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COMPARING INCOMES WHEN NEEDS DIFFER: EQUIVALIZATION FOR THE EXTRA COSTS OF DISABILITY IN THE U.K.

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Equivalization of incomes for household composition is accepted practice when measuring poverty but other variations in needs are rarely acknowledged. This paper uses data from two U.K. household surveys to quantify the extra costs of living associated with disability. The extra costs of disability are derived by comparing the "standard of living" of households with and without disabled members at a given income, having controlled for other sources of variation. Logit and ordered logit regressions are used to estimate the relationship between a range of standard of living indicators, income, and disability. The extra costs of disability derived are substantial and rise with severity of disability. Unadjusted incomes significantly understate the problem of low income amongst disabled people, and thereby in the population as a whole.

1. Introduction

Household or family income is the usual starting point for analysis of poverty and economic inequality. In this context, income is implicitly (and occasionally explicitly) being used as a proxy for standard of living (cf. Ringen, 1996). Although income appears to be a good proxy, there are two main problems. Firstly, income is not correlated with some aspects of standard of living (such as access to public goods). Secondly, even for those aspects of standard of living which are income-related, the rate at which individuals can translate income into a standard of living varies. Thus the same level of income represents different standards of living for different people. This paper is chiefly concerned with one such source of variation, namely, disability.

Amartya Sen (1992, 1999, and elsewhere) has drawn attention to five broad categories of differences in the rate of conversion of household income into well-being: personal heterogeneities (including disability), environmental diversities (for

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example, weather and epidemiology), economic setting (including availability of public goods), social norms (determining what must be purchased in order to "appear in public without shame," for example), and distribution within the household.

Sen argues that measuring specific outcomes (e.g. the standard of living), and, if possible, the overall opportunity for achieving such outcomes (capabilities), is preferable to using income as a proxy. Thus, deprivation should be judged not only in terms of income deprivation but also in the degree of adversity in converting income into gainful outcomes (the phenomenon referred to as "coupling of disadvantages"; Sen, 1999, p. 88).

At least some of the sources of variations in converting income into outcomes can be identified using techniques established within the economics literature, such as equivalization, and equivalization for household size and composition is standard practice (see, *inter alia*, McClements, 1978; Buhmann *et al*., 1988; Coulter *et al*. 1992; van Praag and Warnaar, 1997). It can be argued that identifying and accounting for a fuller set of people's needs through equivalization will lead us towards the operationalization of Sen's capability approach.[1]

The possibility that the income of a household which includes a disabled person has to stretch further than the income of a comparable household without a disabled member is recognized in the U.K.'s official statistics on low income (DWP, 2002). An illustration in the appendix to that volume applies an equivalence scale for households containing a disabled adult; however, the value chosen is arbitrary. Among the working age population, 15 percent of adults are disabled, and among pensioners, the figure rises to 41 percent, so adjustment for the extra costs of disability can have significant effects on overall estimates of poverty and inequality in the population.

The rest of this paper is organized in four sections. Section 2 provides a brief review of various approaches used in estimating the costs associated with additional needs. Section 3 describes the "standard of living" approach used here and various choices that are made in its implementation. Section 4 presents the empirical results. Section 5 provides the main conclusions, including policy implications.

2. Approaches to Estimating Costs of Differential Needs

The extra costs which might be incurred by disabled people include additional expenditure on items which non-disabled people also purchase (such as heating, laundry and transport), as well as expenditure on items specifically relating to disability (incontinence pads, information in Braille, etc). The magnitude and composition of extra costs are likely to vary by type and severity of impairment, as well as the stage of the life-cycle and living circumstances of the individual concerned, and according to how much is provided at a subsidized rate by public services and charities.

[1]Sen himself makes this suggestion: "For example, the income level of a family may be adjusted downwards by illiteracy and upwards by high levels of education, and so on, to make them 'equivalent' in terms of capability achievement" (1997, p. 215).

There have been many attempts to estimate the extra costs of a child but relatively few attempts to estimate the extra costs of disability. Accordingly, this section begins with a general overview of four main equivalence scale estimation methods before focusing on extra cost estimates specifically for disability that are produced using analogous measurement techniques.

2.1. *Overview of Approaches to Estimating Equivalence Scales*

The first set of approaches are based on examination of consumption patterns. The so-called Engel method uses the idea that the welfare of a household is reflected by the expenditure share on food, since, for a given income, a larger proportion of the total expenditure of larger households is devoted to food.[2] The method derived from Rothbarth (1943) focuses on goods that are specific to adults' well-being (rather than the well-being of the whole household). This method is used to estimate extra costs of children, and is not suitable for estimating costs associated with additional adults in the household. A variant of the adult good approach is the use of "fixed costs" as an indicator of personal welfare of adults (see Coulter *et al*., 1992, p. 89).

Approaches based on consumption patterns often focus on adult conditional utility, where children have an impact on the utility of parents only insofar as they affect consumption of adult members of the household. This framework can be contrasted with the one specified in terms of unconditional utility, where the increase in utility derived by parents from their offspring is explicitly taken into account. In their widely cited article, Pollak and Wales take the position that "conditional equivalence scales . . . cannot be used to make welfare comparisons" (Pollak and Wales, 1979, p. 220). In response, the majority of the contemporary literature on estimation of equivalence scales has interpreted family well-being in terms of utility, where the equivalence scales are estimated using the consumer demand theory (see, e.g. Deaton and Muellbauer, 1986). This framework can capture the effect that a demographic change has on household preferences.

One important distinction between equivalization for children and for disability is that fertility decisions may be endogenous whereas disability status is not chosen (see Browning (1992) for a review of literature on the issue of endogenous fertility decisions). Thus, arguably, estimating the extra costs of disability in a conditional framework is less problematic, since no statistical bias arises from endogeneity of preferences for being disabled.

One key issue with the utility based estimation of equivalence scales is whether they should be invariant to the utility level at which welfare comparisons are made (referred to as "equivalence scale exactness" by Blackorby and Donaldson (1993) and "independence of base" by Lewbel (1989)). Although this property is widely accepted in the economic literature, there is no rationale for assuming that the equivalence scales required for welfare comparisons should be equal for (say) "rich" and "poor" households. We refer to Coulter *et al*. (1992) and Nelson (1993) for a more detailed description of various methods to estimate equivalence scales and, also, their limitations in deriving scales that can be used for distributional analyses.

[2]This method is based on a suggestion in Engel (1857), though not implemented by him.

The second approach to equivalization involves asking a sample of the general population what levels of income correspond to different standards of living, and then deriving equivalences from the relationship between income, a subjective evaluation of their standard of living (or needs) and their family composition (see, e.g. Kapteyn and van Praag, 1976; and van Praag and Warnaar, 1997). One problem associated with this subjective approach is that people's welfare-to-income evaluation is income-contingent. This problem, referred to as the "preference drift," is resolved in Kapteyn and van Praag (1976), by selecting the welfare-income relationship for which the equivalent income and household's own income coincides. Mainly due to doubts about the usefulness and the reliability of the subjective data, but also due to other assumptions used in their estimation, the subjective approach to measurement of equivalence scale has not gained wide popularity.

An alternative approach uses a panel of experts to judge the costs of living on a subsistence minimum for families of varying size and composition. This approach comes under attack mainly because costs of living estimates are contaminated by value judgments of budget experts about the basket of goods and services: "what items to be included," "the quantity of items that are required," and "the price that should be fixed to the items" (Bradshaw *et al*., 1987, p. 169). One advantage of this approach is that the experts' judgments, though subjective, are explicit.

Finally, equivalence scales may be derived from the relativities observed in the social assistance system in the country in question. The most obvious problem with these scales is that benefit levels may not have been set with respect to a carefully calculated subsistence minimum, and even if they were, the calculation may not have been revised to keep up with changes in the contents or prices of the basket of minimum necessary goods and services. Moreover, these scales may not be useful for distributional analysis of the whole income distribution since they are derived on the basis of information in the bottom tail of the distribution.

