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Item 3: Measurement challenges in consumption and income poverty

Using statistical matching to facilitate the comparison of poverty estimates using income, consumption and wealth

Prepared by the Office for National Statistics (ONS, United Kingdom) [1]

1. Introduction

Across the European Union, many evidence-based policy initiatives aimed at improving living standards tend to measure poverty relatively within the society, using income as a yardstick. However, there is an argument that income isn't sufficient as a sole measure of poverty, particularly if poverty is seen in terms of achieved standards of living[2].

Ultimately, a household satisfies its wants through the consumption of goods and services over time. Because of this, consumption is arguably a more important determinant of economic well-being than income alone. Indeed, Brewer and O'Dea (2012) and others (see Noll, 2007, for a review) argue that it is preferable to consider the distribution of consumption rather than income on both theoretical and pragmatic grounds.

On a theoretical ground, income can be subject to fluctuations, due to such events as short-term unemployment. However, these fluctuations in income are not likely to be matched by corresponding downturns in living standards, as households are typically able to smooth consumption by drawing on savings or help from family members. This finding leads to Friedman's 'permanent income hypothesis', which suggests that decisions made by consumers are based on long-term income expectations rather than their current income. This view is supported in a number of studies (e.g. Lewis, Snape & Tonkin, 2014) which find stronger relationships between consumption and subjective well-being than between income and such measures.

Beyond these conceptual arguments, there is also the practical consideration that evidence from a range of countries suggests a general tendency for income to be under-reported by households with low levels of resources, whilst reporting of expenditure by this group is relatively accurate (e.g. Meyer & Sullivan, 2011 and Brewer & O'Dea, 2012), though other evidence suggests that expenditure of higher income households may be under-reported (Sabelhaus, et al., 2011).

In economic and social research, data on household expenditures are typically used as a proxy for consumption. These data are often collected through the use of diary studies. However, it should be

[1] Richard Tonkin, Paola Serafino & Ruth E Davies

[2] As well as considering poverty in terms of an individual's standard of living, other approaches are possible, such as considering poverty in terms of a right to a minimum level of resources (see Atkinson et al. (2002) for a discussion).

noted that expenditure is an imperfect measure of consumption as the amount spent by a household in a given month may differ from consumption, due to households making use of goods purchased previously or the purchase of consumer durables. In addition, consumption also includes inter-household in-kind transfers of gifts and services and social transfers in kind. However, these aspects of consumption are generally excluded from data due to the challenges of collecting this type of information. A further potential limitation of using solely consumption based measures of poverty are that, depending on the thresholds used, low levels of consumption may in part reflect individual choices.

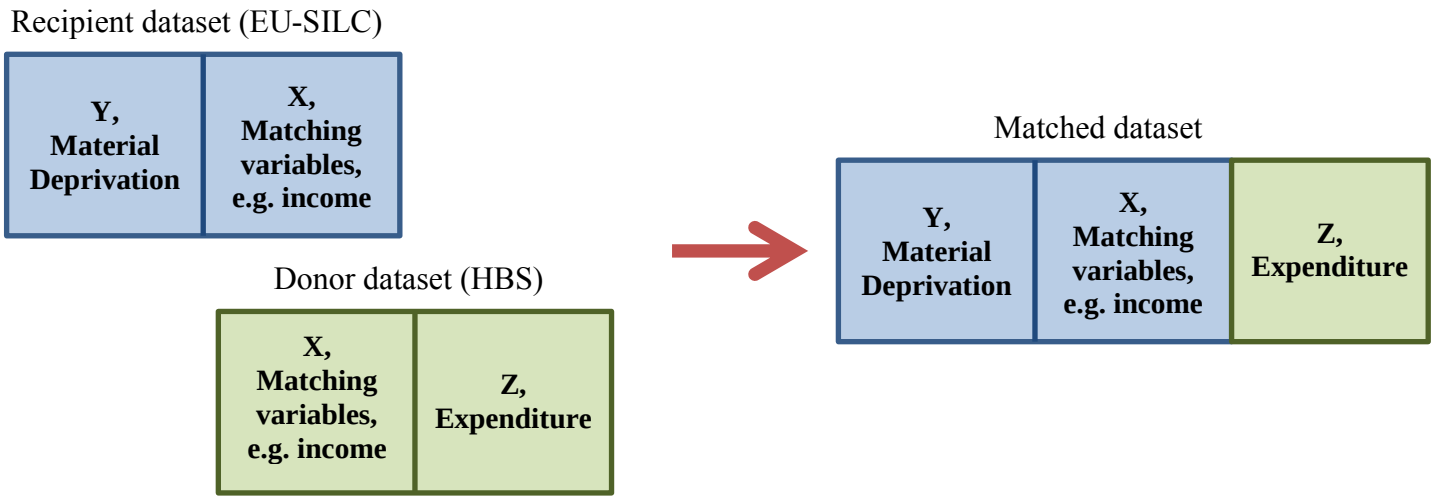
As well as income and consumption, it is helpful to also consider the third primary component of economic well-being: wealth. Compared with income, wealth, a stock measure, is more stable over time, reflecting accumulated saving and investments, although it can drop dramatically in the case of crashes in investment or housing markets. Households can use wealth to consume more than their income, or they may consume less than their income, and thus save. Wealth allows individuals to smooth consumption over time and to protect them from unexpected changes to income. Households that are "asset rich and income poor" can be expected to have a higher material standard of living than would be indicated by their income alone. While some wealth is held in assets that are not easily converted into money, its existence may allow people to borrow to finance expenditures, e.g. for house extensions, motor vehicle purchases, and so on

Overall the evidence indicates that while income can be a good proxy for material living standards, it is better when supplemented with a wider range of measures. This is consistent with the recommendations of the Report by the Commission on the Measurement of Economic Performance and Social Progress (Stiglitz, Sen, and Fitoussi, 2009) as well as the OECD Framework for Statistics on the Distribution of Household Income, Consumption and Wealth (2013).

This paper summarises work carried out by ONS as part of various projects to compare people's exposure to poverty in a range of countries using three different measures: income, expenditure and material deprivation, as well as also look at income and wealth together. As, across the countries studied, there are currently no data sources which provides joint information on all of these variables for households or individuals, statistical matching techniques were used in order to produce synthetic datasets containing the necessary variables. These methods are described in section 2, below.

2. Statistical Matching

Statistical (or synthetic) matching is a broad term used to describe the fusing of two datasets. In this context, the datasets are of households sampled from the same population. The usual approach is to define one data set as the recipient and the other as the donor. For example, in the case of the work ONS has carried out on the joint analysis of income, consumption and material deprivation based measures, EU-SILC was treated as the recipient and the Household Budget Survey (HBS) as the donor. The recipient data contains a variable Y, in this case material deprivation, which is not found in the donor, while variable Z, expenditure, is only contained within the donor. The aim is to use information contained within the set of variables common to both datasets, X, to link records from the donor to the recipient. Therefore, expenditure is linked to EU-SILC, which contains information on income, material deprivation and work intensity.



2.1 Data preparation

Before carrying out statistical matching it is necessary to ensure that the key concepts are defined in a comparable way in the donor and recipient. In this case of the statistical matching of EU-SILC with consumption and wealth data, these concepts included the definitions of household, household reference person, population and income reference period.

In addition, the variables common to both datasets needed to be harmonized across the two sources in order to be used for the matching. This involved recoding of variables to the stage where they have the same degree of detail.

2.2 Variable selection

The variables selected for matching must fulfil two criteria. First, there must be similarity in the distributions of the variables across the two surveys. Second, the variables must be significant in explaining variations in the target variables: expenditure, wealth and material deprivation.

The literature highlights two main methods for calculating the degree to which distributions of variables are similar across data sets. The first is a simple comparison of the weighted frequency distributions of the derived variables in the two datasets. The second is to use a measure such as the Hellinger Distance (HD). The HD is convenient because it provides a single number as a measure for the similarity in distribution of two variables. There is no fixed rule regarding what degree of similarity is suitable for statistical matching purposes, though it is generally suggested (see e.g. Leulescu & Agafitei, 2013; Webber & Tonkin, 2013) that a HD of over 5% should raise concerns about the similarities in distributions. The equation used to derive the HD is:

$$HD\left(V,V'\right) = \sqrt{\frac{1}{2}\sum_{i=1}^{K}\left(\sqrt{\frac{n_{Oi}}{N_O}} - \sqrt{\frac{n_{Pi}}{N_P}}\right)^2}$$

Variable V is in the donor data set, V' in the recipient, K is the total number of cells in the contingency table, n_{Oi} is the frequency of cell i in the original data O, n_{Pi} is the frequency of cell i in the recipient and N is the total size of the specific sources.

In the work presented in this paper, where the HD was found to exceed approximately 5% for the potential matching variables, various options were explored. Two outcomes could be coded to a

single one to overcome large discrepancies in the original proportions of the outcomes. This can reduce the HD thereby ensuring that it is suitable as a potential matching variable. However, by limiting the possible outcome responses in the variable reduces its variation, thereby making it potentially less likely to be useful in explaining variations in material deprivation or expenditure.

Consideration was also given to recoding outcomes with a high divergence as missing observations to be excluded from the analysis. Although this can reduce the HD to an acceptable level, it can remove an unacceptable number of observations.

