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Geary WP2012/11
April 2012

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Abstract

As awareness of the limitations of relying solely on income to measure poverty and social exclusion has become more widespread, attention has been increasingly focused on multi-dimensional approaches. To date efforts to measure multidimensional poverty and social exclusion in rich countries have been predominantly *ad hoc* and have relied on data that are far from ideal. Here we apply the approach recently developed by Alkire and Foster, characterized by a range of desirable axiomatic properties but mostly discussed so far in a development context, to European countries, exploiting the potential of harmonized microdata on deprivation newly available for the European Union. The analysis seeks to overcome the limitations of the union and intersection approaches that have characterized many earlier studies. Multidimensional poverty is characterized and decomposed in terms of the contribution of different deprivation dimensions, and an account of cross-national and socio-economic variation in risk levels is presented that is in line with theoretical expectations. Multilevel analysis of multi-dimensional poverty provides the basis for assessment of the role of macro and micro characteristics and their interaction in relation to levels and patterns of multidimensional poverty and social exclusion.

Key words: Poverty Measurement; Multidimensional poverty; Deprivation; Social exclusion; EU poverty target.

Introduction

In developed as well as developing countries, attention has been increasingly focused on multi-dimensional approaches to measuring poverty and social exclusion, identified by Kakwani and Silber (21) as the most important recent development in poverty research. Non-monetary indicators are increasingly available and used in this context, either separately or in combination with income, in individual OECD countries as well as at the European Union level Nolan and Whelan (25, 26), Förster(13). A variety of sophisticated analytic strategies have been employed in individual countries to explore such issues, including latent class analysis (Dewilde, (10) Moisio (24), Grusky and Weeden (16)), Whelan and Maître (35), structural equation modelling (Carle *et al* (9), Tomlinson *at al* (31), item response theory Capellari and Jenkins (8)) and self-organising maps Pisati *et al* (27). There have also been comparative applications drawing on EU-wide survey micro-data, despite limitations in the dimensions covered by available indicators to date ((Fusco *et al* (15), Nolan and Whelan (26)). Debate on methodological approaches has been vigorous, focusing inter alia on the value of summary indices for communication to a wide audience versus the arbitrary nature of decisions required in combining distinct dimensions in producing such indices. Here we apply the multidimensional poverty measurement approach recently developed by Alkire and Foster (1,2,3) which has been the subject of considerable attention and debate (see for example Lustig (23), Ravallion (28), Thorbecke (30)). This approach has been framed more in a development context than a rich country one. Here we seek to apply it to the countries of the European Union making use of newly-available and richer comparative data on various aspects of deprivation. Our results bring out the relevance of this approach in such a context, and help to illuminate on-going debates about the measurement and targeting of poverty and social exclusion in Europe.

The Alkire and Foster Multidimensional Approach

Bourguignon and Chakravarty (7) provide a framework for multidimensional poverty measurement involving both an identification function for counting the number poor and a poverty measure that combines that information into a statistic summarizing the overall extent of poverty. Axioms analogous to the ones used in the unidimensional case ensure that the measure properly reflects poverty, can be decomposed by sub-group and is consistent with the identification function. The simplest summary measure is the number of dimension on which an individual or household is deprived, which Atkinson (6) refers to as the 'counting' approach. Atkinson (6) distinguishes between the union and intersection approaches, the former counting as poor those deprived on any dimension while the latter counting only those deprived on all dimensions. As Alkire and Foster (4) note, while the union and intersection approaches are easy to understand, they can be particularly ineffective at separating the poor from the non-poor, with the former tending to identify implausibly large numbers as poor and the later tending to capture tiny minorities.

A key motivation underlying the recent methodological contributions of Alkire and Foster (1,2,3), with concrete applications in a development context by Alkire and Santos (4) and Alkire and Seth (5), is to address these shortcomings. Their procedure involves a dual cutoff approach. Given a vector $z = (z_{1,\ldots\ldots\ldots}z_{j)}$ of deprivation cutoffs, one for each dimension, if a person's outcome on a given deprivation dimension j falls short of the appropriate threshold z_j then the person is said deprived on that dimension. A vector of weights $w = (w_{1,\ldots\ldots\ldots\ldots}w_{j)}$ is used to indicate the relative importance of different dimensions; if each deprivation is viewed as having equal importance, all weights are one and sum to the number of dimensions. A column vector $c = (c_{1,\ \ldots\ldots\ldots}c_{j)}$ of deprivation counts reflects the breadth of each person's deprivation. In the case of equal weights, the *i* th person's deprivation count is simply the number of deprivations s/he experiences; more generally, it is the sum of the weighted values

of the deprivations experienced by *i*. A cutoff point $0 < k \leq d$ is used to determine whether a person has sufficient deprivations to be considered poor. If an individual's deprivation count is *k* or above the person is identified as poor.

Following Alkire and Foster (3), the transition between the identification and the aggregation steps is best understood as involving a progression of matrices. The achievement matrix Y shows the outcomes of *n* persons in each of *d* dimensions. The deprivation matrix g^0 replaces each entry in Y that is below its deprivation cutoff z_j with the deprivation value w_j and each entry that is not below the deprivation threshold with 0. It provides a snapshot of who is deprived on each dimension and how much weight the dimension carries. The censored deprivation matrix $g^0(k)$ multiplies each row in the deprivation matrix by the identification function. If a person is poor, the row remains unchanged; but if the person is not poor the deprivation information for that person is replaced with zeros.