2.2. *Previous Estimates of Extra Costs of Disability*

Here, we provide a review of attempts to estimate extra costs of disability in the U.K. The top panel in Table 1 gives the estimates of the disability costs obtained using a subjective approach. None of these controlled for the income of respondents, or other differences between households. Estimates relate to regular items of expenditure (excluding, for example, the cost of purchasing special equipment and adaptations).

The second study (DIG, 1988) was a response by a lobby group to what they regarded as the absurdly low estimates produced by the first study. This could explain the large difference between the results of the two studies; it also illustrates a weakness with the subjective approach. The approach has advantages, in that it is transparent, and that those who incur the expenditure—here, disabled people—provide the estimates. However, for items on which some expenditure would be incurred whether or not the individual was disabled (such as heating and laundry), it is difficult for respondents to evaluate the counterfactual ("what would you spend if you were not disabled?"). A further disadvantage of the subjective approach is that the estimates are budget-constrained: they reflect what disabled

TABLE 1

PREVIOUS ESTIMATES OF EXTRA COSTS OF DISABILITY

Study Type and Name	Data Year	Method	Estimates: £ per Week in 2002 Prices	Estimates: As % Average Earnings in Data Year
1. *Subjective assessment*				
Martin and White (1988)	1985	Face-to-face interview, random sample of disabled adults. N = 9,982	Severity[1]:	
			1/2 7.34	2.6
			5/6 13.30	4.7
			9/10 20.94	7.5
DIG (1988)	1988	Telephone survey of campaigning organization's membership: non-pensioners only	82.41	26.3
2. *Consumption patterns*				
Matthews and Truscott (1990)	1985	Spending patterns of disabled and non-disabled, controlling for income. Costs for 2-person household	£7.88 *more* on fuel, services, tobacco, durables;	+2.8
			£8.85 *less* on transport, clothing.	–3.2
Jones and O'Donnell (1995)	1986/7	Engel curves (modified). Working-age physically disabled people only	Range from 45% extra (on transport) to 64% extra (on fuel)	n/a
3. *"Standard of living"*				
Berthoud *et al.* (1993)	1985	Comparison of incomes required to achieve a given standard of living. Estimates for household on equivalent of £186 per week in 2002 prices	Severity[1]:	
			1/2: 7	4.6
			3/4: 26	17.3
			5/6: 38	24.7
			7/8: 51	34.0
			9/10: 55	36.4

Notes: [1]For explanation of OPCS severity categories of disability, see Martin *et al*. (1998).

people are actually spending, not what they would spend on disability-related goods and services, if they had the resources to do so. Since disabled people are disproportionately poor, this produces a downwards bias in the estimate.

The second panel of Table 1 gives the results from estimations based on consumption patterns. Both studies control for income in calculating additional costs, but restrict themselves to making comparisons within specific areas of expenditure, rather than giving an overall estimate.

The relativities in the British social security system between disabled and non-disabled claimants have not been used as the basis for estimating extra costs. However, as an illustration Table 2 shows estimates derived from current (2002) benefit levels. Social assistance benefits are available on a means-tested basis and reflect the minimum the government expects an individual to live on. The amount of benefit varies by age and severity of disability (shown as "minimum" and "maximum" in the table). Eligibility for extra costs benefits depends on severity of disability, but is not income-contingent.

TABLE 2

ESTIMATES OF EXTRA COSTS OF DISABILITY BASED ON SOCIAL SECURITY BENEFIT LEVELS, 2002

	Non-disabled £ pw	Disabled Minimum £ pw	Disabled Maximum £ pw	Implied Range of Extra Costs £ pw (% of average earnings)
Single person aged 25–59/64				
Social assistance	53.95	91.85	191.05	37.90 to 137.10 (9.8 to 35.5)
Extra costs benefits only	0	14.90	95.55	14.90 to 95.55 (3.9 to 24.7)
Single person over pension age				
Social assistance	98.15	135.80	195.95	37.65 to 97.80 (9.7 to 25.3)
Extra costs benefits only	0	37.65	56.25	37.65 to 56.25 (9.7 to 14.6)

Source: Department for Work and Pensions website: http://www.dwp.gov.uk/.

Most measures of the income distribution in the U.K. include these benefits as income but fail to take account of the additional costs towards which the benefits are designed to contribute. This introduces a serious upward bias in the estimates of disabled people's position in the income distribution, and thereby a downward bias in the estimates of the total numbers on low incomes or below various poverty thresholds. The implications are explored further in Section 4 below.

3. STANDARD OF LIVING METHOD

3.1. *Theory*

The underlying assumption is that disabled people may experience a lower standard of living than their non-disabled counterparts with the same level of income, as a result of the diversion of scarce resources to goods and services required because of the disability. This substitution in favor of disability-related consumption items and away from items which improve the general standard of living is the result of an income constraint. Thus, the operationalization of this method relies heavily on the identification of a standard of living indicator which is affected by this switch in consumption patterns. Note also that we use the term "standard of living" rather than "welfare" to indicate that, in common with early approaches to equivalization, the concept is one of material well-being rather than overall utility (see Nelson (1993) for the history of equivalization, and Sen (1987) for the distinction between material well-being and utility). The approach estimates the extra costs of living that people incur as a result of their disability, but does not reflect any loss in subjective well-being as a direct result of being disabled. The estimates also do not include opportunity costs—loss of personal earnings, or earnings foregone by friends and relatives in providing unpaid care;[3] household income level is treated as exogenous.

[3]The opportunity cost may be large and is certainly important, but is not the subject of this estimation. Similarly, equivalization for household size does not take into account the reduction in women's earnings associated with having children.

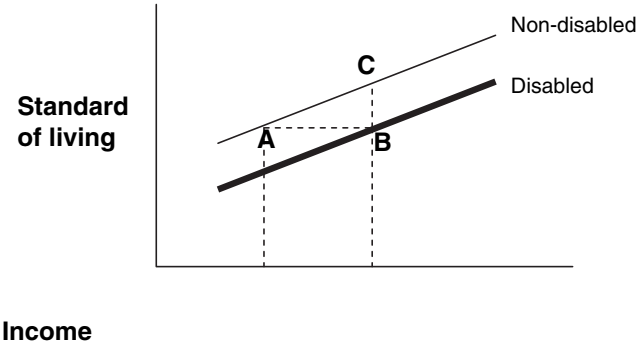

Figure 1. Standard of Living, Income and Disability

Figure 1 highlights the theoretical relationship between income, standard of living and disability used in this approach.

Standard of living is assumed to rise with income for all households, but for a household with greater needs—for example, one containing a disabled person—the same income results in lower standard of living. Conversely, the same standard of living can be achieved by a household with greater needs if it also has a higher income. Thus in Figure 1, income B for a disabled household translates into the same standard of living as income A for a non-disabled household, and B minus A gives an estimate of the extra costs of disability.

Algebraically, if:

$$S = \alpha Y + \beta D + \gamma X + k \tag{1}$$

where S is an indicator of standard of living, Y is household income, D is disability status, X is a vector of other characteristics, including household composition, and k is the intercept term expressing a constant absolute minimum level of standard of living.

Following equation (1), the extra cost of disability, E, is given by:

$$E = dY/dD = -\beta/\alpha \tag{2}$$

This can also be verified graphically. β gives the distance BC between the two lines in Figure 1, while α gives their slope, or BC over AB. Thus β/α = BC/(BC/AB) = AB, which is the extra cost of disability.