Having explored the potential recoding options described, where the HD remained in excess of 5%, the variables were generally dropped. However, where visual inspection of the weighted frequencies indicated a high level of similarity, variables with an HD marginally in excess of 5% were retained.

As well as there being similarity in the distributions of the variables across the sources, potential matching variables must also be statistically significant predictors of the analytical variables of interest. Regression models were therefore used to identify the final set of matching variables.

2.3 Matching methods

Three different matching methods were used in this analysis, covering the three broad categories of approaches typically used in statistical matching:

- Non-parametric methods
- Parametric methods
- Mixed methods

The hotdeck method is a non-parametric approach. The procedure finds records in the donor file and matches them with records in the recipient file, based on a distance function. This results in actual observed values, for expenditure in this case, being imputed onto EU-SILC. A disadvantage of this procedure, and especially relevant in the work to match expenditure data from HBS onto EU-SILC, is that the multiple usage of donors is necessary as the donor dataset was smaller than the recipient in many of the countries studied. This can increase the risk that the distribution of the imputed variable does not reflect the original one.

The second (parametric) approach involves imputing predicted values obtained from a regression model. The reliability of this method is very much dependent on the accuracy of the model. In addition, regression towards the mean can be a potential problem with this approach.

Mixed methods, as the name implies, involves a combination of parametric and non-parametric techniques. A model is first fitted to the data to estimate an intermediate value of the variable to be matched. Then a distance function is used to locate a range of possible observations from the donor set which most closely resembles the intermediate value, with a value for imputation selected from that set. In the method used, this process was performed multiple times, producing multiple imputed datasets. This builds in some allowance for uncertainty in the model. Analysis was carried out on each imputed dataset, before the results were averaged across the imputed datasets to produce one overall set of estimates.

Underlying all three of these matching techniques is the Conditional Independence Assumption (CIA). This assumes that two random variables are independent conditional on a third variable. Letting $X = (x_1, x_2 \dots x_i)$ be the set of all variables common to both the donor and recipient datasets, $Y = (y_1, y_2 \dots y_i)$ be the set of variables present in the donor dataset and Z= $(z_1, z_2 \dots z_i)$ be the set of variables present in the recipient dataset, then if the CIA holds, the measure of association between Y and Z given X is assumed to be 0. In this analysis this amounts to no association between material deprivation and expenditure or wealth variables given knowledge of the common demographic and income variables. Much discussion has surrounded the practical application and verification of this assumption in the matching process (Rässler, 2002), and although the CIA cannot be directly verified from the datasets, it has been established that use of auxiliary variables with high predictive power, in this case income, can go some way to relaxing the CIA (e.g. D'Orazio et al., 2006).

3. Results of statistical matching of EU-SILC and HBS

Matched datasets for Belgium, Germany, Spain, Austria, Finland and the United Kingdom[3] were produced and used for the joint analysis of income and expenditure based poverty and other measures of disadvantage, including material deprivation.

Testing the validity of matching procedures involves comparing the distributions of the matched variables against observed expenditure in the HBS. This was done in three ways:

. By comparing mean expenditure by equivalised expenditure decile to analyse the consistency of the overall expenditure distribution for each method.

. By comparing the consistency of mean expenditure by variables used in the statistical matching for observed and imputed expenditure.

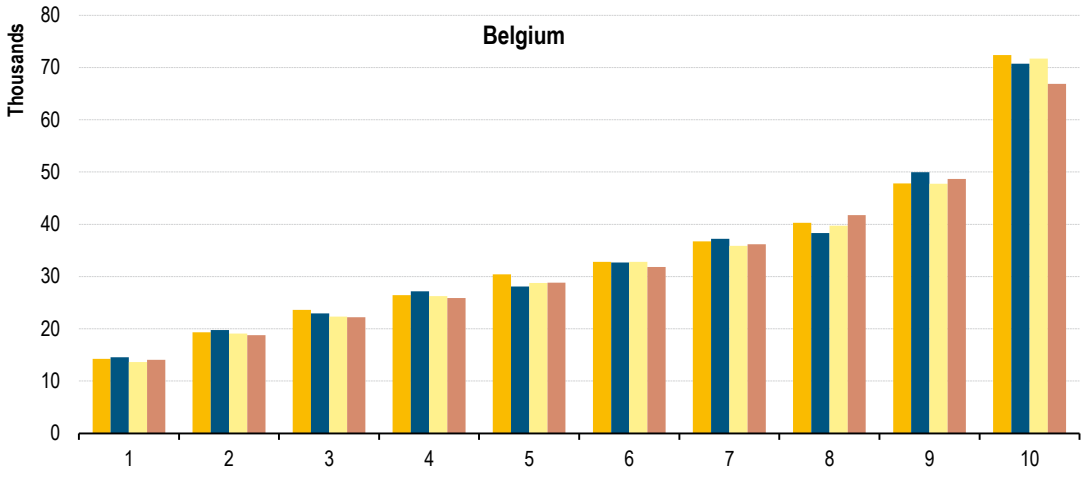
. By comparing the relationship between expenditure and variables in both datasets but not included in the model.

For brevity, the following section provides results of some of the main comparisons that were carried out, for all countries studied. Further details of the comparisons not reported here due to space constraints are available on request.

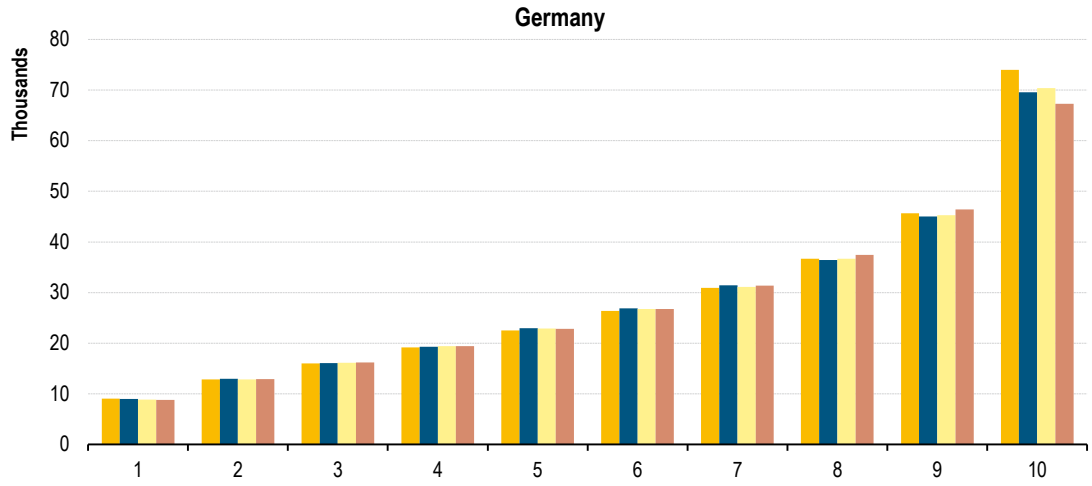
Looking at the performance of the different matching methods across the expenditure distribution (Figure 1), all three methods appear to be relatively effective in replicating mean expenditure by expenditure deciles. No single method was consistently better across the entire expenditure range for any of the countries in the analysis.

The largest divergence between the values observed and those imputed onto EU-SILC through statistical matching was in the top expenditure decile. However, there is no clear pattern in these differences, with the mean expenditure for the top decile from the statistical matching generally lower than in the HBS in Belgium, Germany and the UK, but higher in Spain and Finland.

Figure 1: Mean expenditure by equivalised household expenditure decile for HBS and different matching methods, € per annum