Censoring is central to the method since the censored matrices embody the identification step and provide the basis for the aggregation step. The original deprivation matrices, by comparison, include information on the non-poor, which should not affect any measure that is focused on the poor. The aggregation step builds upon the standard Foster-Greer-Thorbecke (FGT) (14) methodology. Our focus in this this paper is on the *adjusted head count ratio* and its components. The adjusted head count ratio is defined as $M_{0=}\mu(g^0(k))$ or the mean of the censored deprivation matrix. The headcount H is the proportion of people who are who are multi-dimensionally poor. The intensity A is the average deprivation share among the poor. Alkire and Foster (2) demonstrate that for any given weighting vector their methodology satisfies decomposability, relocation, invariance, symmetry, poverty and deprivation focus, weak and dimensional monotonicity, non-triviality, normalization, and weak rearrangements for $\alpha \geq 0$; monotonicity for $\alpha > 0$: and weak transfer for $\alpha \geq 1$.

Data and Measures

The data employed here come from the 2009 round of European Union Statistics on Income and Living Standards (EU-SILC), the EU's data-gathering process aimed at producing regular standardised data on poverty and social inclusion, which in that year included a special module on material deprivation. The availability of this module allows us to explore the dimensionality of deprivation in a more comprehensive way than has been possible to date. Sweden has been excluded from our analysis because of a large number of missing values on the deprivation items, so the analysis covers 28 countries, the other 26 European Member States together with Norway and Iceland. In line with the conventional approach, our analysis of poverty is conducted at the individual level. However, given that the key deprivation indicators are largely measured at the household level, multilevel analysis of the determinants of and consequences of such poverty is conducted at that level employing both household and Household Reference Person (HRP) characteristics. The HRP is the person responsible for the accommodation. Where more than one person is responsible the oldest individual is chosen.[1] Our analysis makes use of 20 non-monetary indicators of deprivation; where questions have been addressed to individuals we have taken the response of the HRP as applying to the household.

The dimensional structure of deprivation in the EU has been the subject of significant investigation, based on data from the European Community Household Panel and then on the more limited set of indicators included in the standard annual EU-SILC (see for example Layte, Maître, Nolan and Whelan (22); Whelan, Layte, Maître and Nolan (31); Eurostat, (12); Guio (17); Guio and Engsted-Maquet (19); Whelan, Nolan and Maître (36); Guio (18). The broader range of deprivation items available in the EU-SILC 2009 special module has been analysed by Whelan and Maître (37), whose factor analysis identified six dimensions of

[1] Where there is difficulty in identifying the HRP we have chosen the first adult on the household register for whom the appropriate information is available,

deprivation. Of these, we exclude the dimension relating to housing facilities because a number of the items it includes have close to zero levels of deprivation in the more affluent countries, and also the dimension relating to access to facilities because it contains only two items. The focus of our analysis is on the remaining four deprivation dimensions, which are:

Basic Deprivation: comprising items relating to enforced absence of a meal, clothes, a leisure activity, a holiday, a meal with meat or a vegetarian alternative, adequate home heating, shoes. This dimension captures enforced deprivation relating to relatively basic items. It is dimension that that has obvious content validity in relation to the objective of capturing inability to participate in customary standards of living due to inadequate resources. Our expectation is that, since households will go to considerable length to avoid deprivation on these items, the dimension will be significantly related to measures of current and longer term resources.

Consumption Deprivation: comprising three items relating a PC, a car and an internet connection. It is obviously a rather limited measure and it would be preferable to have a number of additional items. Our expectation is that the association with current resources will be weaker than in the case of basic deprivation since the items do not necessarily reflect capacity for current expenditure.

Health: captured by three items relating to the health of the HRP, namely current reported self-assessed health status, restrictions on current activity and the presence of a chronic illness. Given the importance of age in relation to health we anticipate a relatively modest correlation with economic resources.

Neighbourhood Environment: the quality of the neighbourhood/area environment as reflected in a set of five items comprising reported levels of litter, damaged public amenities, pollution, crime/violence/vandalism and noise in the neighbourhood. Given the importance of

urban/rural residence and location within urban areas in relation to such deprivations, a much weaker association with resource factors can be expected.

The reliability for these dimensions, as indexed by Cronbach's alpha, ranges from 0.85 for basic deprivation to 0.64 for neighbourhood environment (Whelan and Maître, 2012). Variation in levels of reliability across-countries is extremely modest. The availability of indicators characterized not only by relatively high overall levels of reliability but modest cross-national variation in such levels, allow us to avoid the danger inherent in many cross-national studies of being unable to distinguish genuine substantive variation form variation arising from differences in reliability levels.

In constructing measures relating to each of these dimensions we have used prevalence weighting across the range of counties included in the analysis. This involves weighting each component item by the proportion of households in the overall pan-European sample possessing an item or not experiencing the deprivation (depending on the format of the question). In other words, deprivation on a widely available item or experience of a disadvantage that is relatively rare is treated as more serious than a corresponding deprivation on an item where absence or disadvantage is more prevalent. This implicitly involves a "European" reference point in relation to deprivation with a particular magnitude of deprivation being treated as uniformly serious across different counties. This is appropriate since we are interested in both within and between country variation and we wish to avoid any procedure that by definition reduces such variation. In a final step we normalise scores on each of these dimensions so that they have a potential range running from 0 to 1. The former indicates that the household is deprived in relation to none of the items included in the index while the later indicates that they experience deprivation in relation to all of the items.

The survey included a number of items relating to subjective economic stress, and rather than incorporating these into the measured dimensions of deprivation as some studies do, we keep them distinct in order to be able to examine the relationship between the extent of deprivation and such stress. For this purpose we construct a summary indicator of economic stress from a set of dichotomous items relating to difficulty in making ends meet, inability to cope with unanticipated expenses, structural arrears and housing costs being a burden. The individual items have been weighted by the proportion of individuals not reporting substantial stress on that item across the set of countries as a whole weighted by population size. The final scale has again been normalised so that scores run from 0, indicating experience of stress on none of the items, to 1 where there is reported stress on all items. The overall reliability coefficient for this scale is 0.70 as is the average reliability across countries.