Figure 1, and equation (1), illustrate the simple case where the extra costs associated with disability are a fixed amount, independent of level of income, and where the relationship between income and standard of living is linear. Social security benefits in the U.K. for children, and for the extra costs of disability, are set at a flat rate, and thus reflect this assumption. But in equivalization for household size, it is usually assumed that extra costs are a proportion of income; in that case equation (1) would have to be modified to include an interaction term between Y (income) and D (disability). Alternatively, extra costs might rise with income, but with diminishing returns to income in terms of standard of living: the Y component of equation (1) might be log income, or square root of income.

Which functional form is appropriate can be determined empirically. Berthoud *et al*. (1993), calculating the extra costs of disability using 1985 survey data, found that income minus income squared was the best specification, indicating that the marginal return to income in terms of standard of living decreases as income rises, and that extra costs of disability rise with income. The estimates of extra costs of disability they derived are shown in the bottom panel of Table 1. Berthoud *et al*.'s results provide a useful comparison with our own results but are limited by the fact that the 1985 survey was only of households containing a disabled person. Furthermore there are reasons to believe that extra costs of disability have changed substantially in the last 20 years (see below). We are also fortunate to be in a position to provide a fuller theoretical account of the approach.

The standard of living approach for measuring extra costs of disability is related to Rothbarth's suggestion that the standard of living of households with different needs may be compared by assessing the level of "excess income," where excess income is understood to be that which is available for spending on non-necessities (Rothbarth, 1943).[4] There are two common criticisms of this type of approach. The first is that it estimates conditional rather than unconditional welfare (see Section 2.1 above). This is not problematic for estimation in the case of disability since no-one chooses to be disabled, although it does mean that the results must be interpreted as measuring the additional cost incurred by disabled people in achieving the same level of material well-being, rather than as an overall assessment of differences in utility. The second criticism is that the choice of proxy for standard of living (or excess income) could substantially affect the results. This choice is critical to the success of the method and we return to the question in Section 3.3 below. One further limitation is common to most methods for deriving equivalization scales: it is assumed that all members of the household share the same standard of living. Research on intra-household allocation of resources alerts us to the fact that in practice this is not always the case (Pahl, 1989).[5]

The standard of living approach avoids some of the disadvantages associated with other methods. In contrast to the subjective approach and minimum budget approach, neither individuals nor experts are required to make judgments for the standard of living method about hypothetical levels of consumption with and without disability. It also avoids the arbitrariness associated with deriving equivalence scales from social security benefit levels. In contrast to the Engel method and related goods-shares methods, it does not require detailed data on expenditure.

3.2. *The Data Sources*

We use data from two major U.K. household surveys: The first is the 1996/97 Family Resources Survey (FRS). The FRS is an annual, nationally representative

[4]Subsequent applications of the "Rothbarth approach" have concentrated on expenditure devoted exclusively to adults, but his original formulation is more general.

[5]Lind (2003) offers one possible way to take account of intra-household resource allocation, by means of a new welfare function, which corresponds to an ethically sound aggregation of the utility levels of individual household members.

household survey run by the Department for Work and Pensions, with a sample size of 25,000 households in the U.K. In 1996/97, adult sample members in the FRS who indicated a long-term health problem or impairment were invited to participate in a Disability Follow-Up, which asked more detailed questions on disability. These more detailed questions support the derivation of the so-called OPCS severity scale of disability, which is regarded as the "gold standard" in the U.K. for analysis of disability in a non-medical setting (see Martin *et al*., 1988, for details). A score of 0 on the scale indicates no impairment, while 22 is the maximum score of any individual in the dataset. For any given severity level, we also have information on types of impairment which allows us to estimate how extra costs of disability vary by its type.

The second source of data is the ninth wave of the British Household Panel Survey (BHPS), interviews for which were carried out in 1999/2000. The BHPS began in 1991 as a nationally representative survey of 5,000 households in Britain, run by the Institute for Social and Economic Research at the University of Essex (Taylor, 2000). The BHPS collects information on a wide range of topics. The variables used to construct an indicator of disability are derived from the standard SF-36 questionnaire.[6] Disability is identified with a restriction in social and economic activities due to physical health or emotional problems. In this paper, we present results only from cross-sectional analysis of Wave 9. In future work, we plan to make use of the panel structure of the BHPS to investigate the impact of becoming disabled on an individual's standard of living.

3.3. *Standard of Living Indicators*

It is important to bear in mind that the purpose of the empirical work is not to specify a model that could explain variation in standards of living overall. Rather, the aim is to quantify how income is related to a component of standard of living (i.e. to obtain an estimate of an income curve), and how disability—by shifting the income curve to the right—reduces standard of living.

The level of the standard of living indicator must strictly increase with overall standard of living, and must not be simply a statement of income. Moreover, the indicator should consist of goods and services, preferences for which are *independent* of disability status. So for example, expenditure on home helps would not be a good indicator of standard of living since preference for home helps over other goods and services is increased by (some forms of) disability. In general, the closer an indicator comes to representing a universally-valued functioning (e.g. being warm, secure, or entertained), and the further removed it is from a specific form of consumption, the better.

Variations in preferences or tastes are problematic only if they are systematically related to the characteristic of interest (in our case, disability); other variations will be "averaged out." Ford (1997) argues that composite indicators, based on a range of different items, may help, since even if there is a systematic

[6]The SF-36 is a "short form" of 36 questions, designed to measure physical and mental functioning. It is administered as part of the self-completion section of the BHPS. See Taylor (2000) for details.

relationship between need and preferences on one item for a particular sub-group, the relationship is unlikely to be replicated across different items.

Elasticity in the relationship between the standard of living indicator and income is important so that the indicator will be sensitive to changes in available resources. Food expenditure is relatively inelastic, since a minimum is a necessity and there is a limit to how much one can consume, while ownership of consumer durables may be more responsive to income. Elasticity, or responsiveness to changes in income, may itself vary with income. For example, the proportion of households with access to a telephone increases quickly with income at the bottom of the income distribution, but hardly at all above the median (since nearly 100 percent of richer households have access).

Choosing an indicator which is sensitive to the bottom of the distribution means the results will reflect extra needs (necessities) but may not discriminate well for higher-income households. Choosing an indicator which is sensitive at the top of the distribution means the results will reflect extra expenditure (luxuries). Again, a combined indicator may help to cover the full range. However it is important to remember that the indicator is not intended to measure standard of living overall—it is necessary only that it should be elastic with respect to income (net of disability-related expenditure) for households with a range of tastes.

On the basis of these criteria, we selected three indicators of standard of living: whether the household has any savings (FRS), an index of possession of consumer durables (FRS), and subjective assessment of the household's financial situation (BHPS). These are described in more details below.

Comparing families containing more and less severely disabled individuals using the 1985 OPCS Survey, Berthoud *et al*. (1993) found a combined indicator based on ownership of seven consumer durables and five questions about budgeting (including ability to save) behaved reasonably well. In the present case, for the Family Resources Survey, indicators of consumer durables similar to those used by Berthoud *et al*. were tried initially.[7] Indicators which were found to be responsive to income over a reasonable range of income were selected and combined into composite measures. Details of the full list and composite measures are given in the Appendix.

A second set of variables relating to savings was also tested. The question on whether the household has any savings performed well: highly responsive to income over the full range. This is a satisfactory result since it is common to observe that households with greater disposable income will have higher savings,[8]

[7]An index of consumer durables may not be a good indicator of standard of living for those who have recently become disabled. However, the proportion of the stock of disabled people who have recently become disabled is small, so the effect on overall estimates will be limited. In future work, we intend to take advantage of the panel structure of the British Household Panel Survey data to explore this issue in greater depth.