[3] The selection of countries was constrained by both restrictions on access to HBS microdata and the suitability of the two data sources for statistical matching.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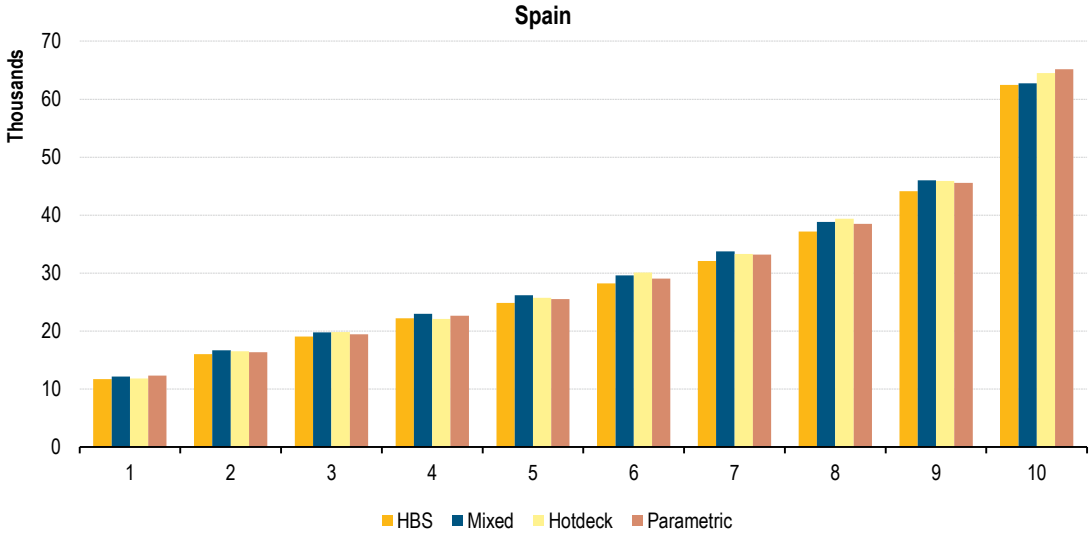
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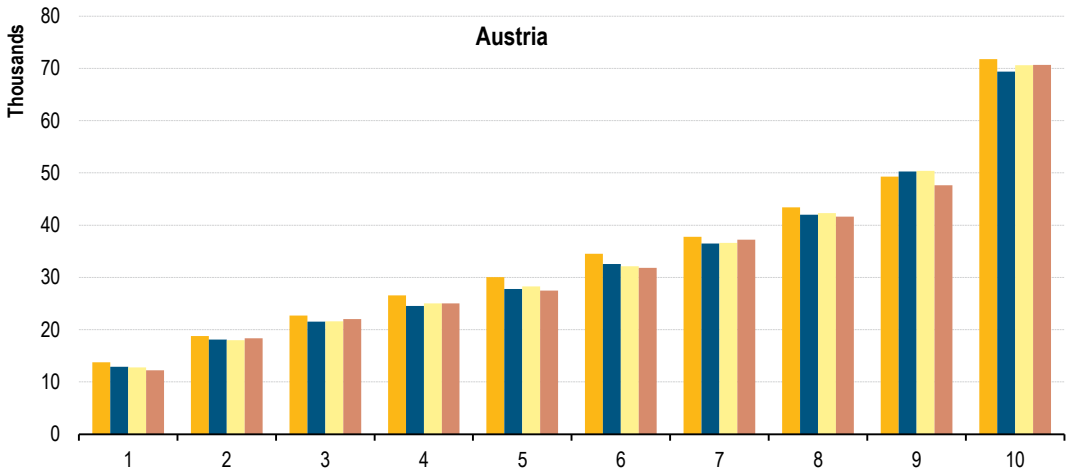
Hotdeck
Parametric


Austria
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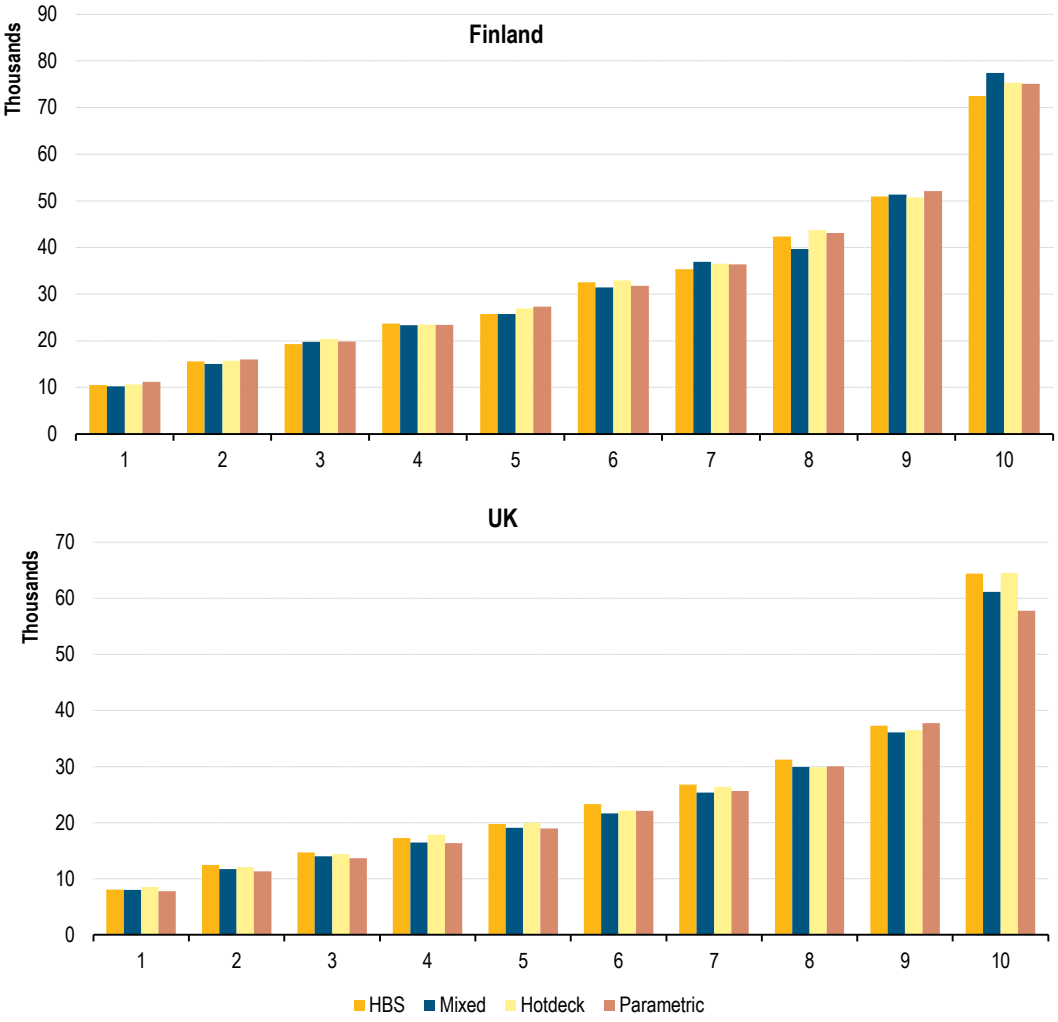
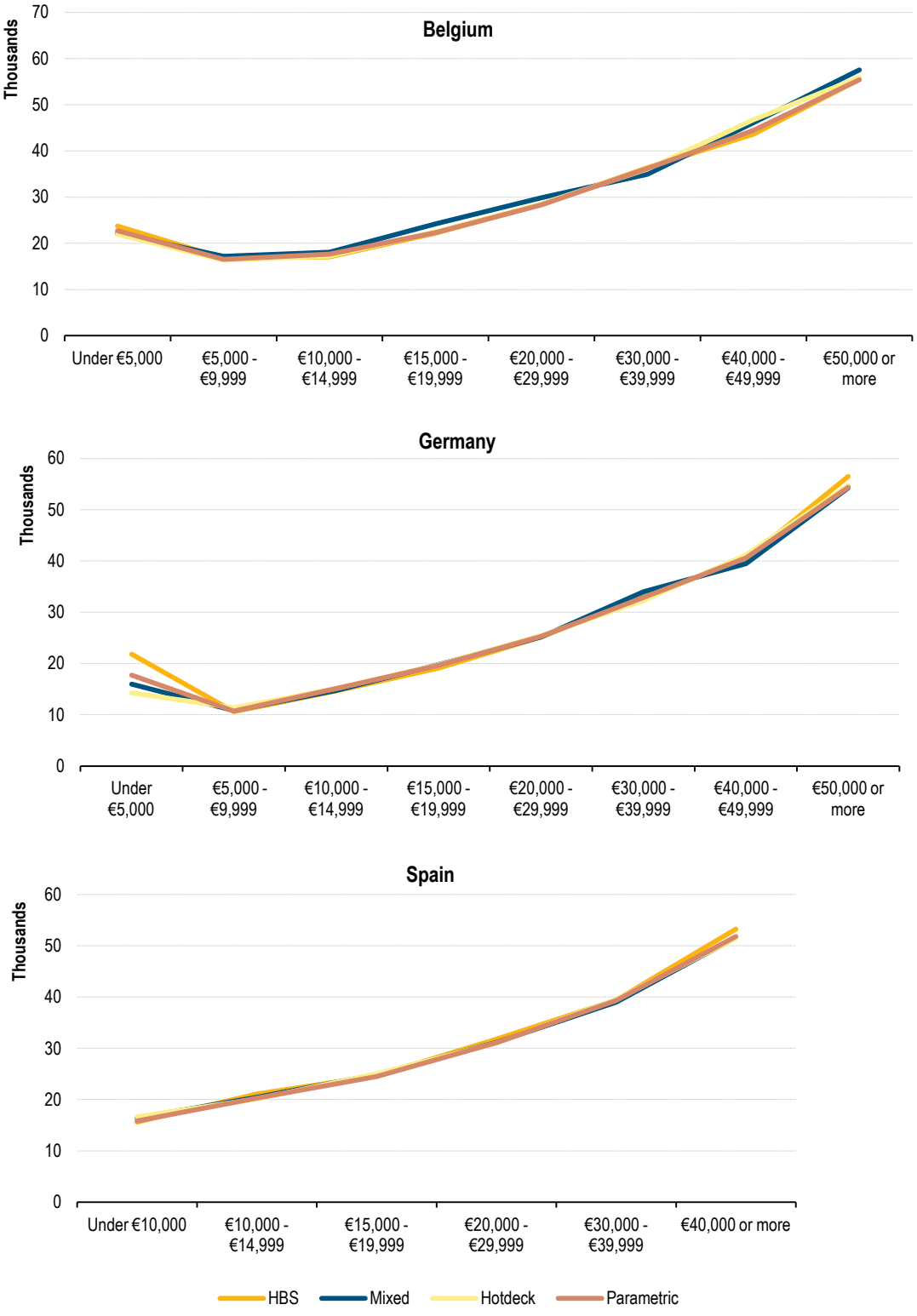
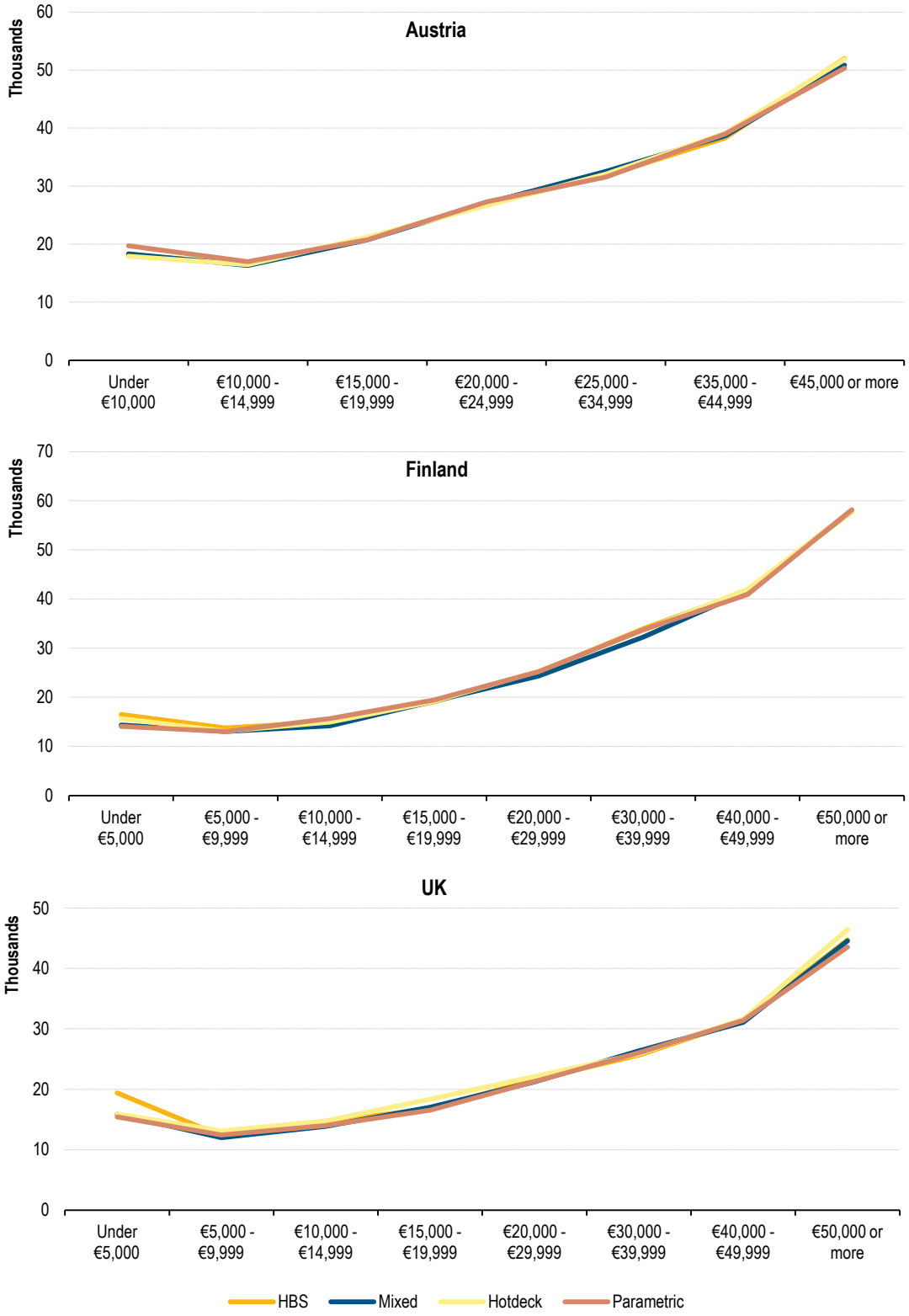