Our multidimensional analysis of poverty focuses on the four dimensions described, together with the conventional relative income poverty measure (or 'at risk of poverty' as it is labelled in the EU's social inclusion indicators) framed vis-à-vis an income threshold set at 60% of median equivalised disposable income in the country in question. Weighting for population differences across counties, this income poverty measure identifies 1?% of individuals in the sample as below the income threshold. For the four deprivation dimensions, there is no natural or readily-justified threshold which would distinguish in each case those who should be counted as "deprived". For the purpose of this analysis we have therefore taken thresholds for each dimension that come as close as possible to identifying 15.7% of individuals as "deprived", i.e. the percentage below the at-risk of poverty threshold.[2] While efforts to underpin specific cut-offs on those dimensions also have merit and are worth exploring, this procedure allows us to examine the extent of overlap across dimensions of income poverty

[2] The actual percentages identified are 1.% for basic deprivation, 15.7% for consumption deprivation, 17.4% for neighbourhood deprivation and 23.4% for health deprivation.

and deprivation and patterns revealed by the adjusted head count measure in a context where the overall scale of poverty or exclusion on each dimension is similar.

We have chosen not to weight dimensions differentially, and the approach we have adopted minimises the impact of prevalence rates for individual dimensions on the adjusted head count ratio and its components. We define as multi-dimensionally poor those individuals who are above the specified threshold on at least two dimensions. Conditional on the choice of deprivation thresholds for the individual dimensions, this produces maximum estimates of multidimensional poverty.

The Relationships between Deprivation Dimensions: Censored and Uncensored Approaches

Before proceeding to look directly at the results of applying the adjusted head count ratio approach, we first explore the consequences for the relationships between our selected deprivation dimensions of moving from an uncensored to a censored approach. In Table 1 we show the correlations between each of the dimensions (including income poverty), and between them and economic stress. The uncensored outcomes are above the diagonal and the censored below. Focusing first on the former we can see that the highest correlation of 0.395 is between basic and consumption deprivation. Of the remaining correlations, only those relating to the basic and consumption deprivation relationships with relative income poverty exceed 0.2. The average correlation is .144 The magnitude of these correlations has inevitable consequences in minimising the numbers counted as deprived if one applies an intersection approach with uncensored variables. Focusing on the correlations with economic stress, the figure for basic deprivation is relatively high at 0.515 but the average correlation across all dimensions is 291.

Turning to the censored data, we find a much more even pattern of correlation between dimensions, reflected in an average correlation of 332 which is over double that in the uncensored cases. The correlations with economic stress are also more uniform with the ratio of the highest to the lowest correlation being 2.0 compared to 3.9 in the uncensored case. It is clear that, conditional on being above the multidimensional poverty threshold, the association between different forms of poverty/deprivation is considerably stronger. This in turn means that the number of individuals fulfilling particular intersection conditions will be significantly increased. In addition, as shown by the relationship to economic stress, the consequences of exposure to forms of deprivation differ for those above versus below the multidimensional poverty threshold.

Table 1 HERE

Multidimensional Poverty Levels by Country

In Table 2 we show the breakdown by country for the relative income poverty measure, M_0 the adjusted head count ratio, H the headcount and I the mean intensity. To facilitate interpretation we have ordered counties by their gross disposable income per capita (GNDH). In column (i) we see the familiar pattern in relation to the relative income poverty measure with very modest variation across countries. Somewhat higher levels are observed in the counties with the lowest income levels. On the other hand, rates in former communist counties such as the Czech Republic, Slovakia and Slovenia are considerably lower than in a range of counties with higher income levels. The H headcount figures in column (ii), indicates the number above the threshold, as a consequence of being above the cut off point on at least two dimensions, reaches. In contrast to relative income poverty, we observe very sharp variation across countries, which is broadly in line with average income levels. The

headcount figure ranges from a low of 0.083 in Norway to a high of 0.592 in Romania. There is a clear tendency for the Scandinavian social democratic countries and the Netherlands (often allocated to the same welfare 'regime') to report rates that are lower than might have been expected purely on the basis of their average income levels. By contrast, Greece and Hungary in particular exhibit rates somewhat higher than one might have expected from their average incomes.

Column (iii) focuses on A the average intensity level among those who have been identified as multi-dimensionally poor. Conditional on being identified as poor the intensity levels are rather similar across counties. There clearly is a relationship between national income levels and intensity with seven of the eleven counties with rates above 0.5 being among the eight lowest income counties. However, outside these counties variation is extremely modest. The headcount and intensity levels are clearly correlated but variation relating to former is a great deal more pronounced.

In column (iv) we focus on M_0 the adjusted head count ratio. This has a potential range of values going from 0 to 1. Where no one in the population experiences any of the deprivations it will take on a value of 0 and where every individual experiences deprivation on all items the value will be 1. Our observed range of values goes from 0.030 for Iceland to 0.313 in Romania. The intra correlation coefficient (ICC) is 0.108 indicating that just over 10% of the total variances is accounted for by between country differences. As with the headcount index, values generally increase as country income levels rise. Once again, values for countries in the social democratic welfare regime are distinctively low. They range from 0.030 in Iceland to 0.060 in the Netherlands and Norway. Countries that show slightly higher values than might be expected on the basis of their income levels are Germany, the UK, Greece and most particularly Hungary. For each of the three lowest income counties the adjusted head count ratio exceeds 0.205. In other words, the multi-dimensionally poor experience an aggregate

level of deprivation that reaches over 25% of that which would be observed if multidimensional poverty was universal and all poor individuals were deprived on all items. Clearly the M_0 measure is a great deal more successful in capturing cross-country variation than the relative income poverty indicator. While the sharpest differential in the latter case is 2.3 in the former it reaches 10.4. In subsequent analysis we will provide a more systematic analysis of such cross-country variation using multi-level models.