[8]Under the life-cycle hypothesis of consumption (and saving), as offered by Modigliani and Brumberg (1954) and Yaari (1965), individuals are forward-looking in their consumption stream: they optimize their consumption and in the process smooth (the marginal utility of) consumption over income variability, so as to save when income is high (say: during working age) and dis-save when income declines (say: during old age). Likewise, the permanent income hypothesis of Friedman (1957) predicts that at any point in time an agent sets his/her consumption equal to the annuity associated with the present value of the total lifetime income. Thus, the economic theory predicts higher savings for those who live in higher income phases of their lives.

and correspondingly that additional needs will reduce prevalence of savings. Overall, 26 percent of non-pensioner households, and 25 percent of pensioner households had no savings.[9]

Some households containing a disabled person may have a stronger preference to save as a precaution against future expenses, but other households may exhibit weaker preferences to save on the grounds of shorter life expectancy (Levin, 1995; Alessie and Kapteyn, 2001). Disincentives to save exist for recipients or would-be recipients of means-tested social assistance and more disabled people are likely to qualify for such benefits than non-disabled people. However *for a given level of income* the incentives and disincentives to save created by the social security system are the same for disabled and non-disabled people. Overall, it is assumed that a similar range of attitudes towards saving exists among households containing a disabled person as among other households.

The BHPS contains many variables that could be used as an indicator of standard of living. In our specification search, we experimented with several of these indicators, and decided finally to use results for the indicator reporting on the self-assessed financial situation of the household. This indicator, for which information was collected by means of a direct subjective question, turned out to be the most responsive to income. Responses to this direct question ("How well would you say you yourself are managing financially these days?") on the household's financial situation fell into four categories:

- Living comfortably.
- Doing alright.
- Just about getting by.
- Finding it difficult.

Estimates based on the different indicators of standard of living are compared below, to show the extent to which results are sensitive to choice of indicator.

3.4. *The Income Indicator*

The income indicator should reflect the resources that can be disposed of according to the needs and preferences of the household in question. This suggests income should be measured net of direct taxes and social insurance contributions, and at a household level.[10] In the U.K., a further consideration is whether

[9]The variable recording *amount* of savings in FRS was unsatisfactory. There was a high rate of non-response, responses were given in fairly wide bands, and recorded at benefit unit rather than household level. Measurement error appears to have made the variable too "noisy" to provide a useful indicator of standard of living.

[10]For the purposes of estimating the relationship between standard of living, income, and disability, social security benefits (including disability benefits) are included as part of household income. This is because they contribute to disposable income. The estimations show that the extra costs incurred by households due to disability rise with income. There is therefore a potential circularity in calculating the amount of income required to raise a household containing a disabled person to the same standard of living as a non-disabled household. If compensation is given on the basis of pre-compensation income, household income will be increased, and hence extra costs will rise, so further compensation will be required. However, if the objective of the exercise is horizontal equity, the first round of compensation is sufficient. One implication is that equivalization for extra costs of disability (as, for example, in Figure 2) should be implemented on pre-compensation incomes, i.e. household income net of disability benefits.

income should be measured before or after housing costs; the answer depending on the extent to which housing costs are considered to be at the discretion of the household. Following the convention adopted in official statistics, we use both before housing costs (BHC) and after housing costs (AHC) measures. Household income is not equivalized for household size or composition; instead we include variables for numbers and ages of adults and children in the models.

Ideally, we would use a measure of permanent income. However, although one of the datasets we use contains longitudinal data, the dataset which provides better information on severity of disability (and therefore the one used for most of the analysis), is cross-sectional. Incomes are also likely to be measured with error; however we have no particular reason to believe that disabled people's incomes will be measured with a different level of measurement error than incomes of non-disabled people. Since our estimates depend on a comparison between the two, we can reasonably expect measurement error not to create a systematic bias.[11]

3.5. *The Disability Variable*

The disability indicators are OPCS severity score in the case of FRS and SF-36 in the case of BHPS (see Section 3.3 above). Unfortunately, these variables are not available for children and as a result our estimates are restricted to the extra costs of disabled adults. An important extension of this work would be to estimate the costs of disabled children.

We suspected that severity of disability might have a non-linear relationship to income and standard of living. We therefore experimented extensively with non-linear specifications of the severity score.[12] While some specifications produced a slight improvement in goodness of fit in some cases, none of the improvements was substantial, and no single non-linear specification produced an improvement consistently across population subgroups. We therefore retained a linear severity variable, which has the advantage of ease of interpretation and consistency across estimations.

We distinguish between households which consist solely of pensioners ("pensioner households") and households which contain at least one adult of working age ("non-pensioner households"), and between single-adult and couple households. For couple households, various specifications of the disability variable in FRS were explored, including: individual's score and dummy variable for whether partner disabled; individual's score interacted with partner's score; and sum of individual's and partner's scores. This last specification produced the best fit. Our estimations are performed for single-adult and two-adult households only. Households with three or more adults are very heterogeneous (for instance, they may contain elderly disabled people living with their adult non-disabled children, or disabled young adults still living with their parents), and any further subdivision of this group of households reduces the cell size to an unacceptable level.

[11]If income is measured with errors, this will generate attenuation bias in the estimated income coefficient. However, one may also expect measurement error in the disability score and thus attenuation bias in the disability coefficient. Extra costs of disability are calculated as a ratio of the two coefficients, hence the direction of bias of these two measurement errors combined is uncertain.

[12]Results are available from the authors on request.

3.6. *Other Explanatory Variables*

The explanatory variables tested were determined by our hypotheses about their importance in the relationship between standard of living, income and disability. For instance, tenure is included (as in previous studies) since it is expected that people with the same level of income but differences in terms of home ownership will have different standards of living. Similarly, regional dummies are included to reflect geographical differences in costs of living. Age and number and ages of children are other important explanatory variables. Interaction terms were also tested. The inclusion of explanatory variables in the final models was governed by their statistical significance.

3.7. *Modeling approach*

A multivariate modeling approach is adopted to analyze the underlying relationship between a standard of living indicator, income, and disability, as shown in equation (1).

Standard of living S is assumed to be continuous but is not directly observable. The indicators of standard of living which we have at our disposal (described above) are binary or composite variables. The probability of observing the outcome in the binary measure of standard of living $T = 1$ is the probability that $S + \varepsilon > J$, where J is a measure-specific threshold and ε is a random term. This probability is estimated using logit model, which is given by the following equation:

$$\log \frac{P_i}{1 - P_i} = \sum_K b_k X_{ik} \tag{3}$$

where P_i is the probability that a household with given characteristics has $T = 1$, b_k are the coefficients associated with different characteristics X_k of the household. As shown in equation (2), the extra costs of disability are calculated by the ratio of two gradients with respect to disability and income. In logistic regression, the same can be achieved by the ratio of the two coefficients (which is also equivalent to the ratio of the corresponding marginal effects).

For composite variables, we use ordered logit model (Greene, 2003, p. 736). Here the latent variable S is measured by U, a count of, for example, the number of consumer durables possessed by a household. The purpose of using a composite variable rather than using possession of each durable as a separate indicator is to allow for variations in taste—some households prefer to purchase a video player rather than a microwave, while other households have the opposite preference. However it is assumed that any of the list of consumer durables (see Appendix) adds equally to S and hence that the *count* of the number of consumer durables is a reasonable proxy for S, whereas the probability of possessing any particular consumer durable would not be.[13] The model can be written as:

[13]This does not imply that the marginal benefit of owning three consumer durables rather than two, is the same as the marginal benefit of two rather than one, simply that it does not matter which particular purchase achieves the move from two to three (or from one to two).

$$
\begin{aligned}
U &= 0 \quad \text{if } S+\varepsilon \le j_0 \\
U &= 1 \quad \text{if } j_0 < S+\varepsilon \le j_1 \\
U &= 2 \quad \text{if } j_1 < S+\varepsilon \le j_2 \\
&\cdots \\
U &= N \quad \text{if } j_{n-1} < S+\varepsilon
\end{aligned}
$$

where $j_0, j_1, \ldots, j_{n-1}$ are the thresholds that the latent variable must cross to change the value of U; they need not be equidistant. Implicitly we assume that the variability in taste for having n consumer durables is constant for any n in the range 0 to the maximum of N, i.e. that ε has constant variance.

