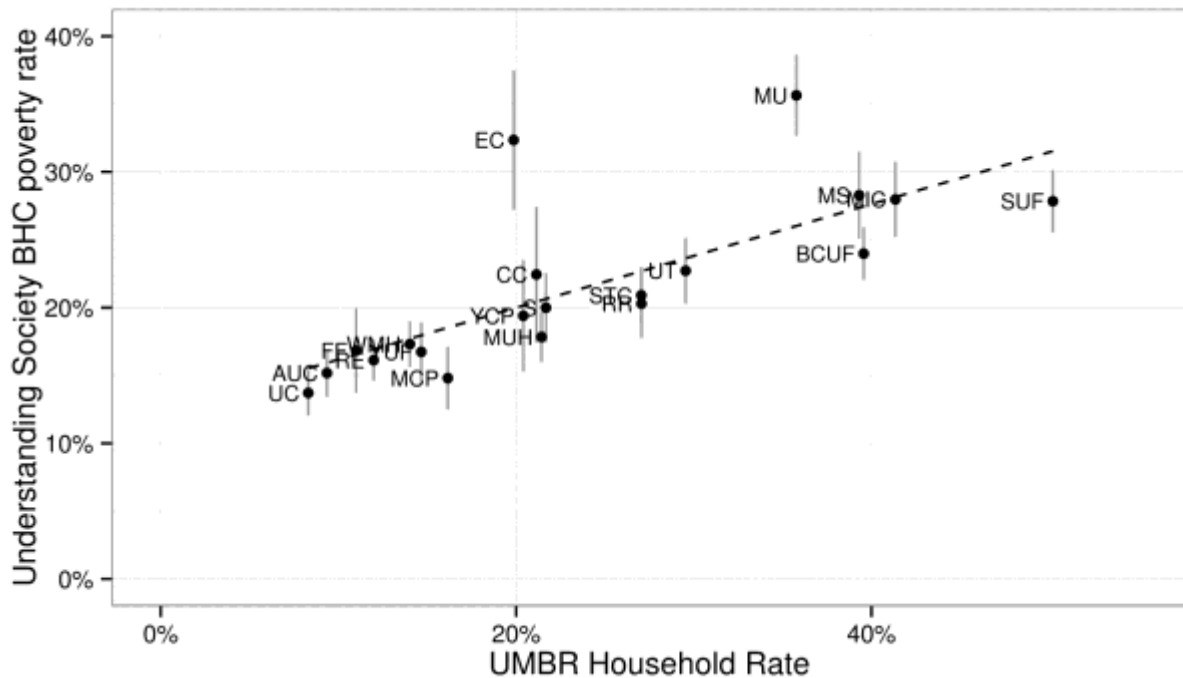


Note: the poverty threshold is below 60% of median income, as recorded by Understanding Society (USoc). Income in USoc is recorded net of direct taxes, but before Council Tax or housing costs. The OAC neighbourhood types used in the chart above are as follows:

| | | | | |
|---|---|---|---|---|
| **AUC** | Affluent Urban Commuter | | **RR** | Resorts and Retirement |
| **BCUF** | Blue Collar Urban Families | | **RE** | Rural Economies |
| **CC** | Countryside Communities | | **STC** | Small Town Communities |
| **EC** | Educational Centres | | **SUF** | Struggling Urban Families |
| **FF** | Farming and Forestry | | **S** | Suburbia |
| **MCP** | Mature City Professionals | | **UC** | Urban Commuter |
| **MUH** | Mature Urban Households | | **UT** | Urban Terracing |
| **MIC** | Multicultural Inner City | | **WMH** | Well off Mature Households |
| **MS** | Multicultural Suburbia | | **YCP** | Young City Professionals |
| **MU** | Multicultural Urban | | **YUF** | Young Urban Families |

