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# Is Fuel Poverty in Ireland a Distinct Type of Deprivation?*

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*Abstract:* In this paper, we draw on the Central Statistics Office SILC data for Ireland to ask whether fuel poverty is a distinctive type of deprivation that warrants a fundamentally different policy response than poverty in general. We examine the overlap between fuel poverty (based on three self-report items) and poverty in general – with a particular emphasis on the national indicator of basic deprivation which is used in the measurement of poverty for policy purposes in Ireland. We examine changes in the overlap between 2004 and 2011 and the risk factors for fuel poverty compared to those for deprivation more generally. The paper concludes, based on evidence from factor analysis and multinomial regression, that fuel poverty is better regarded as an aspect of low living standards rather than being a distinct dimension of deprivation.

## I INTRODUCTION

There are a number of reasons to suppose that fuel poverty – understood broadly as an inability to afford an acceptable level of warmth and energy services in the home – might constitute a type of deprivation that is distinct

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from low living standards linked to low income. These include the fact that the rate of fuel poverty is sensitive to changes in energy prices and the fact that there is a capital component to fuel poverty linked to the energy efficiency of the dwelling structure and of appliances (Scott *et al.*, 2008, p. 2; Hills, 2012). Fuel poverty, in the form of inadequate home heating, also has specific effects on health, particularly of children (Liddell and Morris, 2010).

The link to health is important in motivating an interest in fuel poverty. Liddell and Morris (2010), in a review of five recent large-scale studies in the UK and New Zealand, conclude that for adults the impact of tackling fuel poverty on physical health is relatively modest, but the impact on children is greater. Some recent research on Irish *Survey on Income and Living Conditions* (SILC) data has also found an association between fuel poverty and poor health (Institute for Public Health in Ireland (IPH), 2009, p. 8). Fuel poverty has also been linked to excess winter deaths (Hills, 2012; Healy, 2003).

This paper is concerned with whether fuel poverty is distinct as indicated by the extent of its overlap with poverty and deprivation, particularly the national indicators of income poverty and basic deprivation (an indicator that captures an inability to afford basic goods and services). Are there people who will be missed if we focus on the national indicators of basic deprivation and do not consider fuel poverty as a separate dimension? If so, how large a group is this and is their profile different from that of people experiencing basic deprivation? [1]

### 1.1 *Defining and Measuring Fuel Poverty*

The concept of fuel poverty refers to the inability to afford adequate heat (and other energy services) in the home (DCENR, 2011a*)*. While the concept is simple, measuring it presents a number of challenges. Several approaches are possible, and the results of different measures are correlated but not identical (Waddams Price *et al.*, 2007; DCENR, 2011b, Chapter 2). The first approach, based on expenditure, focuses on the actual amount households spend on fuel. The fuel poor are those who spend more than a specific percentage of their household income on fuel. Boardman (1991) adopts a threshold of 10 per cent of net income excluding housing costs.[2] This is the approach taken by Scott *et al.* (2008, p. 4) in their analysis of the *Irish Household Budget Survey*. The approach proposed in the Affordable Energy Strategy or the Irish Department

[1] Whelan, Maître and Nolan (2007) asked a similar question in the context of childhood deprivation.

[2] The decision to take income net of housing costs is a crucial one because housing costs tend to be much higher for younger householders. If housing costs are subtracted before calculating the percentage of household income spent on energy, the fuel poverty rate will be higher for younger households.

of Communications, Energy and Natural Resources (DCENR, 2011a) is also based on actual spend. A disadvantage of the expenditure measure is that it would regard as non-fuel poor a low-income household spending less than 10 per cent of its income on fuel because it is living in the cold (Hills, 2012, p. 8; DCENR 2011b, pp. 9-11).

An alternative is to use modelled rather than actual energy spending. This method is based on modelling what a household would need to spend to achieve an adequate temperature, given the size and other characteristics of their dwelling and current fuel costs.[3] This strategy avoids considering non-fuel poor a low-income household that cannot afford to spend enough to heat the home adequately if the amount they *would need to spend* to achieve adequate warmth *exceeds* a given level. In Scotland, this amount is set at 10 per cent of income (Wilson, Robertson and Hawkins, 2012). Under the new definition in the UK, a household is said to be in fuel poverty if it has required (modelled) fuel costs above the median level for a household of that size *and* if spending the required amount would leave the household with a residual income below the official poverty line (DECC, 2013, pp. 3-4).

The third method of measuring fuel poverty is based on self-reports by households of their capacity to afford to purchase the fuel and energy they need (Sustainability First, 2010, p. 3). Subjective indicators avoid some of the problems associated with the expenditure method: they allow for fuel poverty in households who cannot afford to spend enough on fuel to heat the home adequately.

An issue with many indicators of fuel poverty is that households with higher incomes can also report fuel poverty (Palmer *et al.*, 2008, p. 16; DCENR, 2011b, pp. 9-11, but see DECC, 2013, p. 42 for the current UK measure). This weak association with income is not peculiar to self-report indicators. Expenditure-based measures of fuel poverty can also show a weak association with household income (Scott *et al.*, 2008, p. 5). The reasons for such weak relationships may include the presence of other demands on income such as accumulated debt, higher than usual costs associated with illness or disability, high housing costs or high commuting costs. Furthermore, in the case of self-report measures of fuel poverty, the respondent's assessment of ability to afford may be influenced by a future expected drop in income or a future increased requirement for income (e.g., anticipated job loss, the birth of a child, health problems or the need to make a major purchase) as well as by current income. Current household income is never more than an approximate indicator of a household's command over resources. It does not take account

[3] The temperature is usually set at 21 degrees centigrade in the main living areas and 18 degrees in other areas.

of assets, savings or debt or the ability to raise money by borrowing from financial institutions, family or friends (Whelan, Layte and Maître, 2004).

In this paper, we draw on self-report data from the CSO SILC survey for Ireland to examine the changes in the extent of fuel poverty between 2004 and 2011 and the extent of overlap between fuel poverty and other indicators of poverty and deprivation. The central concern is with whether fuel poverty is a distinct phenomenon.

We address the following research questions:

- Is fuel poverty distinct from low standard of living in general, as captured by a modified version of the national indicator of basic deprivation?
- Do the risk factors for fuel poverty differ from the risk factors for general household level deprivation?