4. Results

4.1. *Estimates of Extra Costs of Disability*

Table 3 provides an overview of results for different household types for the final model, using FRS data. The subsequent tables (Tables 4 to 6) illustrate the procedure which was followed to arrive at the final results and various sensitivity tests. The dependant variable in Table 3 is whether the household has any savings; consequently a logistic regression was used. The estimate of extra costs is derived from the ratio of coefficients on disability and income; for instance, for single non-pensioners, the ratio of coefficient for disability severity score (0.034) and coefficient for log income (0.756) provides the estimate that this subgroup requires 4.5 percent more income to maintain their living standards for each unit increase in the disability severity score.

A range of income specifications were explored, including linear and non-linear terms and interaction terms—details are given in Zaidi and Burchardt (2003). A log income specification was found to provide the best fit. This implies that the marginal returns of income to standard of living decrease as income rises. In other words, an additional £1 makes more difference to the standard of living of a poor person than a rich person. The coefficients on income and severity score (the two coefficients used to calculate extra costs) are statistically significant at the 5 percent level or below for each household type. The pseudo R-squared statistics—a measure of the explanatory power of the models—while not high, are reasonable for analysis of this kind.

Estimates of extra costs are shown in the bottom two rows of the table, expressed firstly as the percentage of income by which extra costs increase for each additional point on the severity score, and secondly as an amount in £ per week (in 2002 prices) for a household on mean income for each of three levels of severity of impairment.

For both non-pensioners and pensioners, the estimated extra costs as a percentage of income are higher for single-adult households than for couple households. This is as one would expect. In a couple where only one person is disabled, some substitution of unpaid care for disability-related expenditure may be possible, thereby reducing the extra costs of disability. In a couple where both are disabled, some sharing of equipment and other disability-related resources may be possible, thereby reducing the extra cost per person. However, it is important to note that in couples where both individuals are disabled, the absolute amount of

TABLE 3

SUMMARY OF RESULTS FROM FINAL MODELS
LOGIT REGRESSIONS, DEPENDANT VARIABLE (STANDARD OF LIVING INDICATOR): "ANY SAVINGS"

Non-pensioner/ Pensioner:	Non-pensioner	Non-pensioner Couple	Non-pensioner Couple	Pensioner	Pensioner Couple	Pensioner Couple
Household type:	Single	1 disabled	2 disabled	Single	1 disabled	2 disabled
AHC income, log	0.756***	0.875***	0.836***	0.625***	1.350***	1.569***
	(0.069)	(0.036)	(0.040)	(0.089)	(0.126)	(0.144)
Disability severity score	–0.034***	–0.026***		–0.048***	–0.030***	
	(0.011)	(0.008)		(0.009)	(0.012)	
Own plus spouse severity scores			–0.033***			–0.017***
			(0.006)			(0.007)
Age group	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Tenure	Y	Y	Y	Y	Y	Y
Children	Y	Y	Y			
Pseudo R^2	0.19	0.17	0.17	0.10	0.14	0.15
Extra costs estimate as % of income, for each point on severity score	4.5%	3.0%	3.9%	7.7%	2.2%	1.1%
95% confidence interval	+/– 2.9	+/– 1.6	+/– 1.5	+/– 3.4	+/– 1.4	+/– 0.9
Extra costs estimate at mean income, £ pw	(£173)	(£399)	(£412)	(£124)	(£278)	(£281)
Low severity (score 3)	£23	£36	£96	£29	£18	£19
Medium severity (score 9)	£70	£108	£289	£86	£55	£56
High severity (score 17)	£132	£203	£546	£162	£104	£105
Sample size	3,836	15,125	13,399	2,944	3,076	2,482

Notes: All monetary figures in 2002 prices. "AHC" = After Housing Costs. For disability severity score, see text. Coefficients for other control variables available from the authors on request. Age group (3 categories for non-pensioners, 3 categories for pensioners); region (11 categories); tenure (3 categories); – entered as dummy variables. Reference categories: age 16–29 (non-pensioners)/age 60/65–74 (pensioners), living in the North, owner-occupier. "Children": number of children in household in each of 3 age groups.

Robust standard errors given in parentheses. Statistical significance indicated at ***99% level, **95% level, *90% level.

Pseudo R^2 as defined in Judge *et al.* (1985), p. 794.

Data source: Family Resources Survey and Disability Follow Up (1996/97).

extra costs is likely to be higher than in other household types, since their combined severity score is likely to be higher.

Turning to the illustrations of extra costs for households with mean income, it can be seen from the lowest panel of Table 3 that extra costs associated with a low severity of impairment range from £18 (pensioner couple households, one disabled) to £96 (non-pensioner couple household, both disabled). Much of the variation arises from differences in mean income by household type. For a high level of severity, extra costs for a household with mean income range from £104 to £546.

TABLE 4

Comparing Family Resources Survey with British Household Panel Survey Population Subgroup: Pensioner Households; Logit Regressions (FRS) and Ordered Logit Regressions (BHPS), with Standard of Living Indicator as Dependant Variable

Source:	FRS	BHPS	FRS	BHPS	FRS	BHPS
Standard of Living Indicator:	Any Savings	Financial Situation	Any Savings	Financial Situation	Any Savings	Financial Situation
Household type:	Single Pensioner		Couple Pensioner, 1 disabled		Couple Pensioner, both disabled	
BHC income, square root	0.181*** (0.020)	0.218*** (0.023)	0.203*** (0.021)	0.172*** (0.020)	0.235*** (0.024)	0.172*** (0.020)
Disability (binary)		–0.712***		–0.248*		–0.749***
Disability severity score	–0.051*** (0.009)	(0.109)	–0.028*** (0.012)	(0.144)	–0.015** (0.007)	(0.193)
Region	Y	Y	Y	Y	Y	Y
Tenure	Y	Y	Y	Y	Y	Y
Age	Y	Y	Y	Y	Y	Y
Log likelihood	–1,620	–1,404	–1,182	–1,010	–922	–1,010
Extra costs estimate as % mean income (and severity Score 9 for FRS)	44%	50%	15%	16%	14%	50%

Notes: "BHC": Before Housing Costs. For definition of "financial situation" and of disability in BHPS, see text.

See also *Notes* to Table 3.

Source: Family Resources Survey and Disability Follow-Up (1996/97) and British Household Panel Survey (1999/2000).

Table 4 compares results for pensioners based on the FRS and the BHPS. For "before housing costs" income, a square root specification was found to give a better fit than log income.

Despite the fact that the results use different datasets, different indicators of standard of living (for BHPS, self-assessed financial situation), and different definitions of disability, the estimates for extra costs for single pensioners and couples where only one person is disabled are reassuringly similar. For couples where both are disabled, BHPS produces a higher estimate than FRS. It is difficult to assess which is the more accurate, although compared to estimates for other household types, the FRS figure is perhaps rather low (as shown in Table 3, for example).

Table 5 illustrates another sensitivity test, this time by using different standard of living indicators within the same dataset (FRS), for non-pensioners. The two indicators are an index of consumer durables (estimated using ordered logit regression), and whether the household has any savings (the indicator used for the summary of results in Table 3). In general, the consumer durables indicator produces slightly lower estimates of extra costs as a percentage of income, but they are of the same order of magnitude as for "any savings."

Finally, Table 6 shows an extension of the methodology to estimating how extra costs vary by type of impairment.[14] In order to achieve sufficiently large cell

[14]Note that "Independence" is a rather unsatisfactory category in the original OPCS measure, and refers to ability to carry out self-care activities like toileting and feeding.