The figures for M_0 can be contrasted with those for those for the union and intersection counts for the five dimensions involved in our analysis as set out in columns (v) and (vi). For the former, where all individuals experiencing deprivation on any of the dimensions is counted the levels range from a lows of 0.301 in Iceland and 0..381 in Luxembourg to highs of 0.808 and 0.821 in Bulgaria and Romania respectively. The figures in relation to the intersection of the dimensions, involving deprivation on all five dimensions, provide a sharp contrast. Here the counts range from close to zero in a large number of countries to 0.012 in Bulgaria and 0.016 in Latvia.. The fact that the income poverty variable is defined in relative terms contributes to the extreme nature of these results. However, they are generally consistent with earlier research focusing on multiple deprivation in the European Union Tsakloglou and Papadopouous (32) Whelan *et al* 2002 (34), Whelan and Maître (35). The adjusted head count ratio clearly provides a middle ground between the union approach and the intersection approaches.

TABLE 2 HERE

Decomposition of Multidimensional Poverty by Dimension

One of the advantages of the M_0 measure is that it is decomposable in terms of sub-groups. A related property is that sub-group consistency, which requires overall poverty to fall if poverty decreases in one sub-group. Both properties are satisfied by the traditional FGT measures and also by the A-F methodology. M_0 is also decomposable in terms of dimensions. In this case M_0 is equal to the average of the censored head count ratio for the individual dimensions and the percentage contribution of a given dimension to overall poverty is its weighted censored head count ratio divided by the overall adjusted head count ratio..

In Table 3 we show this decomposition broken down by country for the dimensions in our analysis. It is clear that there is substantial variation across countries in the relative importance of dimensions. In the more affluent countries basic and consumption deprivation generally play a less prominent role than other dimensions. In only four of the fifteen most affluent countries does the figure for basic deprivation rise above .20 and in only five cases does it do so for consumption. In no case is this value exceeded for both dimensions. The combined basic and consumption deprivation rates range from 0.268 in the Iceland to 0.421 in German. In only two counties does it exceed .40. In the case of neighbourhood environment the observed rate exceeds .20 only for the Netherlands the UK and Italy. Thus for these countries the largest contributors to the AHR rate are the ARP and Health dimensions. For the combined ARP and health dimensions the rate varies from .441in the Netherlands to .539 in Norway.

The pattern for the six least affluent counties provides a sharp contrast. The lowest value of the basic deprivation rate of .242 is observed for Hungary and the highest values of .329 and .347 for respectively Romania and Bulgaria. For consumption deprivation the rates range from .220 in Hungary to .309 in Romania. The combined basic and consumption deprivation rate goes from .483 in Poland to .638 in Romania. For all of these counties the contribution of

neighbourhood environment is particularly modest and for the three least affluenct counties the same is true of ARO and health deprivation

For the remaining counties variation across dimensions is somewhat more variable. As might be expected the ARP measure makes a modest contribution in Slovakia and the Czech Republic. In addition, Portugal and Estonia exhibit distinctively low rates of neighbourhood deprivation.

TABLE 3 HERE

Socio-economic Variation in Risk Levels for Multidimensional Poverty

At this point we shift our attention from composition to risk levels and explore the extent to which the impact of social class and age group on likelihood of multidimensional poverty vary across counties. In Table 4 we break down M_0 by an aggregated 7-category version of the European Socio-economic Classification (ESeC) schema for the household reference person (HRP) for each of the counties in our analysis.[3] The class category for which the sharpest degree of variation is observed is farmers, where the range runs from 0.020 in Norway to 0.417 in Romania. Values are generally extremely low in the Scandinavian countries. The ratio rises to between 0.050 to 0.126 for the remaining affluent Northern European countries and the Czech Republic and Slovakia and Estonia. Values rise to between 0.159 0.169 for Cyprus, Greece and Portugal. Finally the remaining Eastern European countries display considerable variation. Hungary, Poland and Lithuania exhibit values close

[3] Malta has been excluded from this analysis and the analysis reported in Table 6 because of data problems

to the southern European countries. In contrast for the there least prosperous countries the values rnage from .262 in Latvia to .434 in Romania.

For the remaining categories we observe a similar pattern of class differentiation across countries. Generally the lowest values for M_0 are observed for the higher professional and managerial group. We also observe a consistent increase in rates moving from the more affluent to the less affluent countries. The rate ranges from 0.005 in Sweden to 0.013 in Romania. The next lowest level is observed for the lower professional and managerial class where the rates go from 0 .011in Norway to 0.177 in Bulgaria. The corresponding range for the lower white collar group is from 0.016 in Norway to 0.246 in Bulgaria. For the self-employed group the corresponding figures are 0.032 in Norway to 0.328 in Romania. For the higher working class group, the observed range goes from 0.033 in Iceland to figures ranging from .337, .356 and .371 respectively for Latvia, Romania and Bulgaria. Finally, the highest adjusted poverty ratio is generally associated with the routine working class group and those classified as having never worked. The range runs from between 0.038 and 0.074 respectively in Iceland and Norway and Sweden to in excess of .33 in Hungary, Latvia, Romania and Bulgaria.