The paper begins in Section II by describing the data and measures used and presenting some descriptive results for fuel poverty indicators. In Section III we use factor analysis to examine whether fuel poverty is a distinct dimension of deprivation. We turn to the overlap in Section IV between fuel poverty and other indicators of social exclusion. We ask what proportion of the "fuel poor" would be included in the measures of income poverty, basic deprivation and consistent poverty used in monitoring the Irish anti-poverty strategy (Department of Social Protection, 2012). We then ask, in Section V, whether fuel poverty is shaped by a different set of risk factors – perhaps more strongly influenced than general deprivation by characteristics of the dwelling. We conclude by discussing the implications of the findings for research and policy on fuel poverty.

## II DATA AND MEASUREMENT

### 2.1 *Survey on Income and Living Conditions*

This paper uses microdata from SILC for Ireland. The SILC is part of an EU project to provide harmonised data on the income and living conditions of households. The Irish data is collected and managed by the Central Statistics Office (CSO) and is used to monitor poverty and social exclusion in Ireland. The report draws mainly on the 2011 data but also on data from 2004 to 2011, in order to understand the links between poverty and work in Ireland in a period that spanned both economic boom and recession.

The SILC survey collects information on the income and living conditions of households as well as a large range of socio-demographic information about the household members, ranging from personal characteristics to personal

income, living conditions, labour market position, education and health status. The data are based on a voluntary survey of private households carried out by the Central Statistics Office (CSO). The survey has been carried out annually, with data collection taking place throughout the year beginning in 2004. The number of households in the completed sample varied from 4,600 to 6,000 between 2004 and 2011. In 2011, the total completed sample size was 4,333 households and 11,005 individuals. A two-stage sample design was employed, with eight population density stratum groups (based on the *2006 Census of Population*) with random selection of sample and substitute households within blocks and the application of an appropriate calibration weight (CSO, 2010).

It has become conventional to analyse poverty and deprivation with the individual as the unit of analysis (e.g., Eurostat, 2010a, p. 2), even though many of the indicators are captured at household level, and we follow that convention here. The reason for adopting the individual as the unit of analysis is that a household level of analysis masks the fact that many more persons (usually children) are affected by the income and living standards of larger households.

### 2.2 *Indicators of Fuel Poverty*

There are three items available in the SILC dataset which capture elements of fuel poverty, as shown in Figure 1. The first item ("go without heat") is from the personal questionnaire. The response from the householder (the person responsible for the accommodation) is attributed to all household members. The second and third items ("cannot afford warmth" and "arrears") come from the household questionnaire which is typically completed by the householder. A household is considered deprived on the "cannot afford warmth" item if the householder reports being unable to afford to keep the home adequately warm. Again, the responses are attributed to all household members.

In common with the IPH (2009, p. 6) we include a third item which captures the presence of arrears on utility bills in the past year. Heating and energy bills are likely to account for by far the largest share of utility bills for most households. Following the same methodology used by the IPH (2009), we define fuel poverty as: "… living in a household experiencing at least one of these three types of deprivation: going without heating, unable to afford adequate warmth and arrears on utility bills".

### 2.3 *National Indicator of Basic Deprivation*

We examine whether fuel poverty is distinct from basic deprivation, the national indicator that, together with income poverty, forms the basis for monitoring the effectiveness of anti-poverty policies. Figure 2 shows the items that make up the indicator of basic deprivation. Basic deprivation involves

lacking 2 or more of 11 basic goods and services because the household cannot afford them (Maître, Nolan and Whelan, 2006; Whelan, Maître and Nolan, 2007). Note that two of the basic deprivation items are used in the fuel poverty index (shown in bold in Figure 2). When we examine the overlap between fuel poverty and basic deprivation, we construct a "modified basic deprivation" indicator based on the household lacking two or more of the remaining nine

Figure 1: *Fuel Poverty Indicators on SILC*

| *Name* | *Measure* |
|---|---|
| Cold | Have you ever had to go without heating during the last 12 months through lack of money? (I mean have you had to go without a fire on a cold day, or go to bed to keep warm or light the fire late because of lack of coal/fuel?) (Yes, No) |
| Warm | Does the household keep the home adequately warm? (If no, is it because the household cannot afford to or is there another reason?) (Yes; No, cannot afford; No, other reason.) |
| Arrears | In the last 12 months, did it happen that the household was unable to pay utility bills (heating, electricity, gas, refuse collection) for the main dwelling on time, due to financial difficulties? Telephone bills should NOT be considered as utility bills. (Yes, No, Not applicable – no utility bills.) |

*Note:* Indicators from SILC 2004-2011. These are the same items used by the IPH (2009, p. 6).

Figure 2: *Measures of Basic Deprivation on SILC Dataset*

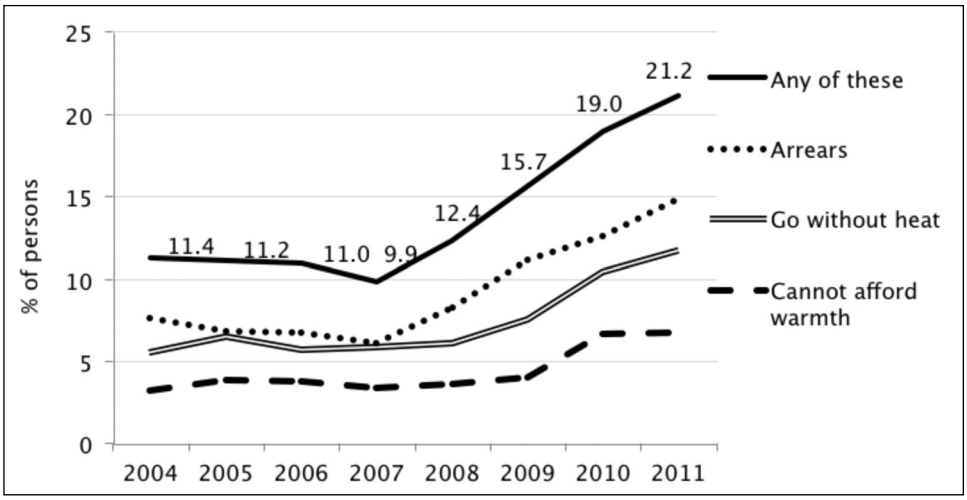
| | |
|---|---|
| *Basic Deprivation: Household Cannot Afford 2 or More of the Following ...* | 1. Two pairs of strong shoes (Shoes)<br>2. A warm waterproof overcoat (Coat)<br>3. Buy new (not second-hand) clothes (Clothes)<br>4. Eat a meal with meat, chicken, fish (or vegetarian equivalent) every second day (Meat)<br>5. Have a roast joint or its equivalent once a week (Roast)<br>6. Had to go without heating during the last year through lack of money (householder – Cold)<br>7. Keep the home adequately warm (Warm)<br>8. Buy presents for family or friends at least once a year (Presents)<br>9. Replace any worn out furniture (Furniture)<br>10. Have family or friends for a drink or meal once a month (Meal-out)<br>11. Have a morning, afternoon or evening out in the last fortnight for entertainment (householder; Evening-out) |

items (i.e., excluding the two items that are already in the fuel poverty indicator).