TABLE 5

Comparing Standard of Living Indicators
Population Subgroup: Non-Pensioners; Ordered Logit Regressions with "Consumer Durables" as Dependant Variable; Logit Regressions with "Any Savings" as Dependant Variable

Type of Household:	Single		Couple, 1 disabled		Couple, both disabled	
Standard of Living Indicator:	Consumer Durables	Any Savings	Consumer Durables	Any Savings	Consumer Durables	Any Savings
AHC income, log	0.765***	0.756***	0.953***	0.875***	0.927***	0.836***
	(0.060)	(0.069)	(0.027)	(0.036)	(0.030)	(0.040)
Disability severity score	–0.030***	–0.034***	–0.018***	–0.026***		
	(0.010)	(0.011)	(0.006)	(0.008)		
Own + spouse severity scores					–0.024***	–0.033***
					(0.005)	(0.006)
Age group	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Tenure	Y	Y	Y	Y	Y	Y
Children	Y	Y	Y	Y	Y	Y
Pseudo R^2	0.11	0.19	0.09	0.17	0.08	0.17
Extra costs estimate as % of income, for each point on score	3.9%	4.5%	1.9%	3.0%	2.6%	3.9%

Notes: For definition of standard of living indicators, see text.
See also *Notes* to Table 3.
Data source: Family Resources Survey and Disability Follow-Up (1996/97).

TABLE 6

Variation in Extra Costs by Type of Impairment; Logit Regressions with "Any Savings" as Dependant Variable

	Non-pensioner		Pensioner	
Type of Household:	Single Adults	All Couples	Single Adults	All Couples
AHC income, log	0.751***	0.878***	0.578***	1.394***
	(0.069)	(0.041)	(0.087)	(0.111)
No disability [omitted]	0	0	0	0
Locomotion	–0.777***	–0.405***	–0.229**	–0.131
	(0.190)	(0.121)	(0.118)	(0.140)
Reaching/dexterity	–0.222	–0.354**	–0.208	–0.077
	(0.220)	(0.162)	(0.154)	(0.195)
Seeing/hearing	0.208	–0.099	–0.184	0.296*
	(0.324)	(0.217)	(0.165)	(0.197)
Continence	–0.173	0.359	0.028	–0.062
	(0.411)	(0.475)	(0.288)	(0.389)
Mental health	–0.349**	–0.155	–0.133	0.328
	(0.173)	(0.142)	(0.238)	(0.307)
Independence	–0.427	–0.410***	–0.714***	–0.431**
	(0.337)	(0.161)	(0.304)	(0.203)
Other	–0.515	–0.163	–0.318	–0.712
	(0.436)	(0.341)	(0.798)	(0.566)
Age group	Y	Y	Y	Y
Region	Y	Y	Y	Y
Tenure	Y	Y	Y	Y
Children	Y	Y		
Pseudo R^2	0.19	0.18	0.10	0.14

Notes: See also *Notes* to Table 3.
Data source: Family Resources Survey and Disability Follow-Up (1996/97).

sizes, couple households are combined. Of course, an individual may have more than one type of impairment. Here individuals are classified according to the dimension on which they had the highest score (i.e. the most severe impairment), with any "ties" being decided in favor of the impairment type higher up the list.

For single non-pensioners, those with locomotion impairment or mental health problems, have significant extra costs. Locomotion impairments are also associated with significant extra costs for non-pensioners in couple households and for single pensioners. These groups also experience extra costs associated with "independence" and reaching and dexterity impairments. The categories of locomotion and independence correspond quite closely to the eligibility criteria for Disability Living Allowance mobility and care components respectively, but mental health and reaching/dexterity may be less well accommodated. Pensioners with limited independence may be eligible for Attendance Allowance but the lack of an equivalent for Disability Living Allowance mobility component for the over-65s is a serious gap.

4.2. *Comparison with Previous Estimates*

The results derived by Berthoud *et al*. (1993) for 1985 data, summarized in the bottom panel of Table 1, are an average of single and couple households, and cover the full age range. They are therefore difficult to compare directly with the results presented here. For the lowest severity category (1/2), Berthoud *et al*. estimate extra costs at 4 percent of income. This category corresponds to an average severity score of 2.3, which translates to an estimate of extra costs based on the results in Table 3 of between 7 and 10 percent for non-pensioners (3 and 18 percent for pensioners). There are reasons to believe that extra costs of disability have increased since the mid-1980s; firstly, because of increased availability of aids and adaptations (which nevertheless have to be paid for), and secondly, because charges for social services have increased and become more widespread (Audit Commission, 2000). So it is plausible that the estimates of extra costs derived from 1996/97 data are higher than those derived from 1985 data. The gradient of extra costs with respect to severity appears to have remained relatively unchanged, however: an 8-fold increase from the bottom to the top of the scale in both cases.[15]

4.3. *Comparison with Extra Costs Benefits Received*

Some individuals receive extra costs benefits, such as Disability Living Allowance (DLA) or Attendance Allowance (AA), in recognition of the extra costs of disability which they incur. Figure 2 compares the receipt of such benefits to the estimates of extra costs incurred, derived from Table 3, for all disabled people.[16] The sections of the stacked bars represent the percentage of the group in question (for example, the first column is disabled non-pensioners with a severity score less

[15]Comparing category 1/2 with category 9/10 in Table 1 panel 3, and severity score 2.3 with severity score 18.1 (the mean scores for categories 1/2 and 9/10 respectively) in Table 3.

[16]Equivalization for extra costs of disability is implemented on pre-compensation incomes, that is, incomes minus any extra costs benefits received. This is to avoid a potential circularity: extra costs rise with income, hence extra costs *after* compensation are higher than before compensation. For the purposes of horizontal equity it is pre-compensation incomes which set the relevant standard.

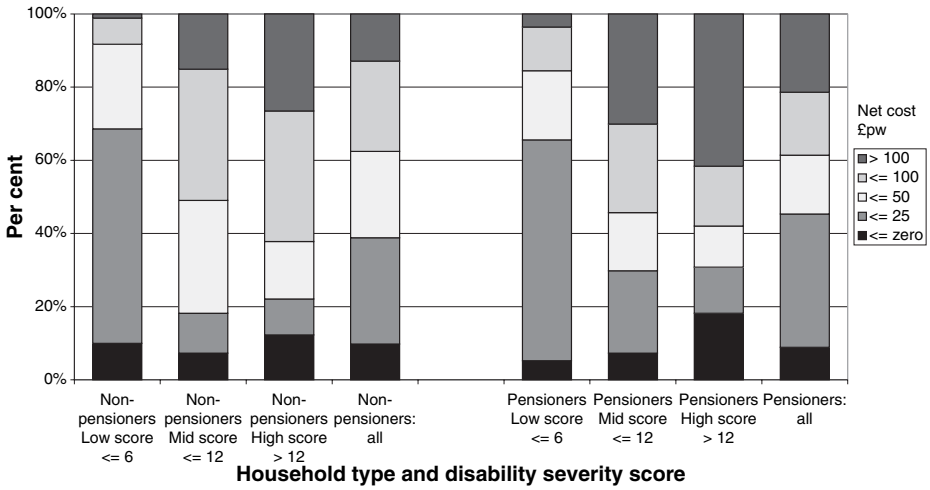

Figure 2. Distribution of Disabled People by Net Extra Costs and Severity Score (estimated costs incurred minus benefits received, £pw in 2002 prices)

Data source: Family Resources Survey and Disability Follow-Up (1996/7).

than or equal to 6) who are estimated to have *net* extra costs of zero or less, more than zero and up to £25 per week, between £25 and £50 per week and so on. Only a small proportion of individuals have their estimated extra costs met in full by the benefits they receive (the bottom section of the stack). The majority of those with low severity scores are short of up to £25 per week, while those with higher severity scores tend to have greater unmet need. In general, net costs are higher for pensioners than for non-pensioners, reflecting the more restricted benefit entitlement for that age group: there is no help with mobility-related costs for those who become disabled over the age of 65.