*Variation by neighbourhood characteristics*
Whether UMBR can be used to make comparisons between regions is distinct from the matter of whether it is a valid proxy for making comparisons between different types of neighbourhood. If the same broad conditions of wages, employment rates, housing costs and so on prevail, does UMBR permit fair comparisons between places? This turns us to more to the question of whether UMBR has a stable relationship with underlying poverty in neighbourhoods which differ systematically in demography and socio-economic composition: inner-urban terraces, peripheral housing estates or market towns, say. To test this, we take the ONS area typology, or OAC, which classifies all LSOAs into one of twenty named groups, based on a reduction and clustering of 2001 Census variables (Vickers & Rees 2007). Using OAC, small areas can be distinguished by features that might be expected to influence the relationship between UMBR and underlying income poverty, such as demography, tenure and occupational class.

The empirical approach is similar to that taken for regions, that is, to compare UMBR aggregated across all neighbourhoods of each group in the OAC classification with a survey estimate of the poverty rate among all households in those same neighbourhoods. Since small-area identifiers are currently not available for HBAI, the first wave of *Understanding Society* (USoc) is used instead, the fieldwork for which took place from 2009 to 2011. This survey includes questions about income, and the findings from these on the overall income distribution and on poverty rates are broadly similar to those from HBAI (Berthoud 2011). However, the way in which housing costs are recorded in USoc does not permit easy calculation of AHC income, so the comparisons here are for BHC income only, for England and Wales. The relationship between UMBR and estimated household poverty rates for the 20 OAC groups is plotted in Figure 3. As with the regional comparisons, each point represents one group of neighbourhoods, labelled by OAC type; the x-axis is the UMBR in all neighbourhoods of that type, and the y-axis is the BHC poverty survey estimate, with the 95% confidence interval shown as vertical tails to it.

Again, there is a strong positive correlation between UMBR and income poverty. The lowest rates are found in such types as 'Affluent Urban Commuter', and the highest in 'Struggling Urban Families'; note that despite the names, the Census-derived OAC groups are not based on any income data. There are two significant outliers: 'Educational Centres' and 'Multicultural Urban', where UMBR implies too low a poverty rate. The former might be expected: student households have low incomes, but most students are ineligible for all the means-tested benefits used in UMBR. The result for 'Multicultural Urban' is less clearly explained, but may reflect differences in eligibility, and in wages and household size that contribute to in-work poverty. Importantly, we have not here tested the joint effects of region and neighbourhood type on the proxy-real rate relationship. The OAC types are not evenly distributed across regions; a high proportion of all 'Multicultural Inner City' neighbourhoods are found in London, whilst London has few 'Farming and Forestry' areas. However, with this caution, the results in Figure 3 suggest that UMBR may be more robust as proxy to differences between types of neighbourhood than to regional economic disparities.

This does not at least rule out the use of this kind of benefits-based proxy for investigating the spatial distribution of poverty within single cities or sub-regions.

*The ratio of UMBR to income poverty*

All of the charts have shown a best-fit line. This is the important relationship between UMBR and the implied real poverty rate in each area. The location and shape of the line affect what might, with due caution about regions and place types, be inferred from differences in the UMBR between two areas. Does twice the UMBR imply that an area has double the poverty rate of another? Does a given increase of UMBR consistently imply a corresponding increase in income poverty? This is what Figure 4 attempts to draw out, by dividing all LSOAs into vigintiles by UMBR, and then estimating the income poverty rate among households in areas in those vigintile groups from survey data.