Source: EU-SILC 2009 (Austria), 2010 and 2012 (Finland): EU-SILC Users' database; HBS 2010: Eurostat/ONS.

Figure 2: Mean total household expenditure by income band for HBS and matching methods, € per annum





Source: EU-SILC 2009 (Austria), 2010 and 2012 (Finland): EU-SILC Users' database; HBS 2010: Eurostat/ONS.

Figure 2 shows the distribution of actual total household expenditure in the HBS and expenditure

derived from the matching methods across the income distribution.

All three methods appear to perform well in general. With the exception of Spain, for all the countries in the analysis, at the low end of the income distribution we see the typical expenditure 'tick'– higher average expenditure for the bottom income group than households in the second income group. The extent to which this is evident varies across the countries. For Finland, the 'tick' is almost negligible, while for Germany and the UK, it is quite considerable, though for these countries, all three matching methods under-estimate its extent. Across all the countries examined, none of the methods appears consistently better than the others at matching across the income distribution.

4. Comparing income and expenditure poverty and material deprivation[4]

For the purpose of this analysis, income poverty is defined as having an equivalised household income below 60% of the national equivalised median income. This is in line with the definition used in the At Risk of Poverty or Social Exclusion (AROPE) indicator which is used to monitor progress towards the Europe 2020 headline target. The main expenditure poverty measure used is defined in comparable terms: equivalised household expenditure less than 60% of the equivalised median.

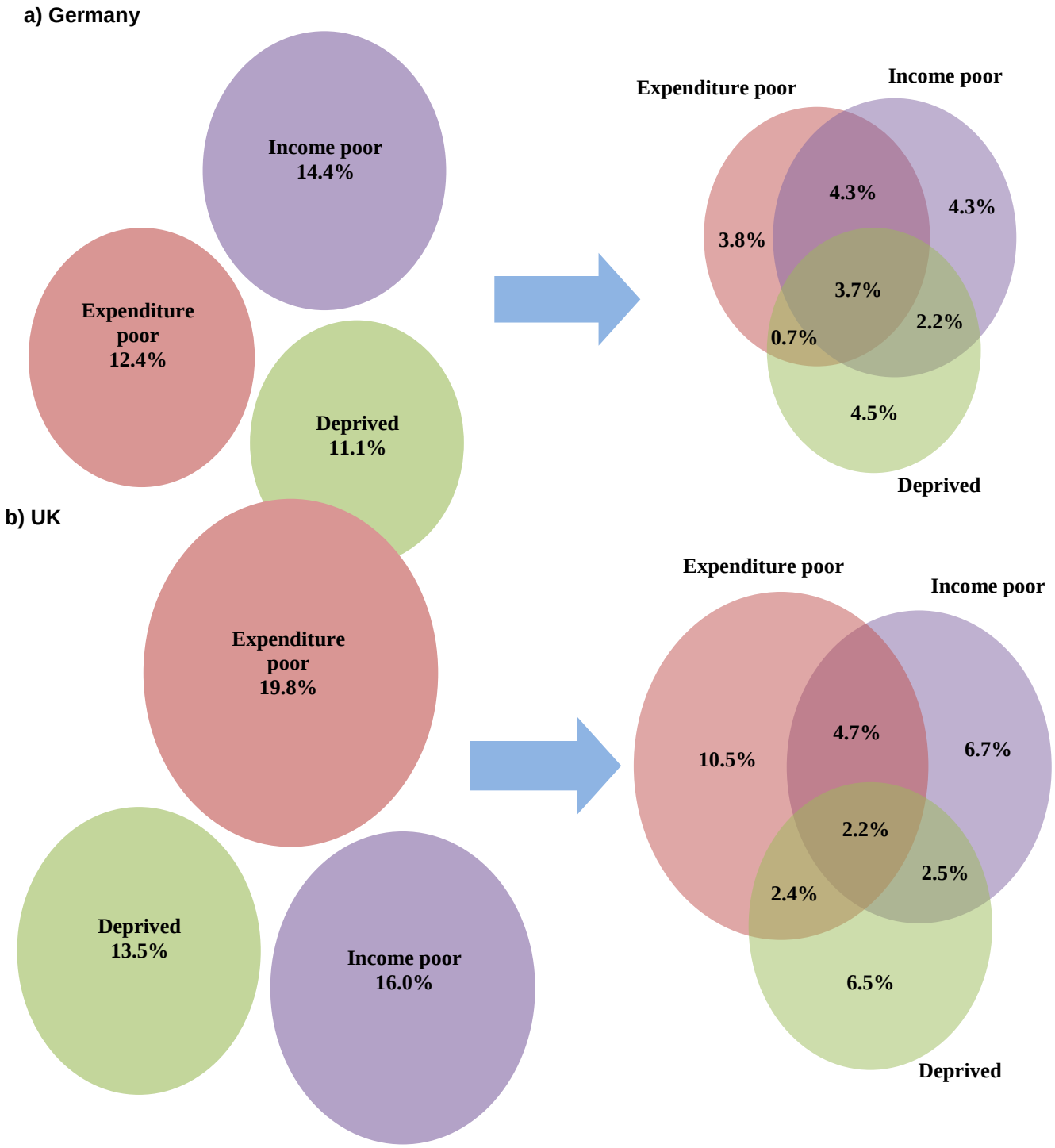
Individuals were classed as being materially deprived if they had an enforced lack of at least three out of a list of nine material deprivation items[5].