2.4 *Prevalence of Fuel Poverty 2004 to 2011*

In Figure 3 we examine the prevalence over time of deprivation on each of the three fuel poverty items as well as on a composite indicator of fuel poverty based on experiencing any of the three difficulties. Between 2005 and 2008 the levels of deprivation on the "going without heat" and "cannot afford warmth" item were quite stable, at about 4 per cent for the former and about 6 per cent for the latter. By contrast, during the period 2004 to 2007 the "arrears" item dropped from 8 per cent to 6 per cent.

Figure 3: *Prevalence of Fuel Poverty, SILC 2004-2011*




*Source:* SILC, 2004 to 2011, analysis by authors.

As Ireland entered the recession from 2008, the levels on the arrears item increased sharply, reaching 8 per cent in 2008 and rising to 15 per cent by 2011. Levels on the two other items increased as well, but the main increase was after 2009. By 2011, 7 per cent of people were in households that could not afford adequate warmth and nearly 12 per cent were in households that had to go without heating at some point in the previous 12 months. The sequencing of these changes is interesting: there was an increase in the percentage of households experiencing problems with arrears sooner in the recession than an increase in the percentage doing without heating. Arrears occur with energy sources where it is possible to use the energy now and pay later: mainly natural gas and electricity in the Irish context.

If we focus on the percentage of people in households experiencing any of these difficulties, we see that the level dropped between 2004 and 2007 (from 11.4 to 9.9 per cent) before rising sharply to 21 per cent by 2011. Compared to the DCENR overall expenditure-based measure for Ireland, the figures based on this self-report indicator are somewhat lower. The DCENR report figures for 2009 showing an overall fuel poverty rate of 20.5 per cent (DCENR, 2011, p. 39). The three-item self-report measure adopted here shows a level of 15.7 per cent experiencing any of the difficulties in 2009 but rising to 21 per cent by 2011.

Scott *et al.* (2008) provide estimates for 2005 based on fuel expenditure being more than 10 per cent of income net of housing. This indicator shows a level of 16 per cent of households in 2005 (pp. 4-5). This is higher than the figure of 11 per cent based on our self-report indicator.[4]

Analysis in the UK points to the role of rising domestic energy prices between 2004 and 2010 in driving a rise in fuel poverty, as measured by the expenditure-based method (DECC, 2012, p. 10; see also Wilson, Robertson and Hawkins, 2012, Figure 5). There were some major fluctuations in Irish energy prices in the 2004 to 2011 period (including a spike in oil prices in 2008) and the cost of energy has increased over time, even when we control for general price inflation. Another factor in the period was the very cold temperature in the winter of 2010-2011. The coincidence of the recession in 2009 and 2010 with the rise in fuel costs and the cold temperatures in 2010-2011 means that it is difficult to isolate the impact of the recession from the effect of these other two factors.

## III IS FUEL POVERTY DISTINCT FROM BASIC DEPRIVATION?

The first step in addressing whether fuel poverty is a distinctive type of deprivation is to examine whether the three fuel poverty items form a distinct factor compared to the basic deprivation items. We already know that two of the items (going without heat and being unable to afford warmth) form part of the basic deprivation scale so we would expect these to be strongly associated with the other basic deprivation items. However, the addition of a third item (arrears) may reveal some common dimension underlying the three items that is distinct from the other basic deprivation items. We make use of the Schmid-Leiman transformation to find the direct effect of the general factor (basic

[4] The second indicator reported by Scott *et al.,* is based on two of the three self-reported indicators from the SILC data (an inability to afford adequate heating and having to do without heat because of lack of money). Since only two indicators are used, they report a lower level of fuel poverty than in the present analysis (7.7 per cent in 2005, p. 7).

deprivation plus arrears) upon the items as well as the effect of orthogonal residual group factors (Schmid and Leiman, 1957). This technique is available in the psych package (Revelle, 2008) for R (R Development Core Team, 2008). It allows us to check whether all the items measure a latent variable in common and to ask what proportion of the variance in the scale scores is accounted for by this common factor (Zinbarg *et al.*, 2006).

Using the tetrachoric correlations is considered to be more appropriate in estimating associations between items that have two categories such as "deprived" and "not deprived" (Pearson, 1900). Tetrachoric correlations are based on asking what the correlation between the two items would be if they represented an underlying continuous, normally distributed variable (such as the probability of lacking each item). Since the tetrachoric correlations between the items will always be higher, the reliabilities under this second assumption will always be higher than those calculated based on Pearson correlations.[5]

Table 1 shows the Schmid-Leiman factor loadings of the items on a general deprivation factor and three sub-factors.[6] The main goal is to test for the presence of a general factor that will explain most of the variation (Revelle and Zinbarg, 2009). The factor analysis is based on the tetrachoric correlation matrix. The three sub-factors are extracted by the omega routine in order to calculate the McDonald's *omega* reliability coefficient. The factors are not necessarily meaningful in themselves, although it is interesting that the first sub-factor contains the three fuel poverty items.

A general factor is extracted which accounts for 80 per cent of the common item variance. The loadings of the 12 items on the general factor range from 0.64 to 0.80. The fuel poverty items have a higher loading on the general deprivation factor than on the fuel poverty factor (F1). The general factor has a Cronbach's alpha of 0.96 and an Omega-h of 0.86. The Omega-h is a test of how well the items measure one construct (general deprivation in this case; Revelle and Zinbarg, 2009; McDonald, 1999).[7]

In addition, the eigenvalue of 7.04 for the general factor is much higher than for the three sub-factors (0.74, 0.63 and 0.46). This indicates that once

[5] Generally, the tetrachoric correlation will be larger and some statisticians (Nunnaly, 1978, p. 102) discourage the use of this coefficient for estimating reliabilities.

[6] The Schmid-Leiman solution first identifies a number of sub-factors based on subsets of the items, rotates the factors to an oblique solution; factors the oblique solution to find a general higher order factor "g", and then residualises "g" out of the group factors (Schmid and Leiman, 1957).