**Figure 4: UMBR household rate against Understanding Society BHC poverty, by UMBR vigintile groups of neighbourhoods , England and Wales, 2010**
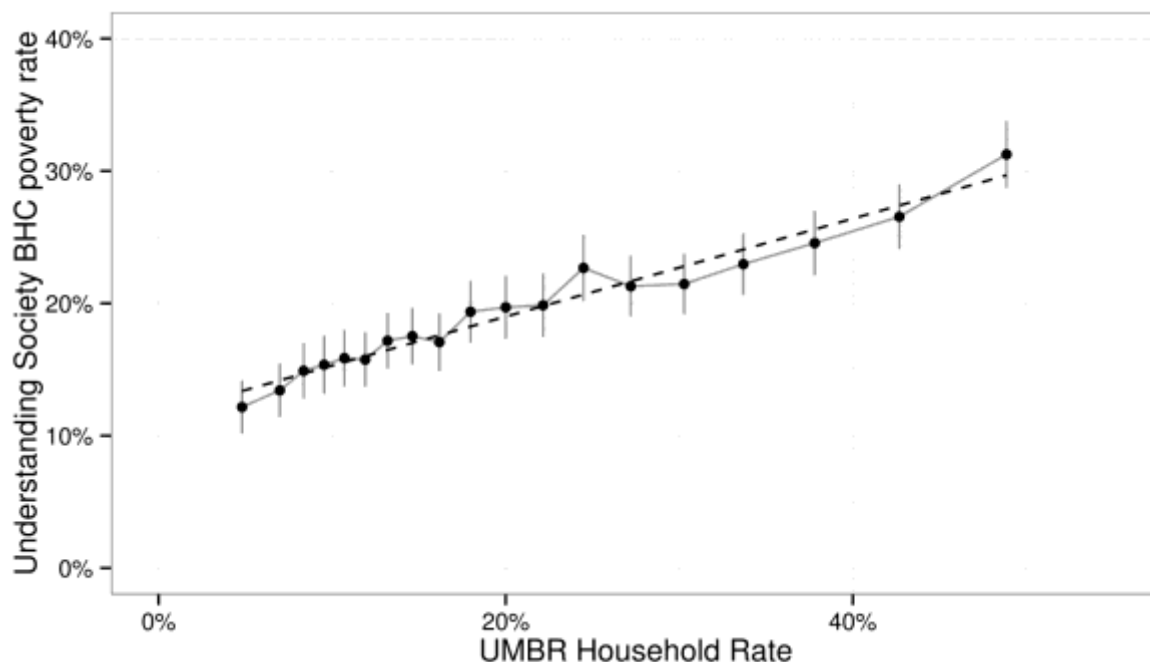


Note: the poverty threshold is below 60% of median income, as recorded by Understanding Society (USoc). Income in USoc is recorded net of direct taxes, but before Council Tax or housing costs.

There are three things to assess with this chart: whether a linear fit appears plausible, and then if so, the intercept and slope of the line. For the first, a linear fit seems suitable. This implies that, other things being equal, a given difference in UMBR between two areas implies a consistent corresponding difference in the areas' poverty rates. Depending on how estimated, a 1% increase in UMBR implies approximately a 0.4% increase in income poverty rate. This relationship is weaker at the tails. There appears to be a small number of exclusively affluent areas, and a small number of highly deprived ones; this is consistent with the findings of other neighbourhood

poverty estimates (Methodology Directorate & Centre for Regional and Local Statistics 2010). However, the intercept of the line in this chart, as in others, is not zero, suggesting that the large majority of small areas include at least some households (10 to 12%) in income poverty even if they have UMBR near or at zero. As a consequence, whilst the relationship is linear, UMBR cannot be seen as identifying a constant *proportion* of income poverty in different areas. It does not follow that because one area has twice the UMBR of another that it therefore has twice the poverty rate.