Figure 3 shows the percentage of the population experiencing poverty on one or more of the measures and the overlap between them. This figure shows that the degree of overlap between the three measures varies across the countries examined, with the difference between the UK and Germany particularly prominent. In the UK, 35% of people experienced poverty on at least one of the three measures, while 12% were in poverty on two or more of the measures and just over 2% were in poverty on all three. In Germany, the degree of overlap between the measures was higher: despite the proportion of people in poverty on at least one of the three measures being lower, at 24%, a similar proportion were in poverty on two or more of the measures (11%) and almost double the proportion were in poverty on all three (almost 4%).

[4] More detailed analysis of these data is contained in Serafino & Tonkin (2016), to be published later this year.

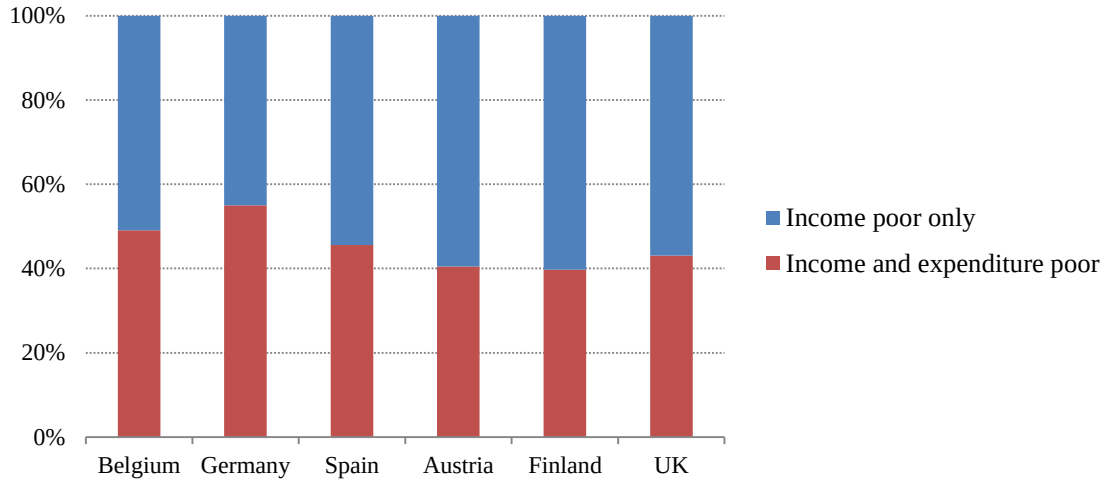
[5] Currently these 9 items are: Arrears on mortgage or rent payments, utility bills, hire purchase instalments or other loan payments; capacity to afford paying for one week's annual holiday away from home; capacity to afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day; capacity to face unexpected financial expenses; household cannot afford a telephone (including mobile phone); household cannot afford a colour TV; household cannot afford a washing machine; household cannot afford a car; ability of household to pay for keeping its home adequately warm.

Figure 3: Breakdown of population by poverty status, (% population)



Looking more closely at the degree of overlap between income and expenditure poverty, Figure 4, shows again how this varies across the countries examined. In Finland and Austria, only around 40% of those in income poverty are also expenditure poor, whereas the overlap between the two measures is slightly higher in the UK (43%), Spain (46%) and Belgium (49%), and higher still in Germany (55%).

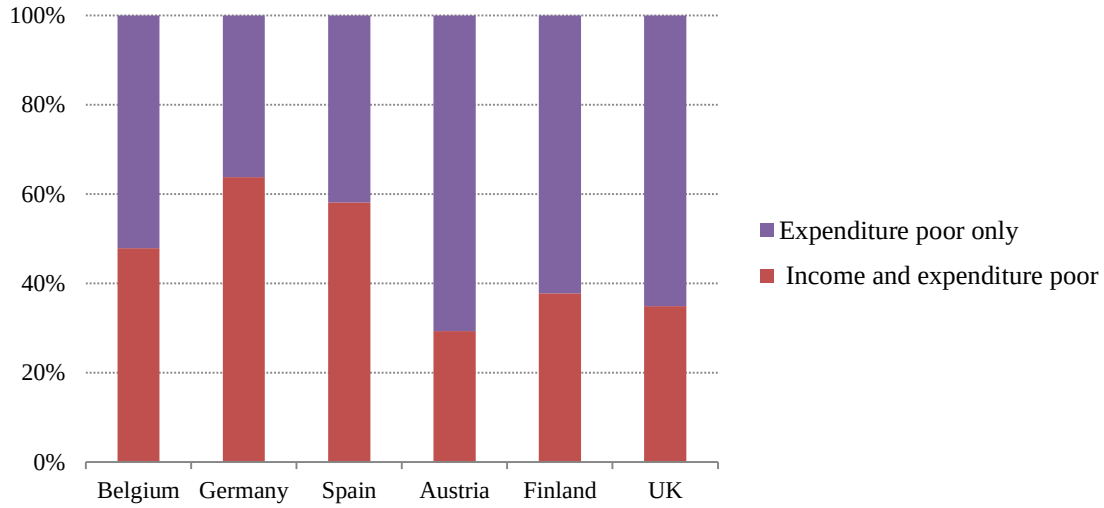
Figure 4: Percentage of income poor individuals experiencing expenditure poverty, 2010 (%)



Source: EU-SILC 2009 (Austria), 2010 and 2012 (Finland): EU-SILC Users' database; HBS 2010: Eurostat/ONS.

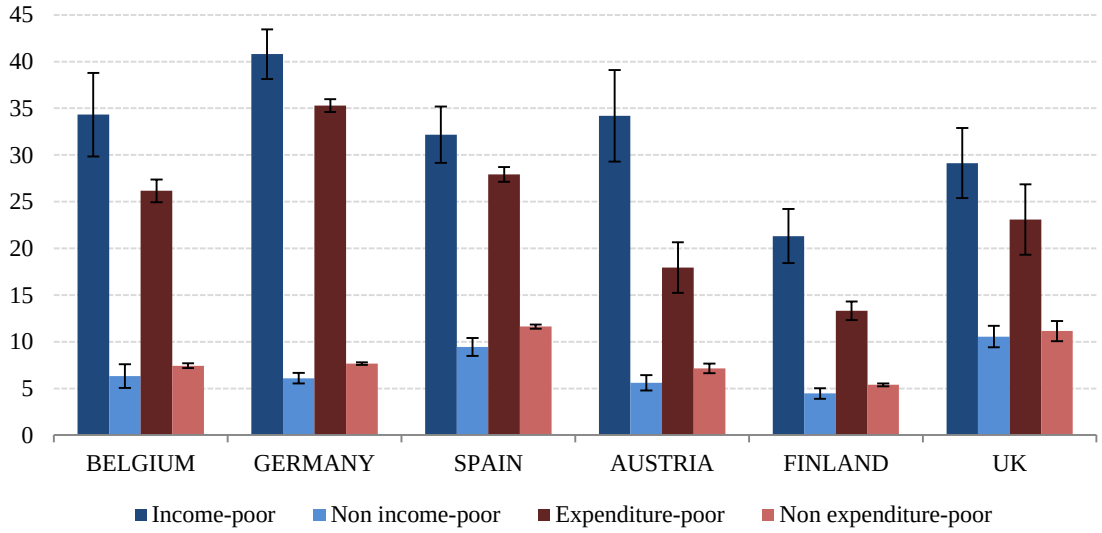
A very similar pattern across countries is observed when looking at the proportion of expenditure poor individuals who were also income poor (Figure 5). The lowest levels of overlap are evident in Austria where only 29% of expenditure poor individuals are also income poor, with slightly higher levels for the UK (35%) and Finland (38%). The highest levels of overlap are evident for Belgium (48%), Spain (58%) and Germany, where 64% of those who are expenditure poor are also income poor.

Figure 5: Percentage of expenditure poor individuals experiencing income poverty, 2010 (%)



Source: EU-SILC 2009 (Austria), 2010 and 2012 (Finland): EU-SILC Users' database; HBS 2010: Eurostat/ONS.

Figure 6: Material deprivation by poverty status, 2010 (%)