[7] The Omega-t would be appropriate if we expected basic deprivation to be composed of a number of sub-factors, for example, deprivation related to food and deprivation related to social participation, all of which contributed to overall deprivation. It will always be higher than Omega-h. We rely on Omega-h here as the more conservative measure as we have no reason to posit specific subscales for the basic deprivation measure.

Table 1: *Schmid-Leiman Factor Loadings for General Deprivation Scale (General Factor) and Sub-Scales (Household Level)*

| | *General Factor* | *F1** | *F2** | *F3** |
|---|---|---|---|---|
| Roast | 0.80 | | | 0.20 |
| Protein_meal | 0.79 | | | |
| Shoes | 0.79 | | 0.47 | |
| Clothes | 0.78 | | 0.24 | |
| Coat | 0.80 | | 0.51 | |
| Furniture | 0.77 | | | 0.20 |
| Meal_out | 0.80 | | | 0.36 |
| Evening_out | 0.71 | 0.23 | | |
| Presents | 0.77 | | | 0.39 |
| Warm | 0.78 | 0.43 | | |
| Cold | 0.76 | 0.62 | | |
| Arrears | 0.64 | 0.30 | | |
| Eigenvalues | 7.04 | 0.74 | 0.63 | 0.46 |
| Alpha (Cronbach) | 0.96 | | | |
| Omega-h (McDonald) | 0.86 | | | |

*Source:* SILC, 2004 to 2011, analysis by authors.
* Note that the sub-factors (F1, F2 and F3) are not necessarily substantively meaningful.

the general deprivation factor is taken into account, the sub-factors explain only a small proportion of the common variation in the items. In other words, the common variation in the fuel poverty items is shared with the common variation in the other deprivation items.

The results of the factor analysis, then, would suggest that fuel poverty is not distinct from basic deprivation. The same general factor underlies the fuel poverty items as the other basic deprivation items.[8]

## IV OVERLAP BETWEEN FUEL POVERTY, BASIC DEPRIVATION AND INCOME POVERTY

Although the factor analysis suggests that the fuel poverty items do not identify a substantially different underlying dimension to the remaining nine basic deprivation items, the fuel poverty items do have meaningful content

[8] The same factor analysis based on the Pearson correlation matrix of the items yields comparable results. Since the Pearson correlations are lower, the Schmid-Leiman factor loadings and eigenvalues are lower, and the general factor accounts for a lower proportion of the item covariation (69 per cent). The analysis yields one general factor with an eigenvalue of 3.14 and sub-factor eigenvalues ranging from 0.35 to 0.70.

coverage of the fuel poverty domain and they have been used in previous analyses of fuel poverty in Ireland (Scott *et al*., 2008; IPH, 2009). In addition, the overlap between fuel poverty and "modified basic deprivation" based on the nine remaining items is imperfect (Table 2 and Figure 4). If we take the fuel poor to be persons in households lacking 1 or more of the three fuel poverty items, then 68 per cent of them experience basic deprivation. This implies that nearly one-third would not be captured by the basic deprivation indicator. Naturally enough, the overlap with modified basic deprivation (which excludes the two basic deprivation items dealing with heating), is even lower (58 per cent), implying that 42 per cent would not be identified by the modified basic deprivation indicator.

Figure 4 shows the relationship between fuel poverty and the modified basic deprivation measure between 2004 and 2011. In 2011, 13 per cent of people were both fuel poor and experiencing modified basic deprivation, 8 per cent were "fuel-poor only" and 9 per cent were experiencing "modified basic deprivation only". There is considerable overlap between fuel poverty and modified basic deprivation. Nevertheless, there are significant groups who experience "fuel poverty only" or who experience "modified basic deprivation only".

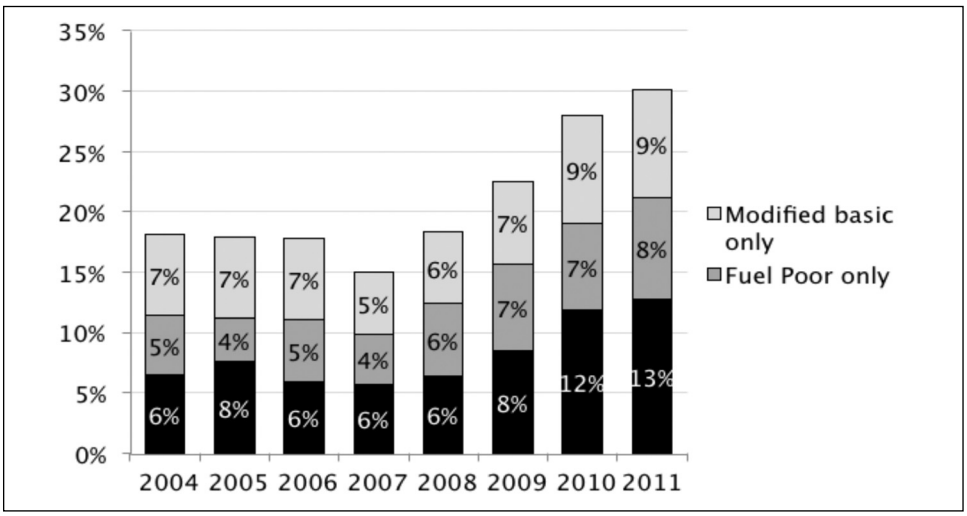
Table 2: *Overlap Between Fuel Poverty, Income Poverty and Basic Deprivation*

| *Overlap With ...* | *Percentage of Fuel Poor Who Are Also ...* | *Per Cent of Persons* |
|---|---|---|
| Basic deprivation | Lacking 2 or more of 11 basic items | 68 |
| Modified basic deprivation | Lacking 2 or more of 9 items (not including heating items) | 58 |
| Income poverty | Below the 60 per cent median equivalent income threshold | 34 |
| Consistent poverty | Below the 60 per cent median equivalent income threshold AND lacking 2 or more of the 11 basic items | 27 |
| *For Comparison, Overlap Between Basic Deprivation and Income Poverty* | | |
| Percentage of those experiencing basic deprivation who are also below the 60 per cent median equivalent income threshold | | 37 |

*Source:* SILC, 2004-2011, analysis by authors.