TABLE 4 HERE

The adjusted head count ratio clearly fulfills key requirements of a valid poverty measure in that it varies systematically by social class group within countries, and across counties in relation to national average income levels. The combined effect is reflected in the fact the full range of variation for the M_0 measure runs from 0.007 for the higher professional managerial

class in Luxembourg to 0.371 for the routine working class & never worked group in Bulgaria – a disparity ratio of 53:1. Social class differences are substantial in every country. We will address this issue more systematically in our subsequent analysis. The cumulative effects of social class and country produces a situation whereby the most favoured social classes in the least affluent countries exhibit lower poverty rates than the least favoured in the more affluent countries. Thus in Norway and Denmark the value of M_0 is respectively 0.074 and 0.086 while for the routine working class and never worked group while in Latvia and Bulgaria the values for the professional and managerial class are respectively 0.123 and 0.135

At this point we shift our focus of attention to another potentially important socio-economic variation in multidimensional poverty namely life-course. In Table 5 we show the breakdown of M_0 by the age group of the HRP. Variation across the life course is modest among the more affluent countries. However, there is a tendency for the AHR level to be highest for tose aged less than 30. For the eight of the ten countries with the highest average incomes per capita the disparity ratio summarizing the ratio of M_0 for the 65+ group to that for the <30 group does not exceed one. On the other hand for all thirteen lowest income countries the highest level of AHR is observed for the group aged 65 or over.. In the more affluent counties the lesser importance of basic and consumption seems to mute age differences. In other words, where health deprivation comes in combination with basic deprivation it produces a clear pattern of age differentiation, On the other hand, where it is to a significant extent detached from such deprivation then that is not the case. This may be because the impact of socio-economic deprivation on health is more clearly seen in older age groups.

TABLE 5 HERE

Multilevel Analysis of Multidimensional Poverty

Our analysis up to this point has been conducted at the level of the individual in order to allow comparison with conventional poverty rates which are calculated at this level. However, at this point since we wish to conduct a formal analysis of the distribution of variance in relation to the adjusted head count ratio and since the construction of the component measures ensures that all member of a household are assigned identical values on each the dimensions included in our analysis,

In Table 6 we present a set of hierarchical multilevel regressions with the adjusted head count ratio as dependent variable. These are appropriate to a population with a hierarchical structure where individual observations within higher level clusters, such as countries, are not independent. Taking into account such clustering allows one to avoid "the fallacy of the wrong level" involved in analysing data at one level and drawing conclusions at another and, in particular, ensures that we do not fall prey to the ecological fallacy (Hox, 20).

Column (i) of Table 6 shows the results for the empty model with no independent variables. The intra-class correlation coefficient (ICC) capturing clustering between counties is 0.108. The ICC captures the between cluster variance as a proportion of the total variance. It can also be interpreted as the expected correlation between two randomly drawn units from the same cluster. (Snijders and Bosker,29). In column (ii) we enter a set of variables relating to household and HRP characteristics. These comprise HRP social class, education, marital and parental status, age group and housing tenure. The pattern of results is very much as we would have expected with M_0 being higher for the most disadvantaged educational, class and labour force status, marital and parental status and tenure groups. The inclusion of this set of variables reduces the deviance measured as -2 log likelihood ratio which is distributed as Chi squared by 22,543 for 19 degrees of freedom. Taking into account compositional differences

in relation to such socio-economic attributes reduces the country variance by 1.9%, the individual variance by 11.7% and the total variance by 10.6%.

TABLE 6 HERE

In equation (iii) we explore the impact of adding potentially important macroeconomic influences on multidimensional poverty. In particular, we focus on the log of gross income per capita (GNDH) and the Gini summary measure of income inequality, with both these variables calculated as deviations from the mean to make later interaction analysis easier to interpret. The values of the Gini variable have also been multiplied by 10 to eases interpretation. The addition of these variables produces a modest reduction in the deviance of 20. The Gini variable is not statistically significant but GNDH with a coefficient of -/152 is highly significant. This model reduces the country variance of the null model by 67.9% but has no further effect on the household variance.

In equation (v) we provided a systematic exploration of the manner in which socio-economic factors interact with GNDH. The coefficients for the socio-demographic variables involved in the interactions are their values at zero deviation from the mean of the log of GNDH. Looked at another way the coefficient for the log of GDH is the value where the set of socio-demographic variables take on the reference category values. The interaction terms show a consistent pattern of negative coefficients whereby socio-economic disadvantage has a more pronounced effect at lower levels of GNDH. Similarly being in an older age group has a sharper effect in less affluent counties. Again, taking an alternative perspective, we can conclude that level of affluences is of greater consequence in explaining variations in

multidimensional poverty among disadvantaged socio-economic groups than for their more favoured counterparts. For example the coefficient of 0.121 for pre-primary education indicates the effect at the mean of log GNDH. The significant negative interaction of -0.044 indicates that the effect of such education relative to third level education declines as the mean level of gross national income per capita increases and is accentuated at lower levels of affluences. Similarly the significant coefficient of -0.025 for the <30 age group shows that at the mean level of log GNDH this group is significantly less likely to be multi-dimensionally poor than the 65+ group. However, the positive interaction coefficient of 0.096 indicates that that this negative effect declines as the national income level increases and is correspondingly magnified as it decreases.

Taking into account the manner in which household and HRP socio-economic characteristics interact with national income reduces the deviance figure for equation (iii) by 2,604 for 10 degrees of freedom. Overall the model reduces the between country variance of the empty model by 71%, the individual variance by 11.7% and the total variance by 18.2%. The multi-level model analysis confirms that the adjusted head count ratio varies systematically across socio-economic groups and countries but that a fuller understanding of these effects requires that we take into account the manner in which micro and macro factors interact. The pattern of interactions we observe is consistent with earlier analysis focusing solely on basic deprivation (Whelan and Maître, 37). However, our ability to explain both within and between country variance is somewhat less.