## Conclusion

The paper set out several criteria for small-area measures of poverty to be used in evaluating the effects of policy and economic events upon the distribution of poverty in Britain. The two broad approaches described, proxies and modelled or simulated estimates, tend to satisfy some of these well and others poorly. Estimates better meet the requirements of theoretical and normative coherence. However, for the purposes of the broader research programme, the use of proxies based on benefits data appears to be the most feasible way to produce measures from public sources on a sufficiently timely basis to contribute to public understanding of policies whilst they are still a matter of public debate. The development of UMBR was used to demonstrate empirical approaches to the problems of validity, coverage, stability and spatial variation that apply to proxies. The results of the latter testing suggest that UMBR is best used, with caution, to look at the distribution of poverty within cities and regions. Inter-regional differences are better described by other methods, such as the direct sample-survey estimates that are currently used. It would be worth repeating some of the spatial tests of validity and coverage as updated survey data on incomes and poverty become available. A couple of other remarks might be made on UMBR as a statistic. There is, of course, error in UMBR in as far as it implies a given income poverty rate in a given area. However, as with modelled estimates of poverty, it is very difficult to quantify this uncertainty, since we do not have direct observations of small-area poverty against which to compare. This paper has not even touched on, further, the considerable uncertainty that arises from the denominator, the total estimated population or households in small areas. Since there is no population register in the UK, the 2011 Census will be the first opportunity to evaluate the accuracy of the small-area population estimates, produced by ONS and GROS, that are used as denominators in local poverty measures. Considering this and other sources of error, and given the size of the intervals that ONS attach to their MSOA estimates, it would seem unwise to conclude that a difference of less than 5 to 10% in a poverty proxy rate between two small areas in a single year demonstrates a significant difference in the underlying poverty rate. However, the initial proposed uses of UMBR are largely for aggregates of areas, where more confidence may be attached to differences. The paper has also not considered the significance of changes in a proxy measure for the same area between years. This is an important question, and one that can be treated with considerable methodological sophistication (Li et al. 2011; Li et al. 2012). The view of ONS, that the wide confidence ranges attached to

single-year poverty estimates mean that annual estimates are unlikely to show changes in the same areas over time is perhaps too pessimistic. It assumes that the error of a modelled estimate for one area in one year is completely uncorrelated with the error for the same area in a subsequent year. In fact, assuming a similar model, it might be expected to be of the same sign and similar in magnitude, because the same unobserved area characteristics pertain. So, whilst small inter-year changes for a single area should be not be interpreted as real changes in poverty, sustained or aggregate changes are likely to merit comment.

Lastly, for all the care that might be taken in the measurement of poverty and inequality for small areas, the values do not directly translate into normatively or theoretically important 'critical measures'. Whether proxy rates or modelled estimates, they do not have the force of a speed limit upon driving, or the legally acceptable deviations from the purported weight of a vended good. As Weber put it "the fate of an epoch which has eaten of the tree of knowledge is that it must know that we cannot learn the meaning of the world from the results of its analysis, be it ever so perfect". The force of any measure of poverty will come from the strength of its connection with some broader enquiry, be that of the means and consequences of policy or the social life of neighbourhoods and cities.

# Annexe: Sources and details of publicly available administrative proxies for poverty

## Table 3: Summary of potential administrative-data indicators of poverty and deprivation, by whether means-tested, source, and coverage over time