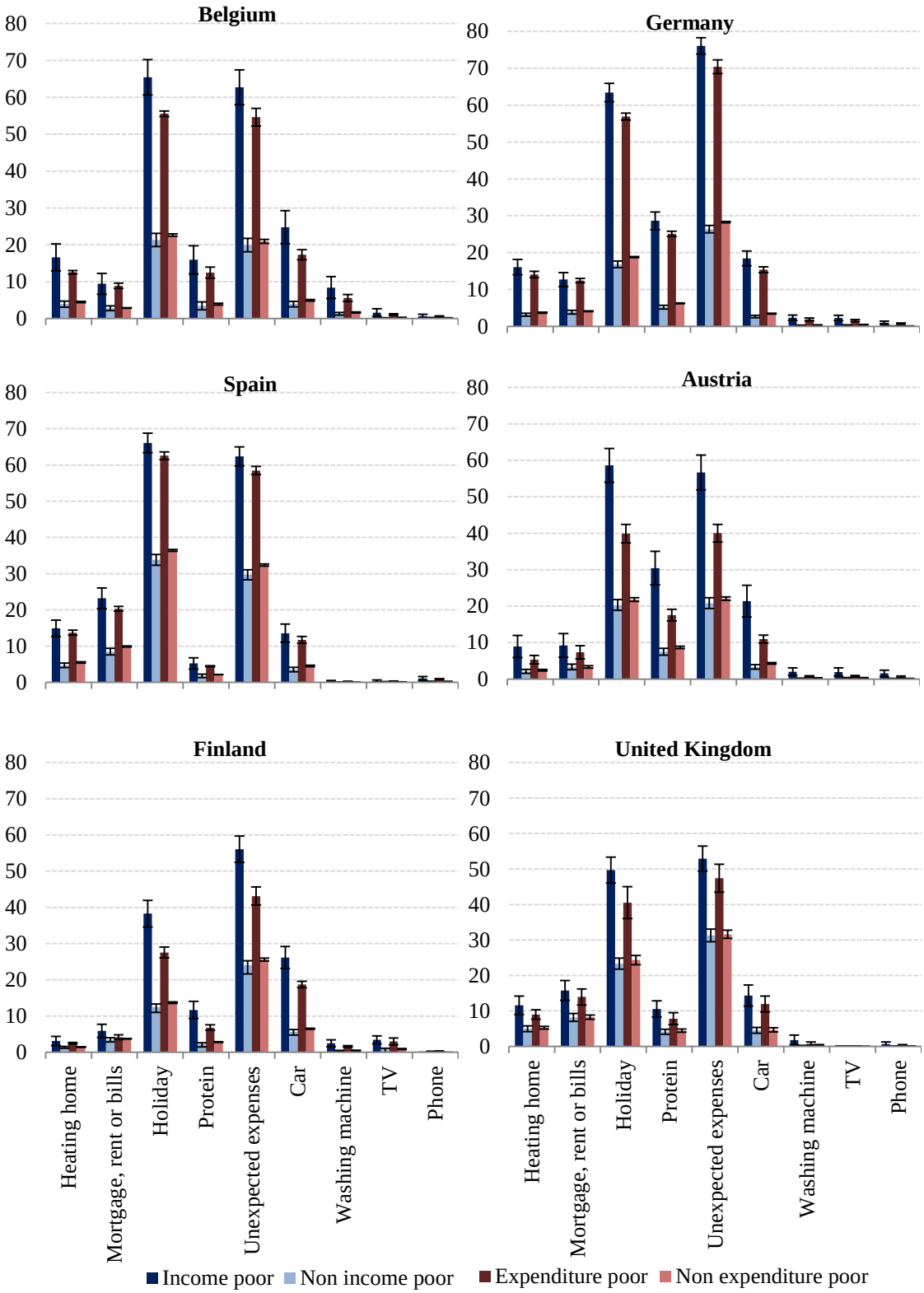
Source: EU-SILC 2009 (Austria), 2010 and 2012 (Finland): EU-SILC Users' database; HBS 2010: Eurostat/ONS.

If expenditure does provide a better measure of material living standards than income, it might be expected that the relationship between expenditure poverty and measures such as material deprivation would be stronger than that between income poverty and such measures. To begin to examine this point, Figure 6 shows for each poverty measure, the percentage of people in poverty and not in poverty who are experiencing material deprivation.

For all countries studied, there appears to be a stronger relationship between income poverty and material deprivation than expenditure poverty and material deprivation, though to varying degrees. For Austria, the relationship between income poverty and deprivation would appear to be much stronger than the relationship between expenditure poverty and deprivation. This also seems to be the case for Finland, though to a lesser degree. In contrast, for Germany and Spain, the relationship between expenditure poverty and deprivation is almost as strong as that between income poverty and deprivation. However, in both countries the material deprivation rate is still slightly higher for those who are income poor than for those who are expenditure poor.

Figure 7 shows the percentage of those with different experiences of poverty that are unable to afford each of the individual items that are used to measure deprivation across the EU. The patterns seen in this figure are similar to those seen for material deprivation as a whole (Figure 13.6). As with material deprivation overall, across all the key items, there is a stronger relationship between inability to afford most of the items and income poverty than there is with expenditure poverty. Similarly, there appears to be a stronger relationship between expenditure poverty and inability to afford these items in Germany and Spain than in some of the other countries, particularly Austria and Finland.

Figure 7: Population unable to afford key deprivation items by poverty status, 2010 (% population)



Source: EU-SILC 2009 (Austria), 2010 and 2012 (Finland): EU-SILC Users' database; HBS 2010: Eurostat/ONS.

5. Statistical matching of EU-SILC and the Wealth and Assets survey

Since 2006, ONS has collected detailed information on household wealth through the Wealth and Assets survey (WAS), a longitudinal survey with an achieved sample of approximately 20,000 households in Great Britain in each wave. While WAS contains some income variables, the income data is less detailed than in EU-SILC and it is not possible to produce a measure of disposable income directly from the survey. Recent work within ONS has therefore explored the potential for the statistical matching of that data with EU-SILC, in order to look at asset poverty alongside income based measures.

The constituent parts which make up total household wealth in WAS are:

- Net property wealth – value of a household's main residence plus any other property such as second or holiday homes, buy-to lets and land. The value of any mortgages are also considered to estimate *net* property wealth.
- Net financial wealth – money saved in both formal and informal financial assets, such as current accounts, savings accounts, ISAs, stocks and shares, money kept at home. Subtracted from these are financial liabilities such as credit card debt, arrears on household bills, student loans etc.
- Physical wealth – the value of a household's contents, possessions and valuables kept in any of their residences as well as vehicles.
- Private pension wealth – the value in all pensions that are not state related. This includes occupational and personal pensions as well as retained rights in private pensions and pensions in payment.

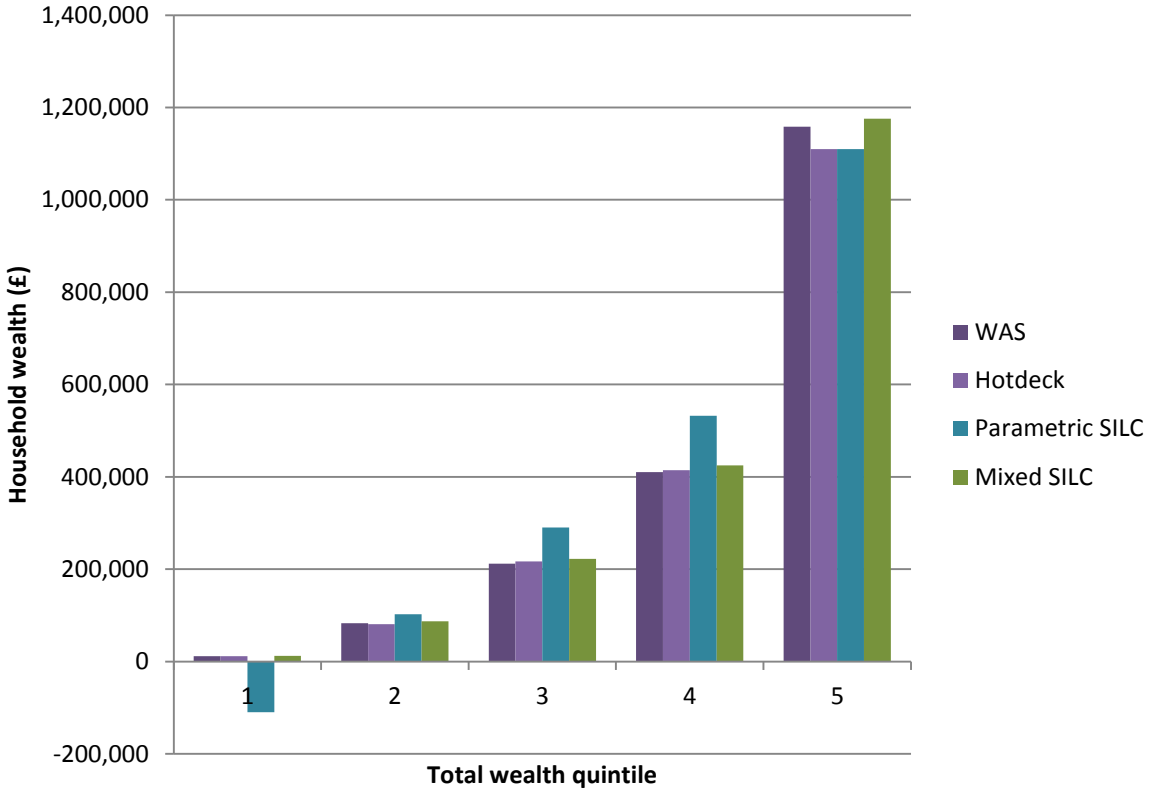
If an individual or household is to mitigate against the potential detrimental effects of a short-term drop in income, then 'liquid' wealth components will be the most important indicator of success. Having substantial pension wealth will not help with current financial strain, and even liquidating property wealth will have a time lag and upheaval for a household. For this reason, as well as matching total (net) wealth onto EU-SILC, the matching was also repeated for financial wealth.

Assessment of the validity of the matching process was carried out in a similar way to that described in Section 3, above. Specifically, assessment was made of how well maintained the:

1. correlation structure was between the income and wealth distributions by using phi coefficients
2. joint distribution of wealth and matching variables was by Hellinger Distances
3. distribution of wealth through matching variables was by mean wealth by age and household type
4. distribution of wealth was by mean wealth of the wealth deciles

Again, for reasons of brevity, this paper does show the full range of assessments carried out, but further details are available on request.