Among non-pensioners who are estimated to face additional costs, the mean net cost was £47 per week (in 2002 prices); for pensioners, it was £59 per week.

4.4. *Implications for Income Distribution and Poverty*

Next, we examine how the relative economic position of population subgroups change when we account for differences in their disability status. Our results show that applying the estimates for extra costs to disabled people's incomes has substantial effects both on their own position in the income distribution, and on overall estimates of poverty rates. Disability equivalization scales were derived (by household type) from the final estimates in Table 3 and applied to household-level data from the Family Resources Survey.[17]

Table 7 reports the incidence and severity of income poverty amongst non-disabled and disabled people, further divided into pensioners and non-pensioners.

[17]The estimates for two-adult households were also used for households containing three or more adults. After applying the adjustment for disability, incomes were equivalized for differences in household size using the McClements scale.

TABLE 7

POVERTY OF HOUSEHOLDS WITH AND WITHOUT DISABLED ADULTS, USING THREE INCOME DIFFERENT DEFINITIONS AND POVERTY MEASURES (USING 60% OF MEDIAN IN EACH INCOME DISTRIBUTION AS THE POVERTY LINE)

	Population Share %	Poverty Head-Count		Poverty Gap		FGT Measure ($\alpha = 2$)	
		Index	Poverty Share	Index	Poverty Share	Index	Poverty Share
Income definition A							
Non-pensioners							
No disabled in household	80.1	20.7	73.8	7.9	78.9	4.7	82.0
Disabled persons in household	19.9	29.4	26.2	8.4	21.1	4.1	18.0
Total	100.0	22.4	100.0	8.0	100.0	4.6	100.0
Pensioners							
No disabled in household	52.4	33.4	51.3	6.6	52.5	2.3	53.8
Disabled persons in household	47.6	34.9	48.7	6.5	47.5	2.2	46.2
Total	100.0	34.1	100.0	6.5	100.0	2.3	100.0
All							
No disabled in household	74.5	22.4	67.6	7.7	74.4	4.4	78.9
Disabled persons in household	25.5	31.5	32.4	7.7	25.6	3.4	21.1
Total	100.0	24.7	100.0	7.7	100.0	4.1	100.0
Income definition B							
Non-pensioners							
No disabled in household	80.1	20.5	69.8	7.8	75.5	4.7	79.4
Disabled persons in household	19.9	35.5	30.2	10.1	24.5	4.9	20.6
Total	100.0	23.5	100.0	8.2	100.0	4.7	100.0
Pensioners							
No disabled in household	52.4	33.2	46.1	6.4	47.3	2.3	48.6
Disabled persons in household	47.6	42.7	53.9	7.8	52.7	2.7	51.4
Total	100.0	37.7	100.0	7.0	100.0	2.5	100.0
All							
No disabled in household	74.5	22.2	63.1	7.6	70.5	4.3	75.8
Disabled persons in household	25.5	38.2	36.9	9.3	29.5	4.0	24.2
Total	100.0	26.3	100.0	8.0	100.0	4.3	100.0
Income definition C							
Non-pensioners							
No disabled in household	80.1	18.4	62.2	7.1	59.2	4.3	59.4
Disabled persons in household	19.9	45.0	37.8	19.5	40.8	11.9	40.6
Total	100.0	23.7	100.0	9.5	100.0	5.8	100.0
Pensioners							
No disabled in household	52.4	26.5	32.4	5.0	14.0	1.9	7.1
Disabled persons in household	47.6	60.9	67.6	33.4	86.0	26.8	92.9
Total	100.0	42.9	100.0	18.5	100.0	13.7	100.0
All							
No disabled in household	74.5	19.6	52.9	6.8	44.6	4.0	40.1
Disabled persons in household	25.5	50.9	47.1	24.7	55.4	17.4	59.9
Total	100.0	27.5	100.0	11.3	100.0	7.4	100.0

Notes:

(1) Income definitions:

Income definition A: net current household income after housing costs, equivalized for household size using McClement's scale.

Income definition B: income definition A, minus Disability Living Allowance and Attendance Allowance (i.e. state-provided extra costs disability benefits).

Income definition C: income definition A, minus extra costs of disability as calculated in Table 3 of this paper.

(2) Sample size: There are 27,020 individuals as non-pensioners, and 6,702 individuals as pensioners. Thus the total sample size used in this table is 33,712 individuals.

(3) Poverty measures: The poverty indices are drawn from the Foster-Greer-Thorbecke class of poverty measures (i.e. head-count ratio $\alpha = 0$, the poverty gap $\alpha = 1$, and the FGT index with $\alpha = 2$), the formal definition of which is given in the main text (Section 4.4). The poverty share gives the profile of the poor population, and it is calculated as the relative poverty risk of sub-group i multiplied by the population share of i: $S_i = V_i\,[\mathrm{FGT}_i(\alpha)/\mathrm{FGT}(\alpha)]$ (where V_i is the population share of sub-group i).

Data source: Family Resources Survey and Disability Follow-Up (1996/97).

Three popular Foster-Greer-Thorbecke (FGT) measures of poverty have been used, which are defined in discrete terms as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^\alpha$$

where N is the population size, y is the equivalized income, z the poverty line and q is the number of poor (having equivalized income no greater than z). The coefficient α is viewed as a poverty aversion measure. The poverty measure P_0 (i.e. $\alpha = 0$) is simply the head count ratio and P_1 ($\alpha = 1$) is the poverty gap measure. These two measures are supplemented with another FGT poverty measure with $\alpha = 2$, which gives greater weight to greater depths of poverty (for properties of this family of poverty measures, see Foster *et al*., 1984).

These results are provided for three different measures of income—A, B, and C—which differ from each other in their adjustment for extra costs of disability. The poverty line used is 60 percent of median income for the whole population for the particular definition of income in question. Income A is obtained using the standard HBAI-type income definition: it includes the disability-related benefits received by different members of the household, and equivalization of household resources is carried out for differences in household size only (using McClements equivalence scales).[18] Income B is an improvement over A since it deducts "extra costs" disability state benefits (namely, Disability Living Allowance and Attendance Allowance) from household income. The assumption underlying B is that all extra costs of disability are offset by the state benefits available to disabled people. However, as implied by our analysis in the previous section, there is a considerable doubt about the availability and sufficiency of benefits that are available. Income C is the result of deducting from total household income the estimated extra costs of disability as calculated in this paper for all those identified as disabled.[19]

Obviously, a move from income definition A to B and then to C will imply a greater income disadvantage for households with disabled people in comparison to the rest of the population. Results presented in Table 7 show that income poverty for individuals living in disabled households is clearly higher in B (23.5 percent for non-pensioners; 37.7 percent for pensioners) than in A (22.4 percent for non-pensioners; 34.1 percent for pensioners). As can be expected, there are no significant differences between A and B in the poverty rate for individuals in households which do not have disabled members. These results provide a clear indication of under-estimation of the poverty incidence amongst the disabled population in the HBAI-type analysis of income distribution.

Results for income definition C indicate even greater disadvantage for households with disabled people relative to those with no disabled in the household. The

[18]The basis for choosing any one equivalence scale, while important, remains largely arbitrary (see DWP (2004) and De Vos and Zaidi (1997) for more discussion on this issue). Our choice is influenced by our U.K. research perspective, as it facilitates a more useful comparison with other studies using British data and also a comparison with official estimates of Household Below Average Income.

[19]Total household income includes Disability Living Allowance and Attendance Allowance. Thus income C takes into account that some disabled people have already been partially compensated for the extra costs of disability through receipt of these benefits.

poverty rate amongst the disabled population overall is very high according to this measure: 50.9 percent. These differences in the poverty rate for individuals in households with disabled members across the three definitions of income provide a good approximation of income disadvantage as a consequence of extra costs of living associated with disability. The poverty gap and Foster-Greer-Thorbecke index results are in line with the patterns observed for the poverty incidence.