| Code | Proxy | Means-tested? | Source | Available from | Dates/Geographies |
|------|-------|---------------|--------|----------------|-------------------|
| *Out-of-work benefits for working-age adults* | | | | | |
| JSA | Job-Seeker's Allowance claimants | Y/N[a] | DWP | DWP, NOMIS, NSS | 1999- (LSOA) 1985- (postcode sector) |
| JSA(IB) | - income-based JSA | Y | DWP | DWP, NOMIS | 1999- (LA, 5% sample) |
| JSA(CB) | - contribution-based JSA | N | DWP | DWP, NOMIS | 1999- (LA, 5% sample) |
| IncSupp | Income Support claimants | Y | DWP | DWP, NOMIS, NSS | 1999- |
| IB/SDA | Incapacity Benefit & Severe Disablement Allowance | N | DWP | DWP, NOMIS, NSS | 1999- (LSOA) |
| ESA | Employment & Support Allowance | Y/N | DWP | DWP, NOMIS, NSS | 2007- (LSOA) |
| *Other major means-tested benefits* | | | | | |
| HsgBen | Housing Benefit | Y | DWP | DWP, NSS | 2000-2006, 2008- (districts) 2004/05 only (LSOA) |
| PenCred | Pension Credit (Guarantee and Savings elements) | Y/N[b] | DWP | NOMIS, NSS | 2003- (LSOA)[d] |
| *Tax Credits* | | | | | |
| WTC | Working Tax Credits | *[c] | HMRC | HMRC, NSS | 2003-2009[e] (LSOA) 2003- (districts) |
| CTC | Child Tax Credits | *[c] | HMRC | HMRC, NSS | 2003-2009[e] (LSOA) 2003- (districts) |
| *Dwelling Characteristics* | | | | | |
| Ctax.A | Dwelling in Council Tax Band A | - | DCLG/VOA | VOA, NSS | 2001-2011 (LSOAs) |
| CTax.B | Dwelling in Council Tax Band B | - | DCLG/VOA | VOA, NSS | 2001-2011 (LSOAs) |
| Flat | Dwelling is a flat or maisonette | - | VOA/ONS | VOA, Census | 1991, 2001, 2011[f] (LSOA) |
| *Combined means-tested benefits indicators* | | | | | |
| MTB.WkAge | Major means-tested working-age benefits: JSA & Income Support & ESA | Y | DWP | NOMIS, NSS | 1999- (LSOA) |
| MTB.PC | As above, plus Pension Credit recipients | Y[b] | DWP | NOMIS, NSS | 1999- (LSOA) |
| MTB.TaxCred | As above, plus tax credit recipients | Y+N[b] | DWP | NOMIS, NSS | 2003- (LSOA) |

**Notes:**

(a)     Job-Seeker's Allowance can be paid either on the basis of National Insurance Contributions accumulated in previous employment, or on a means-tested basis if the claimant does not have, or has exhausted their NI contributions. Income-based is more common.

(b)     Pension Credit replaced the Minimum Income Guarantee under Income Support for pensioners in 2003. It includes a Guarantee Element which supplies a minimum income level, and a Savings Element which provides additional matched payments to pensioners with some savings. Those receiving the former only are used as a low-income proxy in, for example, the English Indices of Multiple Deprivation. However the Guarantee Element ensures an income for all pensioners that is higher than the equivalent amount guaranteed by Income Support to working-age adults.

(c)     The amount of Working Tax Credit and Child Tax Credit a family receives is calculated from its income and composition. Families that are well above standard poverty thresholds may receive some WTC. HMRC has published additional analyses that break down the number of tax-credit-recipient families, and the number of children in those families, by thresholds of income. One such breakdown shows those whose income is below 60% of median and is a "local child poverty measure" (HM Revenue and Customs 2010). Another shows receipt of different elements, where those receiving 'above the family element' excludes higher-earning tax credit recipients who are unlikely to have incomes below poverty thresholds.

(d)     From 1999 to 2003, pensioners on means-tested income benefits are included in counts of Income Support claimants.

(e)     Counts of Child Tax Credit claimants for LSOAs are published several years in arrears; the most recent year at the time of writing is 2009.

(f)     In 2011, the Valuation Office Agency started publication of tables of dwelling type and number of bedrooms at small-area level, using records derived from Council Tax lists.

Acronyms of providers:

DCLG: Department for Communities and Local Government

DWP: Department for Work and Pensions

HMRC: HM Revenue and Customs

NOMIS: National Online Manpower Information System (online labour-market data distributor)

NSS: Neighbourhood Statistics Services, including Neighbourhood Statistics (England and Wales) and Scottish Neighbourhood Statistics

ONS: Office for National Statistics

VOA: Valuation Office Agency

## Annexe: UMBR - The unadjusted means-tested benefits rate

The local income poverty measure proposed for use in the *Social Policy in a Cold Climate* research programme is called *UMBR*: the Unadjusted Means-tested Benefits Rate. Its count is the number of claimants of major means-tested benefits in the area of interest. In this, it is similar to the Income Domains of the various UK indices of deprivation, and the debt to those is acknowledged. The Income Domain of the IMDs are non-overlapping count of means-tested benefit claimants, plus employed recipients of Child Tax Credit with incomes below 60% of the national median, plus asylum seekers. In all cases partners and children are identified and included; this total count is divided by the estimated resident population.