Figure 8: Mean total wealth by wealth quintile for WAS and different matching methods, 2011

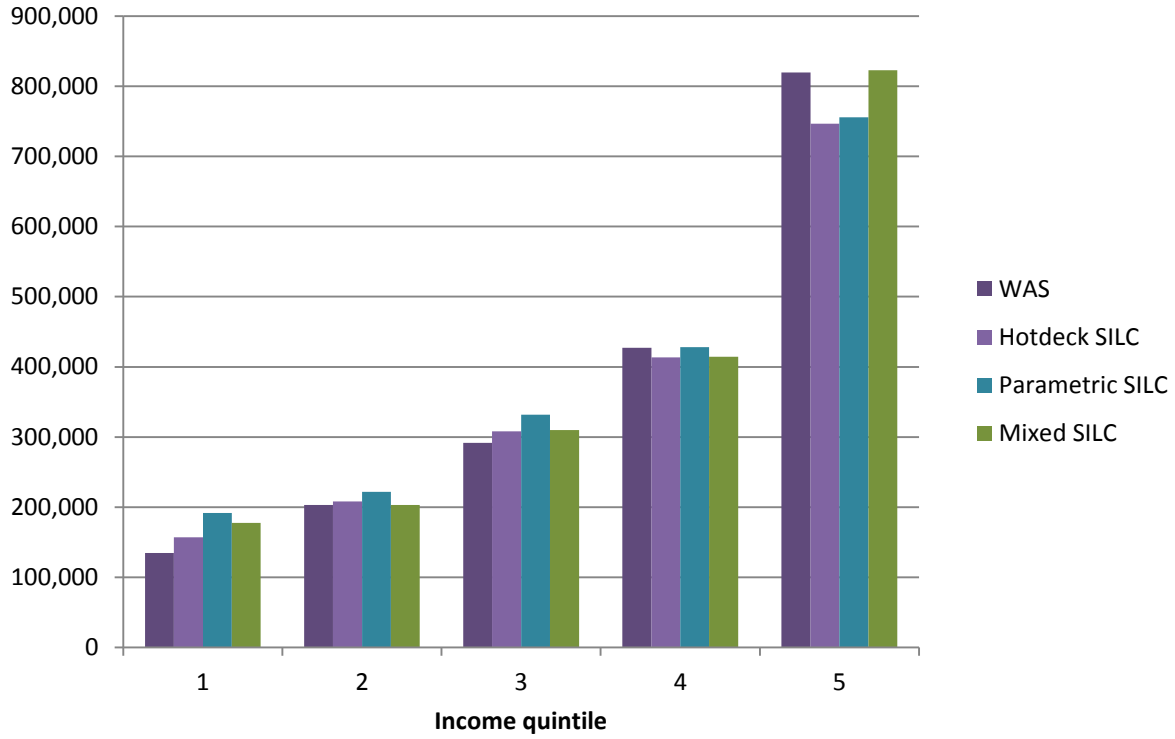


Source: Wealth and Assets survey (Wave 3 2011 cases only): ONS; EU-SILC 2011: Eurostat/ONS.

Figure 8 provides an indication of how well the matching methods maintain the wealth distribution present in the original data in WAS. Mixed and hotdeck methods appear to be broadly similar in performance, though the mixed method is most effective at maintaining the right tail of the distribution. The parametric method is the poorest performing, particularly with the discrepancy in the first quintile.

Figure 9 provides an indication of how successful the different in replicating the joint distribution of income and wealth. This shows the mixed and hotdeck methods are very similar in all but the top income quintile. As previously stated, this work is aimed at income and asset poverty alongside other measures such as material deprivation, so effective estimation in the lower quintiles is generally more important than the higher quintiles for these purposes. There appears to be an over-estimation of wealth in the bottom income quintile and underestimation in the upper quintiles for all methods.

Figure 9: Mean total wealth by income quintile for WAS and matching methods, 2011

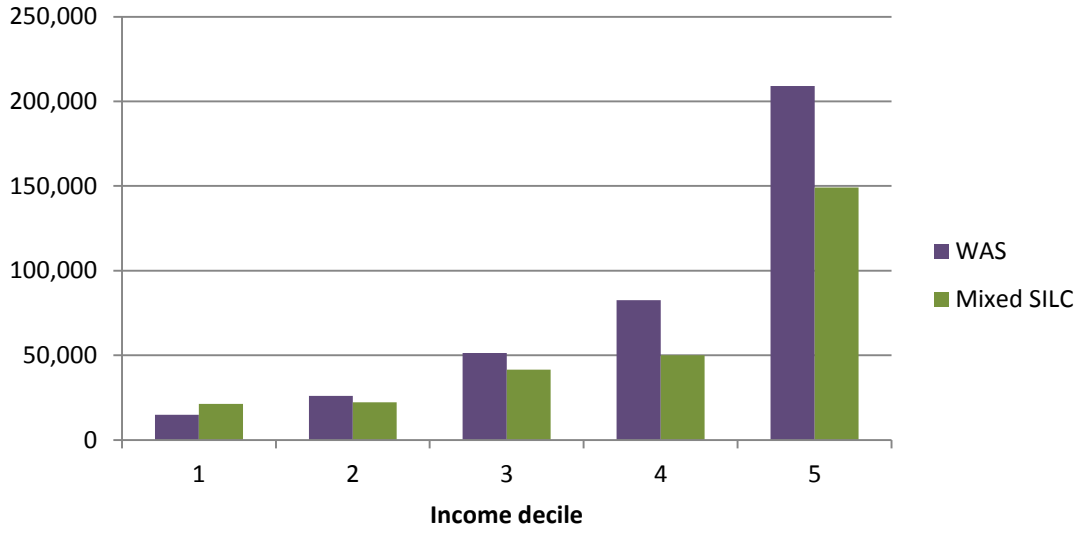


Source: Wealth and Assets survey (Wave 3 2011 cases only): ONS; EU-SILC 2011: Eurostat/ONS.

As highlighted above, the statistical matching was also carried out using financial wealth instead of total wealth as the variable to be matched onto EU-SILC. Prior to matching, it was identified that the relationship between financial wealth and the potential matching variables was weaker than that for (R^2 between 0.61 and 0.70 for total wealth compared with 0.20 and 0.26 for financial wealth, dependent on variables used).

This is reflected to some extent in Figure 10, which shows that for upper income quintiles, the matched dataset is relatively unsuccessful at replicating the joint distribution of financial wealth and income. However, towards the bottom of the income distribution, which is more important when the focus is on asset based poverty measures, the statistical matching is relatively successful. Furthermore, inspection of Phi coefficients shows that the correlation structure is maintained between wealth quintiles and financial wealth quintiles as well as income quintiles and financial wealth quintiles (Table 1).

Figure 10: Mean total wealth by income quintile for WAS and matched data (mixed), 2011



Source: Wealth and Assets survey (Wave 3 2011 cases only): ONS; EU-SILC 2011: Eurostat/ONS.

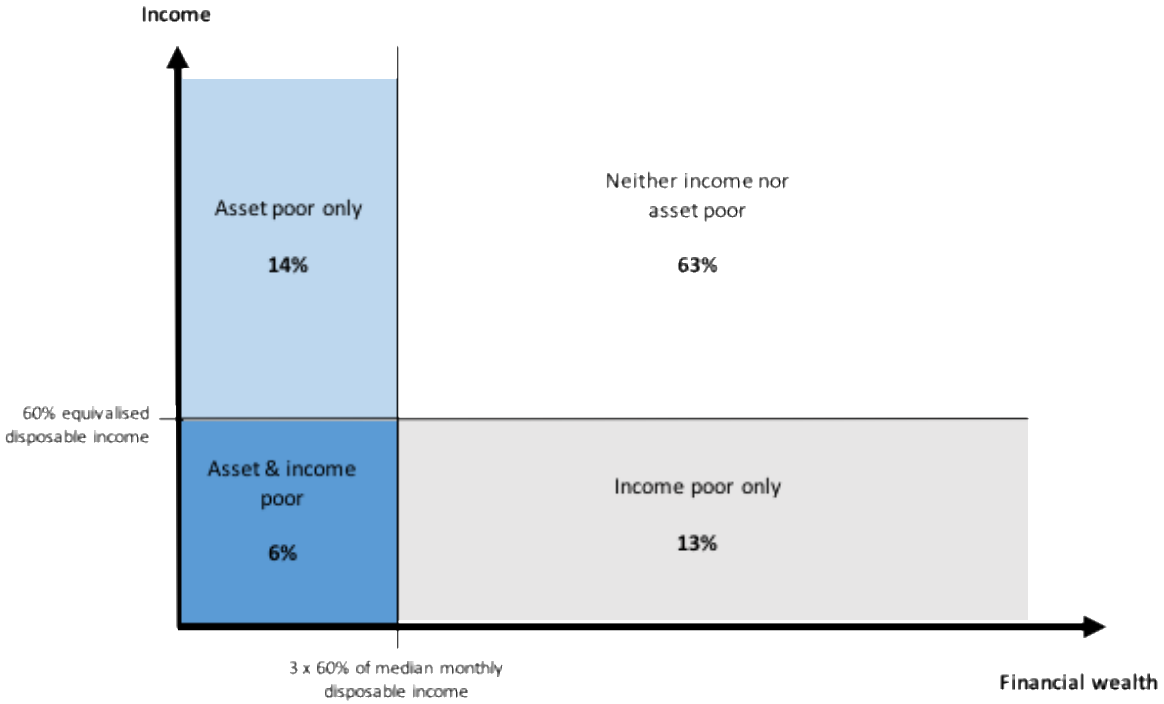
Table 1: Phi coefficients for financial wealth quintiles with income and wealth quintiles

	Original WAS	Mixed SILC
Phi coefficient (income quintile with financial wealth quintile)	0.45	0.44
Phi coefficient (wealth quintile with financial wealth quintile)	0.78	0.76

6. income and asset poverty

For the purpose of this analysis, asset poverty was defined as having net financial wealth sufficient to cover three months of 60% of median income, taking account of household composition using the modified OECD equivalisation scale, an approach similar to that used in other research in this area (e.g. Azpirarte, 2008).