Taking account of disability does not just affect the position of disabled households relative to their non-disabled counterparts; it also affects overall estimates of poverty, as shown in the last rows in each panel of Table 7. The percentage of the whole population estimated to be in poverty changes from 24.7 to 27.5 percent when we use income definition C instead of A.

Table 7 also reports contributions of the two subgroups to overall poverty. The results for three different poverty indices exhibit patterns that are consistent with the above findings: the contribution of disabled households to overall poverty is higher when accounting for disability related benefits and costs (i.e. moving away from definition A to B and C). For instance, using the Foster-Greer-Thorbecke index, the contribution to overall poverty of households with disabled members rises from 21.1 percent for income definition A to 24.2 percent and 59.9 percent for income definition B and C, respectively. The effect is particularly large for pensioners: for A and B, the poverty contribution of pensioner units with disabled members is almost the same as their population share (around 50 percent), but for income definition C the poverty share is in excess of 90 percent.

One other notable result is that for income definition A, compared to the head-count, the poverty contribution of disabled households is lower when we use the poverty gap or the distribution-sensitive and additively decomposable index of Foster, Greer and Thorbecke. This suggests that with the usual income definition, existing state benefits are effective in protecting households containing disabled people from experiencing *acute* poverty, although they do not prevent a high proportion from falling below the poverty line. However, once the extra costs of disability are fully taken into account (income definition C), the result is reversed: households containing disabled people are at greater risk of poverty *and* experience a greater depth of poverty.

The changes in the relative position of the disabled population can also be observed when we analyze differences in the whole distribution. Figure 3a shows the share of disabled population of non-pensioner households per quintile group, using the three income definitions and quintiles defined on the basis of total population of pensioners and non-pensioners. The share of disabled population in the bottom quintile is a little higher than 25 percent when using definition A and B, but this share is as high as 40 percent for income definition C, which provides a clear evidence of disproportional representation of disabled population in the bottom parts of income distribution when disability costs are taken into account. Figure 3b presents the same results for pensioners, and the fact that U.K.'s pensioner households with disability are concentrated towards the bottom of the income distribution even before adjusting for the extra costs of disability comes as no surprise. However, this phenomenon becomes pronounced when a disability adjustment is made.

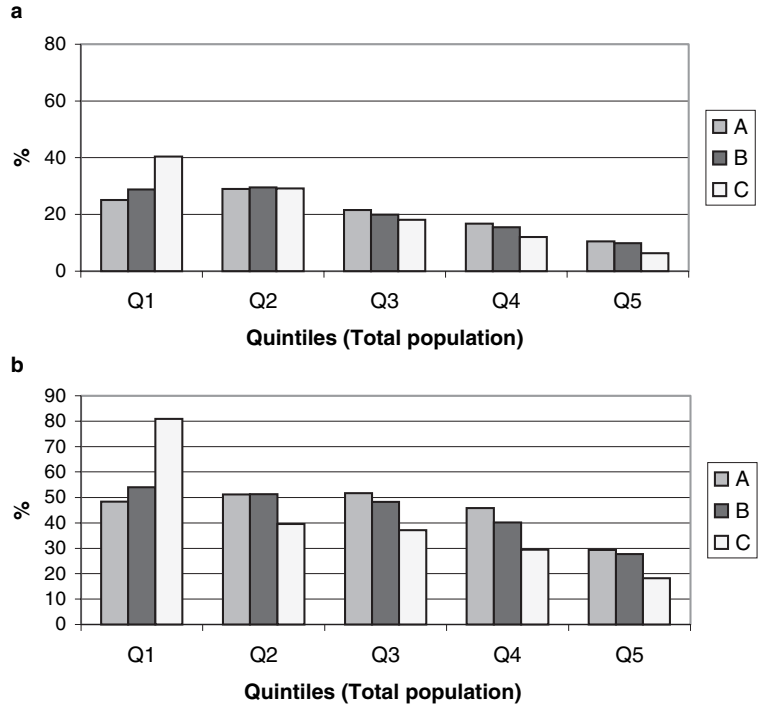

Figure 3a. Share of Disabled Persons per Quintile in Three Income Definitions (Non-pensioners)
Figure 3b. Share of Disabled Persons per Quintile in Three Income Definitions (Pensioners)

Notes: Income definition A: net current household income after housing costs, equivalized for household size using McClement's scale.

Income definition B: income definition A, minus Disability Living Allowance and Attendance Allowance (i.e. state-provided extra costs disability benefits).

Income definition C: income definition A, minus extra costs of disability as calculated in Table 3 of this paper.

Data source: Family Resources Survey and Disability Follow-Up (1996/97).

5. Concluding Discussion

Pragmatic and theoretical reasons provide the motivation for the empirical work performed in this paper: the requirement to take account of variations in different types of needs when using income to measure poverty and inequality. Household size is one such source of variation, as commonly acknowledged by equivalizing incomes for differences in household size and composition. Disability is another source of variation in needs but equivalization for disability has been hitherto largely overlooked. This paper has demonstrated that disability generates significant additional costs of living and that these extra costs should be taken into account in comparing incomes across the population. Moreover, a move towards identifying and accounting for a fuller set of needs will bring us closer to the operationalization of Sen's capability approach.

Empirical implementation of the standard-of-living approach to quantifying the extra costs of disability has shown that it is feasible to derive an equivalence

scale to account for differences in disability status across households. The methodology adopted depends crucially on the choice of a suitable standard of living indicator and its elasticity with respect to income and disability status. Thus, the paper also performs sensitivity analysis with respect to the choice of standard-of-living indicators and the income specification in the model. One interesting extension of the approach presented here would be to use the panel structure of the BHPS and examine the costs of *becoming* disabled, after controlling for changes in income and other fixed attributes.

The results show that the extra costs of disability are substantial, especially for disabled people living alone, and that such extra costs rise with severity of disability. These findings have important implications for the adequacy of disability-related state benefits and for devising poverty thresholds when comparing poverty across people with varying severity of disability. Our results show that taking the extra costs of disability into account has a substantial impact not only on the relative position of disabled and non-disabled people in the income distribution, but also on estimated poverty rates in the population as a whole. For the U.K. in the late 1990s, the poverty rate among pensioners is about 18 percentage points higher after equivalizing for disability (using 60 percent median income threshold), and three percentage points are added to the poverty rate for the whole population. A careful scrutiny of existing state benefits designed to compensate for the extra costs of disability is essential, since their levels fall well short of the extra cost estimates obtained by using the standard of living approach in this study. Moreover, the results present a strong case for developing robust disability-adjusted poverty and inequality statistics to present alongside other official figures.

Appendix: Details of Variables Used in the Analysis

Standard of Living Indicators in Family Resources Survey

For the consumer durables indicators (pensioner and non-pensioner), the following variables were tested individually for responsiveness to income:

*†Video player
*†Tumble dryer
*†Dishwasher
*†CD player
*†Access to a motor vehicle
*Microwave
*Mobile telephone
*Washing machine
*Home computer
†Satellite TV
Central heating
Fridge/freezer
Telephone

Those marked * were included in a composite indicator for non-pensioner households and those marked † were included in a composite indicator for pensioner households. For non-pensioners, the composite was scored 1 to 6, with 1

representing ownership of two or less of the items (17 percent of households), and 6 representing ownership of seven or more items (10 percent of households). This categorization was designed to ensure sufficient numbers in each category; no weighting is applied to individual items. For pensioners, the composite was scored 1 to 4, with 1 representing ownership of no items (27 percent of households) and 4 representing three or more items (26 percent of households).

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