The most important differences between UMBR and the English IMD's Income Domain are thus:

➢ Low-income households receiving Tax Credits but not claiming out-of-work benefits are not included in the UMBR numerator.

➢ Asylum seekers are not included in the UMBR numerator.

➢ Job-Seeker's Allowance and Employment Support Allowance claimants who receive their benefit on the basis of National Insurance contributions are included in the numerator.

➢ The denominator of UMBR used here is *households*, whereas the denominator of the IMD is *people* (including most people in communal establishments). UMBR does not need or try to identify partners and children of claimants.

These differences primarily reflect differences between sources in the public domain and those used to produce the IMD. The IMD's Income Domain entailed extremely time-consuming and costly linkage of sensitive data from multiple government databases, conducted in a secure environment. UMBR is, by contrast, designed to be reproducible from sources that are wholly in the public domain.

*The numerator: means-tested benefit claims*
The numerator is all claimants of JSA, Income Support, ESA and Pension Credit (Guarantee Element). The arithmetic mean of four calendar-year quarters for each benefit is summed for each LSOA or Datazone for each year. The counts come from NOMIS and so are subject to disclosure-control rounding to the nearest five.

Working Tax Credits are not used because there are several discontinuities in the series over 2001 to 2011, and because the publication of small-area data by HMRC currently has a delay of around two years. Inclusion of these data does not improve the overall correlation between UMBR and ONS's modelled estimates of household poverty rate at MSOA level in England and Wales, although it does improve the correlation for MSOAs with the lowest estimated poverty rates.

Contribution-based claimants of JSA and ESA are not excluded principally because the distinction between them and income-based claimants is only made in the 5%

sample DWP data, and so is unavailable for small areas. Contribution-based claimants comprise a relatively small proportion of all JSA claimants, between 10 and 20 percent between 1999 and 2012. Also, as Table 1 in the main text demonstrates, contribution-based JSA claimants are almost as likely to be in poverty as income-based (means-tested) claimants.

### The denominator: estimated households

The denominator for each LSOA/Datazone in each year is the estimated number of households in that area. These estimates are derived from ONS and GROS's small-area population estimates by broad age and sex bands. The number of people in communal establishments (from the Census) is deducted from each age/sex band to give a household population. Household representative (HRP) rates are then applied to each age/sex band to give counts of households. The procedure is very similar to that used to produce the English household projections (Department for Communities and Local Government 2010), and as with those, the HRP rate for each band in each small-area combines information from the Census and the Labour Force Survey (LFS). The household populations are constrained to the official household estimates published by DCLG and by the Scottish and Welsh Governments.

The use of a household denominator reflects the principle that the units of the measure should resemble those used in national poverty measures. It is also a pragmatic response to the problem that public benefits data for small areas do not provide information on partners and dependants of the claimant. Using claims divided by total or adult population leads to inaccuracies where there are systematic differences in family size between different neighbourhoods. Using claims divided by dwellings creates inaccuracies where there are variations in dwelling vacancy rates. Household- and dwelling-denominated versions of UMBR are better correlated with ONS's MSOA poverty estimates.

There are some cautions with the household denominator. Some residents of communal establishments can and do claim means-tested benefits, and so are potentially included in the numerator but excluded from the denominator. Also, there is the possibility of double-counting where there is more than one claimant within a household. Results from the FRS show that there are negligibly few benefit units where more than adult claims a means-tested benefit. However, households can comprise multiple benefit units. Reflecting these two problems and other uncertainty in small-area population estimation, a small number of LSOAs / Datazones have in some years an UMBR household rate greater than one. A future development of UMBR might be to experiment with using estimated numbers of families rather than households as a denominator. The definition of a 'family unit' in the LFS is closer than that of a 'household' to the definition of a 'benefit unit', though they are not identical.

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