Multidimensional Poverty and Economic Stress

In this section, in order to further explore the validity of the measure of multidimensional poverty we consider its relationship to subjective economic stress. In Table 7 equation (i) we show the results for the empty model where economic stress is the dependent variable. The

intra-class correlation coefficient indicates that 14.6% of the variance in economic stress is accounted for by between country differences. When H^0 is entered in equation (ii) it has a coefficient of 0.607. It reduces the between country variance by 0.499, the individual variance by 0.198 and the total variance by 0.242. It reduces the log likelihood by 40,857 for 1 degree of freedom. Adding the log of GNDH in equation (iii) produces a significant coefficient of -0.138 for that variable but has no impact on the coefficient for H^0. The addition of log GNDH reduces the likelihood by a modest 13.1. It also reduces the country variance by 0.687 and the total variance by 0.270.[4]

The above analysis shows that, in addition to revealing expected patterns in relation to country and social class, the adjusted head count ratio is a powerful predictor of economic stress. This effect is not accounted for by its association with gross average national income per capita. A comparison with findings by Whelan and Maître (38) focusing on basic deprivation reveals that its impact is a good deal stronger than for H^0. Despite the more uniform impact of the deprivation dimensions on economic stress in the censored mode, there is clearly some loss of explanatory power in subsuming different deprivation profiles under the multidimensional poverty label. Extracting the full explanatory power of the original continuous deprivation measure, required taking into account a significant interaction with the log of GNDH with the effect of basic deprivation increasing significantly as average income levels rose. The fact that this is not the case for H^0 is likely to be a consequence of these two effects cancelling each other out. Multidimensional poverty in less affluent countries involves a higher proportion of basic deprivation. However, the impact of such deprivation is greater in countries with higher income levels. The outcome is that H^0 has a uniform effect on economic stress across countries.[5]

[4] Adding the Gini coefficient to the analysis produces no significant increase in explanatory power.
[5] Adding the interaction terms reduces the log likelihood estimate by only 28.

TABLE 7 HERE

Conclusions

Multidimensional approaches to measuring poverty and social exclusion have as much relevance in rich as in poorer countries and have received a good deal of attention in each, with a substantial range of methodological approaches being advanced and applied. This paper has applied to European countries the multidimensional poverty measurement approach recently developed by Alkire and Foster (1,2,3,4), characterized by a range of desirable axiomatic properties but mostly discussed so far in a development context. In doing so it has exploited the potential of newly-available harmonized and more comprehensive microdata on different aspects of deprivation for the European Union. Such an analysis requires measures of a range of dimensions exhibiting reasonably satisfactory levels of reliability, with modest variability in those levels across counties; the dimensions we have employed in our analysis have been shown to fulfil these conditions to a much greater extent than was possible with earlier waves of EU-SILC.

Our findings first demonstrate once again that what have been described as union versus intersection approaches produce sharply contrasting results. The union approach leads to rather trivial levels being defined as experiencing multidimensional poverty, certainly in the better-off of the countries covered, while the intersection approach captures a very substantial proportion of the population in every country and the vast majority of the population in the least affluent counties . Application of the Alkire and Foster (1,2,3,4) approach in effect provides a middle ground characterised by a set of desirable axiomatic properties. Central to this approach is a censoring of data that counts deprivations only for those above the relevant threshold: the strength of the correlations between the deprivation dimensions is then substantially greater and the patterning of deprivation substantially more structured than for

their counterparts below the threshold, as one would want in a valid indicator of multidimensional poverty and social exclusion.

In contrast to the conventional relative income poverty approach, the adjusted head count ratio approach identifies a non-trivial minority as poor in each of the countries covered. The size of this group varies in a fairly predictable manner with the country's level of average income per capita. The main source of such variation derives from corresponding variation in the multidimensional head count: while the intensity level is also related to national income, that variation is relatively modest, with those above the multidimensional threshold in every case experiencing a high level of intensity.

A decomposition of multidimensional poverty by dimension also reveals systematic variation across counties associated with national average income levels. In the less affluent counties basic and consumption deprivation play a more prominent role while in their more affluent counterparts relative income poverty and health are the key factors.

The overall level of multidimensional poverty varies significantly by national income level. In contrast, income inequality as captured by the Gini coefficient has no such impact. It also varies systematically by socio-economic group. In order to understand the distribution of multidimensional poverty it is necessary to take into account the manner in which the latter effects vary by national level of income. The impact of key factors such as social class, education, and age are significantly stronger in low income countries. Thus both the nature of multidimensional poverty and the extent to which it is socially stratified varies by national level of income.

The adjusted head count ratio measure was found to be strongly related to levels of self-reported economic stress, with an additional influence of national average income levels. The ability to account for both within- and between-country variance in multidimensional poverty

is more restricted than it would be for a specific dimension such as the one we have termed basic deprivation.

The advantages and disadvantages of a multidimensional perspective depend on the aims of the analysis, the particular approach adopted and the manner in which it is implemented. Furthermore, as Nolan and Whelan (25) emphasise, the identification of those exposed to multidimensional poverty is primarily intended to help in understanding and addressing the causes of poverty; the framework employed and groups identified can clarify or obscure those causal mechanisms. This is a matter of immediate policy relevance, notably in the European Union where a union approach combining three indicators (relative income poverty, material deprivation and household joblessness) has been adopted to identify those 'at risk of poverty and social exclusion' in setting and monitoring a poverty reduction target for 2020 (see Nolan and Whelan (26). In this context the EU Commission (11) argues that the computation of a single indicator is an effective way of communicating in a political environment, and a necessary tool in order to monitor 27 different national situations. However, the *ad hoc* manner in which the EU poverty target has been framed serves to highlight the advantages of a more structured approach such as the one proposed by Alkire and Foster (1,2,3,4) and investigated here, within which the implications of crucial choices in relation to dimensions, thresholds and weighting can be assessed in a consistent and transparent way, and for which this paper is intended to serve as a base.