Table 2 also shows the overlap between fuel poverty and income poverty and consistent poverty. As noted earlier, income poverty is measured as being below the 60 per cent of median equivalised income threshold. Only about one-third of the fuel poor (34 per cent) are below this threshold. This limited over-

Figure 4: *Overlap Between Fuel Poverty and Modified Basic Deprivation, 2004-2011*




*Source:* SILC, 2004 to 2011, analysis by authors. Modified basic deprivation means lacking 2 or more of 9 basic goods and services (not including heating items).

lap is not unique to fuel poverty, however, but is characteristic of the relationship between income poverty and deprivation more generally. Only 37 per cent of those who are experiencing basic deprivation (lack 2 or more of the eleven items) are also below the income poverty threshold. The mismatch between income poverty and deprivation has been discussed elsewhere and is due, in part, to the inadequacy of income as an indicator of a household's long-term command over resources (see discussion in Whelan, Layte and Maître, 2004).

Other research examining different dimensions of deprivation has also found an association between different dimensions but an imperfect overlap between them (Atkinson, 2003; Bradshaw and Finch, 2003; Whelan, Maître and Nolan, 2007; Saunders, Naidoo and Griffiths, 2008). For instance, Whelan Maître and Nolan (2007) find that housing amenities deprivation (lack of basic amenities such as bath or shower, flush toilet, hot running water and central heating) is correlated with basic deprivation, but that a substantial majority of people reporting basic deprivation do not experience housing deprivation (p. 48). Similarly, comparing basic deprivation to an indicator of environmental deprivation captured by dwelling and neighbourhood quality problems (dampness/leaks, dwelling too dark, pollution, noise, crime, vandalism or violence in the neighbourhood), the authors find a statistically significant association but a relatively modest overlap (p. 49).

Consistent poverty is defined as being both income-poor and lacking 2 or more of the 11 basic deprivation items. As we might expect, the overlap between fuel poverty and consistent poverty is also low: only 27 per cent of the fuel poor are also in consistent poverty.

The overlap with modified basic deprivation is low enough to warrant asking if there is any "added value" to the fuel poverty indicator in terms of identifying a group that is distinctive in some way to those experiencing basic deprivation. We, therefore, proceed to our second question which concerns whether the risk factors for fuel poverty differ from the risk factors for deprivation in general. In particular, are the fuel poor distinct in terms of some aspect of the characteristics of their dwelling type or tenure. This is the kind of finding that would be needed if one were to argue that fuel poverty warranted a distinct policy response.

We focus on the contrast between modified basic deprivation and fuel poverty, rather than the contrast between income poverty and fuel poverty for a number of reasons. The first reason is that fuel poverty and modified basic deprivation are the same *kinds* of indicators: they are direct self-report measures of what a household can afford to have or to do rather than indirect measures focusing on the inputs such as income or wealth. This increases the likelihood that any differences between them will be due to the specific content of the indicators (fuel versus more general content) rather than to the type of indicator. The second reason is that some of the differences between income poverty and fuel poverty may reflect the substantial overlap between fuel poverty and basic deprivation. In other words, if we were to focus on the overlap/non-overlap with income poverty, we may attribute to fuel poverty patterns of association which are true of deprivation in general rather than features which are specific to fuel poverty.

Before proceeding, we checked the reliability of the three-item fuel-poverty scale. Based on the tetrachoric correlation coefficients the Cronbach's alpha would be 0.88 for this scale.[9]

## V IS FUEL POVERTY INFLUENCED BY THE SAME RISK FACTORS AS BASIC DEPRIVATION?

At this point we report the results of a multivariate model designed to investigate which groups are most at risk of fuel poverty and whether the risk factors are different to the risk factors for (modified) basic deprivation. The

[9] Alpha based on Pearson correlation coefficients would be 0.65. As noted above, the Pearson correlation coefficients based on dichotomous items cannot reach 1 or –1, so the reliability based on Pearson correlation coefficients is likely to be understated.

dependent variable is the overlap between fuel poverty and modified basic deprivation, with four categories: neither fuel poor nor deprived (the reference category); "fuel-poor only", "(modified basic) deprived only" and "both fuel poor and deprived". The goal of the analysis was to determine whether fuel poverty was structured differently from deprivation in general, with deprivation in general captured by the modified basic deprivation index.

We are interested in two sets of risk factors: those associated with the household members and those associated with the dwelling. In terms of characteristics of the household members, we include gender and age of the person, whether the person has a disability, whether another adult in the household has a disability, household type, the marital status and level of education of the householder, household joblessness and household social class. Household joblessness is measured using the EU "very low work intensity" indicator. It refers to a household with at least one working age adult (aged 18 to 59) where the working age adults work less than 20 per cent of the available time over the past year. Household joblessness is attributed to all persons aged 0 to 59 in the household (European Commission, 2010, p. 3; Eurostat, 2010b). It is not defined for people age 60 and over so this group is never counted as "jobless". Household joblessness is a very strong risk factor for poverty and social exclusion (Watson, Maître and Whelan, 2012). Social class is based on the occupation of the householder and is coded according to the European Socio-economic Classification (Rose and Harrison, 2007 and 2010). Where the householder is married or cohabiting and both partners are at work, the dominance rule is used to decide which occupation to use. Where the person is retired or unemployed but worked in the past, social class is based on the previous occupation of the householder.

We are also interested in whether fuel poverty is related to aspects of the dwelling (such as tenure, age of dwelling and quality problems with the dwelling). To some extent, the characteristics of the dwelling will be an outcome of the resources available to the household. Better-off households will tend to own rather than rent and will live in better quality housing. This means that the association between dwelling characteristics and deprivation/fuel poverty may have an element of endogeneity. For this reason, we assess the association between the categories of the dependent variable and characteristics of household members separately. We add the indicators related to the dwelling to the model in a separate step. While there may still be an element of endogeneity in the model,[10] there is no reason to suppose that

[10] The endogeneity may arise if some unmeasured aspect of access to resources is causally related to both dwelling characteristics and fuel poverty/deprivation. This would have the effect of biasing the coefficients upwards.

it would affect fuel poverty more than basic deprivation. We are not so much interested in the strength of the association between dwelling characteristics and fuel poverty/deprivation per se, but in whether the strength of the relationship is stronger for fuel poverty than for basic deprivation.