Figure 11: Asset and income based poverty measures, UK, 2011



Source: Wealth and Assets survey (Wave 3 2011 cases only): ONS; EU-SILC 2011: Eurostat/ONS.

Figure 11 highlights that, based on the matched data, 14% of households were asset poor but not income poor in Great Britain in 2011. This highlights that the percentage of people in the population who might be expected to find it challenging to cope with shocks to their private financial situations stretches beyond those identified in the at-risk-of-poverty measure. It should be noted that the asset-poor definition is based on being able to afford 3 months at the AROP threshold. For most households their monthly living costs are above this figure, so the percentage of asset-poor would likely to be considerably higher if it was based on individual's ability to afford their current expenditure for three months from their financial wealth.

In contrast, 13 % of individuals were at risk of poverty using an income definition but were not asset poor. This means that for those with a relative low income, over two thirds (68%) did have some security in the form of financial assets they could use if necessary.

Table 2 shows the interaction between income and asset based poverty measures and material deprivation, using the same measure used above (enforced lack of at least 3 out of 9 items). This shows that the proportion of 'asset poor only' individuals who are materially deprived is relatively low, compared with the proportion of individuals with relative low income who are also materially deprived. This supports the position that the asset poverty measure is more a measure of vulnerability to future difficulties, rather than an indicator of current low material living standards.

Table 2a & b: Percentage of population by poverty and deprivation status

a. Not asset-poor

		Material deprivation	
		Yes	No
Income poor	Yes	3%	10%
	No	5%	63%

b. Asset poor

		Material deprivation	
		Yes	No
Income poor	Yes	2%	4%
	No	2%	12%

7. Conclusions

On one level, the results of the analysis of the matched EU-SILC and HBS data do not appear to directly support the assertion that expenditure provides a better measure of material living standards than income, at least for the countries examined. Comparisons with material deprivation and a number of other related measures of living conditions in general suggest a slightly stronger relationship between these measures and income poverty than expenditure poverty.[6]

Nevertheless, there is still evidence of a clear relationship between expenditure and other measures of living standards; in many cases this relationship is a strong one, particularly for certain countries. Furthermore, the fact that these measures do not entirely overlap with one another in terms of the people they include highlights the importance of each in identifying different groups that are vulnerable to poverty and disadvantage.

There are a number of reasons that the measures may not overlap. These include the difficulty in measuring them, particularly for certain groups. Income can be difficult to measure for households where it varies, for example among the self-employed. In addition, evidence suggests that the quality of income data may be lower for low income households. While expenditure data is arguably of better quality, the expense of data collection results in smaller, more irregular samples. Furthermore, expenditure is not the same as consumption. Finally, material deprivation is measured using relatively subjective questions and is subject to individual preferences.

However, there are other explanations for the lack of overlap between these measures. Where a household is income poor but is maintaining expenditure and is not materially deprived (those in income poverty only), this may indicate that the household is able to draw on savings or access loans either informally or formally to maintain living standards. In some cases, such behaviour may be driven by knowledge or an expectation that household income will increase in the near future, for example, those starting a new job soon or students. However, many households of this type will remain vulnerable to poverty as the resources they are relying on are finite and the situation cannot continue indefinitely.

[6] It is possible that the apparently weaker relationship between material deprivation and expenditure poverty may be an artefact of carrying out statistical matching with a relatively limited pool of harmonised variables (see Serafino and Tonkin, forthcoming). Repeating this exercise with datasets designed for ex-ante matching may provide slightly different results.

Expenditure poverty in the absence of either income poverty or material deprivation can be seen as an indicator of uncertainty over future income levels and a lack of accumulated wealth or assets which could be used to maintain living standards if income does drop. This may occur in employment that has no guaranteed future income, for example those in short-term employment and the self-employed. Additionally, an important phenomenon in the labour market, at least in the UK, are so-called "zero hours" contracts; under such arrangements the employer is not obliged to provide the worker with any minimum working hours, and the worker is not obliged to accept any of the hours offered. These provide flexibility for both parties, but also provide no guarantee of levels of future income, which could result in people adjusting their expenditure to account for such uncertainty.

Material deprivation may be high in the absence of a low income and low consumption because the household is able to afford consumption of day-to-day goods but is in debt and cannot afford the additional material goods key to social inclusion. Conversely, a household may not be materially deprived, despite having a low income and low consumption, because they have low needs, either because they already own the items used to measure material deprivation, or because they choose not to have these items.

The analysis of the matched income and wealth data demonstrates the potential value of work to consider stock and flow variables together in the household context. Taking wealth into consideration makes it possible to distinguish, among the income-poor, those who have sufficient wealth to support their living standards for a given period those who lack this buffer. Both groups experience low income, but the latter are clearly worse-off than the former. Additionally, it allows the identification of the "asset-poor only", that is, households who have a high enough income to achieve a given minimum standard of living at this moment but do not have enough assets to protect them should their income fall suddenly.

Together, these analyses contribute to work highlighting the value in considering income, consumption and wealth, as well as material deprivation in order to best understand the nature of poverty and disadvantage: As Stiglitz et al. (2009), OECD (2013) and others have recommended, only by using multiple measures can all aspects of poverty and disadvantage be adequately captured.

8. References

Azpitarte, F. (2008). *Measurement and Identification of Asset- Poor Households: A Cross-National Comparison of Spain and the United Kingdom*. Retrieved from Society for the Study of Economic Inequality: http://www.ecineq.org/milano/WP/ECINEQ2008-105.pdf

Atkinson, T., Cantillon, B., Marlier, E., and Nolan, B. (2002). *Social indicators: the EU and social inclusion,* Oxford University Press, Oxford.

Brewer, M., and O'Dea, C. (2012). *Measuring living standards with income and consumption: evidence from the UK,* retrieved from Institute for Social and Economic Research (ISER) - University of Essex: https://www.iser.essex.ac.uk/publications/working-papers/iser/2012-05.pdf

D'Orazio, M., Di Zio, M., & Scanu, M. (2006). *Statistical Matching: Theory and Practice.* Chichester: John Wiley & Sons Ltd.

Meyer, B., and Sullivan, J. (2011). Further results on measuring the well-being of the poor using income and consumption, *Canadian Journal of Economics* , 44 (1): 52-87.

Leulescu, A. and Agafitei, M. (2013). *Statistical matching: a model based approach for data integration.* Eurostat methodologies and working paper, Luxembourg: Eurostat.

Lewis, J., Snape, D. & Tonkin, R.P. (2014). *Income, Expenditure & Personal Well-being, 2011/12.* Retrieved from Office for National Statistics: http://webarchive.nationalarchives.gov.uk/20140723050536/http://ons.gov.uk/ons/rel/wellbeing/measuring-national-well-being/income--expenditure-and-personal-well-being/index.html

Noll, H-H. (2007). *Household consumption, household incomes and living standards – a review of related recent research activities.* Retrieved from GESIS – Leibniz Institute for the Social Sciences: http://www.gesis.org/fileadmin/upload/institut/wiss_arbeitsbereiche/soz_indikatoren/Publikationen/Household-Expenditures-Research-Report.pdf

OECD (2013). *OECD framework for statistics on the distribution of income, consumption and wealth.* OECD Publishing

Rässler, S. (2002). *Statistical Matching, a Frequentist Theory, Practical Applications and Alternative Bayesian Approach,* Springer.

Sabelhaus, J., Johnson, D., Ash, S., Swanson, D., Garner, T., Greenlees, J., et al. (2011). *Is the Consumer Expenditure Survey representative by income?* Retrieved from CRIW/NBER Conference: http://conference.nber.org/confer/2011/CRIWf11/CRIWf11prg.html

Serafino, P. and Tonkin, R.P. (forthcoming). Statistical *matching of EU-SILC and the Household Budget Survey to compare poverty estimates using income, expenditure and material deprivation (2016 edition),* Eurostat methodologies and working paper, Luxembourg: Eurostat.

Serafino, P. and Tonkin, R.P. (2016),. Comparing poverty estimates using income, expenditure and material deprivation. In: A. B. Atkinson, A.-C. Guio, and E. Marlier (Eds.), *Monitoring social Europe.* Luxembourg: Eurostat.

Stiglitz, J. E., Sen, A., and Fitoussi, J. P. (2009). *Report by the Commission on the Measurement of Economic Performance and Social Progress.* http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf.

Webber, D. and Tonkin, R.P. (2013). *Statisical matching of EU-SILC and the Household Budget Survey to compare poverty estimates using income, expenditure and material deprivation (2013 edition),* Eurostat methodologies and working paper, Luxembourg: Eurostat