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TABLES

Table 1: Censored and Uncensored Correlation Matrices for Deprivation Dimensions: Uncensored Above the Diagonal & Censored Below

	Relative Income Poverty	Basic	Consumption	Health	Neighbourhood	Stress
Relative Income Poverty	*1.000*	0.248	0.222	0.079	0.028	0.284
Basic	0.423	*1.000*	0.395	0.132	0.104	0.515
Consumption	0.325	0.471	*1.000*	0.094	0.084	0.373
Health	0.335	0.378	0.258	*1.000*	0.054	0.133
Neighbourhood	0.225	0.308	0.223	0.378	*1.000*	0.147
Economic Stress	0.327	0.483	0.373	0.255	0.240	*1.000*

Table 2: Multidimensional Poverty by Country EU-SILC 2009						
	(i) Relative Income Poverty	(ii) MD Headcount	(iii) MD Intensity	(iv) MD Adjusted Headcount Ratio	(v) Union	(vi) Intersection
	proportion	proportion (2+)	proportion	proportion		
Luxembourg	.149	.116	.469	.054	.381	.001
Norway	.117	.083	.473	.060	.434	.001
Netherlands	.111	.126	.476	.060	.434	.001
Austria	.120	.165	.503	.083	.465	.004
Denmark	.132	.115	.472	.054	.387	.002
Germany	.155	.201	.530	.107	.489	.006
Belgium	.146	.175	.523	.091	.423	.007
Finland	.138	.139	.476	.066	.409	.002
UK	.173	.212	.493	.105	.544	.002
France	.129	.162	.500	.081	.438	.001
Spain	19.5	.213	.480	.102	.531	.002
Ireland	.150	.192	.498	.096	.455	.002
Italy	.184	.189	.452	.092	.512	.002
Iceland	.150	.067	.484	.030	.310	.000
Cyprus	.162	.166	.472	.078	.438	.001
Greece	.197	.272	.499	.136	.606	.004
Slovenia	.113	.166	.496	.082	.446	.004
Portugal	.179	.330	.517	.171	.617	.005
Czech Republic	.086	.208	.491	.102	.569	.003
Malta	15.1	.186	.473	.088	.522	.001
Slovakia	11.0	.311	.507	.158	.668	.005
Estonia	19.7	.248	.494	.123	.551	.002
Hungary	12.4	.460	.521	.240	.770	.006
Poland	17.1	.310	.507	..157	.637	.005
Lithuania	20.6	.320	.530	.170	.611	.008
Latvia	25.7	.456	.554	.253	.731	.016
Romania	22.4	.592	.529	,313	.821	.006
Bulgaria	21.8	.535	.540	.289	.808	.012

Table 3: Decomposition of the Adjusted Head Count Social Exclusion Ratio by Dimension by Country EU-SILC 2009						
	ARP	Basic	Consumption	Health	Neighbourhood	Total
	%	%	%	%	%	%
Luxembourg	.276	.173	.146	.227	.178	1.0
Norway	.281	.128	.220	.258	.112	1.0
Netherlands	.199	.107	.133	.242	,246	1.0
Austria	.190	.205	.180	.265	.160	1.0
Denmark	.236	.111	.226	.254	.172	1.0
Germany	.215	.228	.193	.228	.136	1.0
Belgium	.224	.186	.181	.228	.177	1,0
Finland	.265	.092	.243	.269	.132	1.0
United Kingdom	.212	.174	.136	.234	.240	1.0
France	.206	.233	.179	.228	.154	1.0
Spain	.238	.154	.216	.237	.156	1.0
Ireland	.203	.154	.243	.217	.182	1.0
Italy	.238	.208	.116	.230	.208	1.0
Iceland	.243	.143	.125	.325	.166	1.0
Cyprus	.257	.197	.153	.278	.116	1.0
Greece	.223	.208	.214	.176	.179	1.0
Slovenia	.173	.247	.156	.262	.162	1.0
Portugal	..161	.286	.211	.226	.116	1.0
Czech Republic	.130	.164	.201	.282	.215	1.0
Malta	.210	.286	.119	.183	.202	1.0
Slovakia	.108	.184	.238	.243	.226	1.0
Estonia	.230	.153	.250	.246	.126	1.0
Hungary	.094	.289	.220	.205	.192	1.0
Poland	.170	.242	.241	.226	.120	1.0
Lithuania	.201	.321	.234	.220	.119	1.0
Latvia	.179	.256	.225	.187	.154	1.0
Romania	.134	.329	.309	.123	.106	1.0
Bulgaria	.144	.347	.240	.120	.150	1.0