The indicators related to aspects of the dwelling are urban/rural location, type and age of dwelling, dwelling quality problems and tenure. We might expect some differences between urban and rural areas related to the availability of different options for central heating because urban areas are more likely to be located on a natural gas pipeline.[11] When it comes to dwelling type, we would expect that detached dwellings – since they have a larger area of exterior walls – would be more expensive to heat than semi-detached or terraced dwellings or apartments. We might expect some differences by age of dwelling as the building regulations governing housing standards and energy efficiency changed appreciably over time. Watson and Williams (2003) using the *2002 Irish National Survey of Housing Quality* found that only 37 per cent of dwellings built pre-1940 had wall insulation compared to 100 per cent for those built after 1990. The same pattern of lower insulation standard for older dwellings was found also in relation to roof insulation and double glazing. Similarly Watson and Williams (2003) reported more frequent problems with leaks/dampness for the older dwellings. Of course, some of the older dwellings will have been refurbished, but we are not able to identify the extent to which this is the case.

We include three indicators of dwelling quality: whether the dwelling has problems with leaking roof, damp walls/ceilings/floors/foundations, rot in doors, window frames; whether the rooms are too dark/have insufficient light and whether the dwelling lacks central heating.

As Scott *et al.* (2008) note, we would expect to see an association between fuel poverty and housing tenure. This is because there is a disincentive for private tenants to invest in efficiency improvements to the dwelling since their tenure is not secure and they may not be in a position to reap the benefits of the investment. While local authority tenants enjoy greater security of tenure, their incomes tend to be lower – since low income is one of the criteria according to which local authority dwellings are allocated – and they may lack the resources to invest in energy efficiency improvements. On the other hand, housing tenure is also strongly influenced by command over resources and life cycle stage. Better-off households opt for home ownership, with younger householders purchasing with a mortgage and many older householders owning the home outright.

[11] Urban areas are those with a population of 1,000 or more.

Finally, the year of the survey is included. This will allow us to check whether the changes over time remain statistically significant when we control for changes in the composition of households, particularly in the increase in the number of households where nobody is at work. As noted earlier, as well as the recession which began in 2008, there was an increase in energy prices over the period (including a spike in oil prices in 2008), and a particularly cold winter in 2010. Unfortunately, the recession, cold winter and higher prices are all occurring at about the same time, which means that we are not able to statistically separate the effects on fuel poverty.

The models were estimated in Stata using multinomial logit analysis with sample weights and robust standard errors to control for clustering of individuals within households.[12] The model estimates the overall odds of being in modified basic deprivation only, fuel poverty only or both (versus neither) by characteristics of the individual, the household and the dwelling. The model was estimated on the pooled data for 2004 to 2011, with variables included for the main effect of year. The advantage of this approach is that it allows us to highlight relatively enduring risk factors, rather than those that may be specific to the boom years or specific to the recession years. The results are shown in Table 3. We will discuss the impact of the characteristics of household members first and then discuss the impact of housing-related indicators.

### 5.1 *Model A: Characteristics of Household Members*

The first thing to notice in the results for Model A in Table 3 is that household characteristics bear a very similar relationship to "fuel poverty only" and to "both fuel poor and deprived" or "modified basic deprivation only". There is no evidence that the fuel poor are a distinct group in terms of these characteristics of the residents. Although there are some differences in the magnitude of the coefficients across the categories of the dependent variable, the significant coefficients are all in the same direction. The largest coefficients tend to be for the group "both fuel poor and deprived" which is not surprising since this group experiences a deeper degree of deprivation.

The largest differences in the risk of deprivation are associated with living in a jobless household (5.46 odds of "both"). Education and social class are more consequential for modified basic deprivation than for fuel poverty. There are substantial differences by education and social class in the

[12] The method of analysis (using Stata's "svy" routine) adjusts the standard errors for the impact on efficiency of the clustering of individuals within households.

odds of "modified basic deprivation only" and experiencing "both" type of deprivation, but fewer significant differences in the odds of "fuel poverty only".[13]

Other patterns conform to the familiar risk profile for deprivation in Ireland. The odds are slightly higher among women; higher where the householder is single or divorced/separated, among lone parents, those living alone and the odds increase with the number of children in the household. We find lower odds of experiencing both types of deprivation among older adults. The odds are higher where an adult in the household has a disability. The age pattern is consistent with research findings on poverty and deprivation in Ireland in recent years (e.g., CSO, 2013, Table 1, p. 9).

In common with others (e.g., Scott *et al.*, 2008; IPH, 2009, p. 7) we find a higher rate of fuel-poverty among younger than elderly persons. This contrasts with the findings of expenditure-based approaches that focus on total income (i.e., before subtracting housing costs). In expenditure based methods that do not take account of housing costs, the fuel poverty rate looks higher for older householders and older dwellings (e.g., DCENR, 2011a, pp. 48-49; DECC, 2012, pp. 34-35). On the other hand, when housing costs are taken into account (such as the "Low Income High Costs" indicator proposed by Hills, 2012, p. 7) a higher risk of fuel poverty is found for younger households.

There are also significant changes over time in Model A, and the pattern is very similar for the three categories of deprivation. We see a fall between 2004 and 2007 and a rise again to reach the highest level of poverty or deprivation by 2011. The "fuel poor only" group is smallest in 2005 (odds ratio of 0.69 for 2005 versus 2004), but the "modified basic only" and "both" groups are smallest in 2007. We see a rise in fuel poverty after 2008, and of modified basic deprivation after 2009. By 2011, the odds of being "both fuel poor and deprived" are 2.8 times higher than in 2004 and the odds of "fuel-only" deprivation are 2.1 times higher.

The results from Model A, then, suggest that there is little to distinguish those "fuel-poor only" from those experiencing basic deprivation apart from the fact that they look somewhat less disadvantaged in terms of education and social class.

[13] We tested whether the odds were significantly different for "modified basic deprivation only" and "fuel poverty only" and found significantly stronger effects on "modified basic deprivation only" associated with lower levels of education (no qualifications or lower second level versus higher third level) and lower social class (lower service/manual, unskilled and "unknown" versus professional/ managerial).

Table 3: *Multinomial Logit Model for Overlap Between Modified Basic Deprivation and Fuel Poverty (Odds vs. "Neither")*

| | *Model A* | | | *Model B* | | |
|---|---|---|---|---|---|---|
| | *Basic Only* | *Fuel Only* | *Both* | *Basic Only* | *Fuel Only* | *Both* |
| Female vs. male | 1.04 | 1.08 * | 1.08 * | 1.03 | 1.07 | 1.08 |
| Age 0-17 vs.65+ | 1.22 * | 1.47** | 2.33** | 1.04 | 1.18 | 1.80** |
| Age 18-34 vs. 65+ | 1.33** | 1.80** | 2.62** | 1.08 | 1.32 | 1.85** |
| Age 35-44 vs. 65+ | 1.13 | 1.35 * | 2.22** | 0.96 | 1.08 | 1.69** |
| Age 45-64 vs. 65+ | 1.18 | 1.05 | 1.80** | 1.14 | 0.96 | 1.65** |
| Has disability vs. none | 1.69** | 1.56** | 2.40** | 1.56** | 1.45** | 2.18** |
| Another adult has a disability | 1.67** | 1.49** | 2.26** | 1.59** | 1.44** | 2.10** |
| HRP single vs. married | 1.70** | 2.00** | 2.65** | 1.15 | 1.34 | 1.55** |
| HRP widowed vs. married | 0.89 | 1.07 | 1.04 | 0.84 | 1.06 | 1.06 |
| HRP separated/divorced vs. married | 2.49** | 2.32** | 2.92** | 1.97** | 1.86** | 2.15** |
| Live alone vs. couple and children | 1.36 | 1.12 | 1.49 * | 1.46 * | 1.17 | 1.63** |
| All adult HH vs. couple and children | 0.86 | 0.83 | 0.63** | 0.96 | 0.88 | 0.76 |
| Lone parent vs. couple and children | 1.69** | 1.78** | 2.02** | 1.59** | 1.63** | 1.87** |
| Number children | 1.36** | 1.24** | 1.43** | 1.32** | 1.22** | 1.40** |
| HRP no qualifications vs. high 3rd level | 3.19** | 1.30 | 2.20** | 2.91** | 1.32 | 2.04** |
| HRP lower 2nd level vs. high 3rd level | 2.09** | 1.09 | 1.55 * | 2.18** | 1.23 | 1.72** |
| HRP higher 2nd level vs. high 3rd level | 1.74** | 1.12 | 1.09 | 1.79** | 1.21 | 1.18 |
| HRP lower 3rd level vs. high 3rd level | 1.53 * | 1.01 | 1.24 | 1.50 * | 1.02 | 1.24 |
| Intermed. Soc. class vs. professional/managerial | 1.29 | 1.24 | 1.83** | 1.25 | 1.16 | 1.75** |
| Self-employed vs. professional/managerial | 1.12 | 0.94 | 1.18 | 1.21 | 1.04 | 1.37 |
| Lo. service/manual vs. professional/managerial | 2.18** | 1.48** | 1.98** | 1.94** | 1.28 | 1.68** |
| Unskilled vs. professional/managerial | 2.32** | 1.45** | 2.18** | 1.98** | 1.22 | 1.79** |
| SC unknown vs. professional/managerial | 2.50** | 1.08 | 2.94** | 2.05** | 0.83 | 2.00** |
| Jobless household (age 0-59) | 2.66** | 2.32** | 5.46** | 2.27** | 2.06** | 4.59** |
| 2005 vs. 2004 | 0.92 | 0.69** | 1.04 | 0.88 | 0.66** | 0.98 |
| 2006 vs. 2004 | 0.96 | 0.97 | 0.88 | 0.91 | 0.90 | 0.84 |
| 2007 vs. 2004 | 0.68** | 0.75 | 0.73 * | 0.63** | 0.67** | 0.60** |
| 2008 vs. 2004 | 0.89 | 1.18 | 0.96 | 0.85 | 1.15 | 0.94 |
| 2009 vs. 2004 | 1.08 | 1.47** | 1.32 | 1.01 | 1.43 | 1.28 |
| 2010 vs. 2004 | 1.70** | 1.68** | 2.24** | 1.53** | 1.64** | 2.24** |
| 2011 vs. 2004 | 1.97** | 2.14** | 2.81** | 1.65** | 2.04** | 2.77** |

Table 3: *Multinomial Logit Model for Overlap Between Modified Basic Deprivation and Fuel Poverty (Odds vs. "Neither") Contd.*

| | *Model A* | | | *Model B* | | |
|---|---|---|---|---|---|---|
| | *Basic Only* | *Fuel Only* | *Both* | *Basic Only* | *Fuel Only* | *Both* |
| Rural vs. urban area | – | – | – | 1.18 | 0.88 | 1.12 |
| Semi-detached vs. detached dwelling | – | – | – | 1.40** | 1.18 | 1.78** |
| Terraced vs. detached dwelling | – | – | – | 1.72** | 1.13 | 1.80** |
| Apartment vs. detached dwelling | – | – | – | 1.39 | 1.51 | 1.52 |
| Built 1941-70 vs. pre-1941 | – | – | – | 1.09 | 0.87 | 0.99 |
| Built 1971-80 vs. pre-1941 | – | – | – | 0.89 | 1.28 | 0.95 |
| Built 1981-1985 vs. pre-1941 | – | – | – | 1.13 | 0.92 | 1.07 |
| Built 1986-1995 vs. pre-1941 | – | – | – | 1.12 | 1.18 | 1.20 |
| Built 1996 or later vs. pre-1941 | – | – | – | 1.46 * | 1.15 | 1.16 |
| Leaks etc. | – | – | – | 2.00** | 2.30** | 3.01** |
| Too dark etc. | – | – | – | 1.26 | 1.69** | 2.59** |
| Lack central heating | – | – | – | 1.88** | 1.60** | 2.31** |
| Home purchaser vs. own outright | – | – | – | 1.34 * | 1.36** | 1.69** |
| Social renter vs. own home outright | – | – | – | 2.52** | 2.79** | 3.78** |
| Private renter vs. own home outright | – | – | – | 1.94** | 2.40** | 3.22** |

*Source:* SILC 2004-2011, analysis by authors. "**" indicates statistical significance at p < = .01; "*" indicates statistical significance at p<=.05 "–" indicates variable not included in this model. N cases = 105,306 person/years.

5.2 *Model B: Characteristics of Dwelling*

In Model B, we add the housing-related indicators: urban/rural location, dwelling type and age, dwelling quality and housing tenure. The coefficients for the socio-demographic variables are somewhat lower in Model B, though the general pattern is very similar. The fall in the magnitude of the socio-demographic coefficients is consistent with the fact that socio-demographic characteristics influence the probability that people will live in poor quality housing or will be renters rather than owners.

Our focus in Model B is on whether these housing-related factors have a stronger relationship to fuel poverty than to modified basic deprivation, with socio-demographic characteristics controlled. This is not the case: the relationship is very similar for both. Fuel poverty and modified basic deprivation are both higher in dwellings with quality problems, rented dwellings or in those being purchased (compared to those owned outright). Modified basic deprivation is significantly higher in semi-detached or terraced housing than in detached housing, but dwelling type is not significantly associated with being "fuel poor only".