Table 4: Adjusted Head Count Ratio by Social Class and Country							
	Higher Professional & Managerial	Lower Professional & Managerial	Intermediate & Lower Supv	Small Employer & Self-employ	Farmers	Lower services & Clerical & technical	Routine & Never Worked
Luxembourg	.007	.019	.038	.073	.027	.100	.106
Norway	.011	.011	.016	.032	.020	.052	.074
Netherlands	.026	.053	.048	.056	.050	.069	.121
Austria	.021	.040	.062	.087	.082	.109	.158
Denmark	.025	..030	.041	.042	.049	.050	.086
Germany	.034	.040	.086	.098	.135	.137	.195
Belgium	.020	.038	.064	.081	.063	.146	.196
Finland	.022	.033	.062	.049	.083	.082	.104
UK	.035	.054	.099	.101	.116	.137	.199
France	.017	.032	.057	.068	.053	.104	.158
Spain	.012	.027	.062	.102	.126	.133	.160
Ireland	.032	.022	.071	.062	.040	.128	.180
Italy	.025	.038	.053	.092	.098	.113	.136
Iceland	.012	.019	.033	.048	.039	.033	.038
Cyprus	.019	.026	.037	.109	.159	.090	.161
Greece	.033	.042	.080	.142	.187	.185	.181
Slovenia	.024	.041	.062	.062	.090	.098	.125
Portugal	.040	.061	.089	.162	.248	.217	,244
Czech Republic	.052	.066	.092	.050	.052	.119	.174
Malta							
Slovakia	.078	.115	.140	.109	.116	.192	.224
Estonia	.054	.088	.107	.056	.094	.135	.190
Hungary	.101	.166	.214	.139	.199	.272	.339
Poland	.045	.076	.123	.078	.185	.192	.224
Lithuania	.075	.107	.123	.077	.141	.201	.229
Latvia	.123	.146	.209	.177	.262	.296	.337
Romania	.073	.155	.182	.328	.434	.319	.356
Bulgaria	.135	.177	.246	.195	.309	.313	.371

Table 5: Mean Adjusted Head Count Social Exclusion Ratio by Age Group by Country EU-SILC 2009				
	<30	30-49	50-64	65+
Luxembourg	.079	.054	.051	.052
Norway	.068	.034	.025	.035
Netherlands	.102	.055	.057	.057
Austria	.113	.070	.090	.091
Denmark	.097	.043	.040	.054
Germany	.154	.088	.114	.119
Belgium	.133	.081	.087	.109
Finland	.078	.041	.061	.116
UK	.111	.081	.083	.070
France	.073	.070	.091	.098
Spain	.085	.089	.102	.132
Ireland	.116	.087	.107	.090
Italy	.079	.073	.082	.119
Iceland	.029	.024	.029	.039
Cyprus	.080	.051	.071	.174
Greece	.127	.110	,125	.193
Slovenia	.042	.060	.115	.143
Portugal	.115	.136	.174	.219
Czech Republic	.108	.090	.109	.119
Malta	.082	.078	.083	.121
Slovakia	.124	.140	.167	.230
Estonia	.080	.088	.135	.233
Hungary	.283	.222	.246	.258
Poland	.118	.124	.176	.219
Lithuania	.121	.142	.197	.259
Latvia	.199	.221	.253	.370
Romania	.253	.289	.323	,345
Bulgaria	.202	.236	.290	.385

Table 6: Multilevel Random Intercept Model for Basic Deprivation: HRP and Macro Predictors				
	(i)	(ii)	(iii)	(iv)
Fixed Effects				
HRP Social Class				
Ref: Professional & Managerial				
Lower Non-Manual		.008***	.008***	.006***
Self-employed		.021***	.021***	.022***
Farmers		.071***	.071***	.058***
Lower Service & technical		.049***	.049***	.045***
Routine/never worked		.067***	.067***	.064***
HRP Education				
Ref; Third level				
Pre-primary		.118***	.118***	.121***
Primary		.069***	.069***	.071***
Lower secondary		.056***	.056***	.060***
Higher secondary		.018***	.018***	.020***
HRP				
Separated/widowed/Divorced		.033***	.033***	.031***
Female		.020***	.020***	.021***
Non-European		.057***	.057***	.054***
Number of children 3+		.057***	.057***	.053***
Market tenant		.067***	.067***	.069***
Other tenant		.071***	.071***	.073***
Lone Parent		.061***	.061***	.062***
HRP Age < 30		-.021***	-.021***	.-.025***
HRP Age 30-49		-.017***	-.017***	-.016***
HRP Age 50-64		.001 ns	.001 ns	.003*
Macro Variables				
Log GNDH (deviation from mean)			-.152***	-.875***
Gini coefficient (deviation from mean)			.022 ns	.023 ns
Interactions				
<30*Log GNDH				.096***
<30-49*Log GNDH				.021***
<50-64*Log GNDH				.003 ns
Farmers*GNDH				-.064***
Lower Service & technical*GNDH				-.050***
Routine*GNDH				-.064***
Pre-primary*GNDH				
Primary*GNDH*				-.040***
Lower secondary*GNDH				-.098***
Higher secondary*GNDH				-.111***
Intercept	.118	.024	.019	.016
Random Effects				
Variance				
Country	;005	.005	.039	.039
Individual	.044	.039	.002	.002

Intra Class Correlation Coefficient	.108	.117	.042	.038
Reduction in country variance		.019	.679	.710
Reduction in household variance		.106	.106	.117
Reduction in total variance		.092	.168	.182
Deviance	-59,781	-82,315	-82,335	-84,939
N	199,354	199,354	199,354	199,354
Degrees of freedom		19	21	31
*p < .05 ** p < .01, *** p < .001				

Table 7: Multilevel Regression of Adjusted Head Count Ratio and Log GNDH on Subjective Economic Stress

	(i)	(ii)	(iii)
H^0		.646***	.648***
Log GNDH			-.121***
Intercept		.258	.184
Random Effects			
Variance			
Country			
Individual			
Intra Class Correlation Coefficient	.125	.086	.061
Reduction in country variance		.490	.650
Reduction in household variance		.224	.224
Reduction in total variance		.253	.268
Deviance	72,757	17,749	17,743
N	211,560	211,560	211,560
Degrees of freedom		1	2
*p < .05 ** p < .01, *** p < .001			