We tested whether the coefficients for the housing related items on "fuel poverty only" were significantly different from the coefficients for these items on "modified basic deprivation only". The items tested were housing tenure, dwelling quality (leaks etc., too dark, lack of central heating), dwelling type (semi-detached, terraced, apartment versus detached) and dwelling age. Only one of the effects was significantly different and this showed a larger influence on basic deprivation than on fuel poverty: the gap between terraced and detached housing was larger (p=.018) for "modified basic deprivation only" than for "fuel poverty only".

In terms of dwelling type, we see that the odds of "both" types of deprivation are higher for semi-detached or terraced dwellings (both about 1.8) than for detached residences. We see a similar pattern for "modified basic deprivation only". Although the coefficients for "fuel poverty only" do not reach statistical significance, they are in the same direction, indicating an increased risk for those in semi-detached or terraced dwellings. As noted above, we might expect that detached houses would be more costly to heat. However, detached houses also tend to be more expensive so that the residents need to be better off in order to purchase them. The lack of a relationship between "fuel poverty only" and dwelling type may be a product of these two countervailing influences. The finding of a lower risk of "both" fuel poverty and basic deprivation for those living in detached houses suggests that the dominant factor is the household's command over resources, rather than the energy efficiency of the dwelling. This would be consistent with other research that links fuel poverty to low resources (DECC, 2012, p. 10; IPH 2009, p. 8; Wilson, Robertson and Hawkins, 2012).[14]

We found few significant differences by the age of the dwelling when other characteristics are controlled. The exception was a higher odds ratio for "modified basic deprivation only" where the dwelling was built after 1996. Nor were there significant differences between urban and rural areas.

As anticipated, housing tenure is associated with fuel poverty and deprivation. Renters, particularly those renting social housing, and purchasers have higher odds of fuel poverty and basic deprivation than those who own the homes outright. Scott *et al.* (2008) found that both the expenditure and self-report methods in the Irish context showed a higher risk of fuel poverty among renters.

[14] Some additional analyses indicated that the odds of all three kinds of deprivation are higher in the lowest income quintile, but with much larger differences for "both" or "basic-only" than for "fuel-only" (odds ratios of 12, 11 and 3, respectively, for the bottom vs. top quintile). Controlling for income slightly reduces the differences by household joblessness, education and social class but has virtually no impact on the pattern by tenure, dwelling type, dwelling quality and dwelling age.

The results from Model B, then, do not show a stronger link between fuel poverty and characteristics of the dwelling than between basic deprivation and characteristics of the dwelling.

## VI CONCLUSION

The central concern in this paper was with whether fuel poverty is a distinct dimension of deprivation that warrants a different type of explanation and, perhaps, a different policy response than deprivation more generally. In other words, we asked whether fuel poverty was distinct from general deprivation and whether it was more affected by characteristics of the dwelling than characteristics of the residents. We drew on the SILC data for Ireland from 2004 to 2011 and used three self-report items to measure fuel poverty: an inability to afford adequate home heating, having to go without heat in the previous year due to lack of money and being in arrears on utility bills. Fuel poverty consisted in living in a household that experienced one or more of these difficulties.

To investigate whether fuel poverty was distinct from general deprivation, we conducted a factor analysis to check whether a single latent construct underlay the three fuel poverty items and the remaining nine items that form the national indicator of basic deprivation. The results suggested that the fuel poverty items load on the same general deprivation factor as the remaining nine basic deprivation items. A "fuel poverty" factor could be identified, but it had an eigenvalue of less than one (0.74), which by conventional standards would be considered redundant, while the general factor had an eigenvalue of 7.04.

Nevertheless, the overlap between fuel poverty and the other nine basic deprivation items (which we call "modified basic deprivation") is not perfect: about 42 per cent of the fuel poor would not be identified as lacking two or more of the remaining nine basic deprivation items. Given the expectation that fuel poverty may be as much about the quality of the dwelling as about the characteristics of the residents, we conducted a multinomial logit analysis to check whether "modified basic deprivation" and fuel poverty were shaped by substantially different risk factors.

The results suggested that this was not the case. We found that the same factors were associated with both general deprivation and fuel poverty. Indeed, the strongest associations with many of the risk factors were observed for the group experiencing both fuel poverty and modified basic deprivation. This was true in particular of household joblessness, being younger, presence of a disability, living alone, lone parenthood and larger family size. Furthermore,

the fact that education and social class have a stronger association with "modified basic deprivation only" than with "fuel poverty only" strengthens the argument that fuel poverty detached from more generalised deprivation is a less than interesting phenomenon. "Fuel poverty only" is only weakly structured by indicators of human capital that we would expect to increase the risk of poverty or deprivation.

Next, we turned to the housing-related factors such as dwelling type, dwelling age and housing quality problems, and asked whether these were more strongly associated with fuel poverty than with basic deprivation. This is what we would expect to see if fuel poverty was mainly structured by housing quality problems. However, the association between housing variables and fuel poverty was not significantly different than the association with modified basic deprivation. There is indeed an association between dwelling quality problems and deprivation, but the link is just as strong for general deprivation as it is for fuel poverty.

The results of the factor analysis and the multivariate model suggest that the problem of fuel poverty is primarily one of inadequate resources rather than being mainly a housing issue. In fact, the differences by type of dwelling were in the opposite direction to what we would expect if energy efficiency were the main driver: people living in detached dwellings (which would be more expensive to heat) were less likely to be fuel poor than those living in semi-detached or terraced housing. Since detached dwellings tend to be more expensive, living in a detached house captures differences in command over resources such as having savings or owning other assets. Command over resources, rather than the cost of heating the dwelling, is the dominant influence on fuel poverty.

Fuel poverty, as measured by the self-report indicator, is not primarily about the energy efficiency of the dwelling, then, but about the capacity of the household to afford an adequate level of living. This suggests that the problem of fuel poverty and its solution lies in understanding and addressing the constellation of factors that erode a household's material well-being. This includes factors which affect the capacity to earn an adequate income (such as low levels of education, lower level of skill, history of non-employment, and restrictions on labour supply such as the need to care for adults with a disability or children). It also includes factors which may increase the demands on household income, such as having a disability, large family size and renting or purchasing accommodation rather than owning it outright.

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