PARTICIPATION IN MULTIPLE WELFARE PROGRAMMES: DISCRETE CHOICE WITH HETEROGENEOUS AWARENESS

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Abstract

We estimate a discrete choice model of welfare participation by British pensioners who may have entitlements under multiple welfare programmes (Income Support, Housing Benefit and Council Tax Benefit). The model allows for imperfect information and subjective claim costs and is estimated using data from three years of the Family Resources Survey. We use the model to estimate the distribution of claim costs using the compensating variation principle and assess the impact of claim costs and information search costs on poverty measurement.

KEYWORDS: programme participation, benefit take-up, discrete choice, information search, compensating variation

JEL CLASSIFICATION: C25, D63, H55, I32, I38

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1 Introduction

Income-testing is a widely-used way of focusing welfare spending on those most in need and therefore of controlling the burden on public finances. The drawback of this form of targeting is that people who are entitled to receive welfare benefit may not come forward to claim it and non-participation in welfare programmes is widespread. The issue of welfare programme participation has been the subject of a great deal of applied research. The studies by Hosek (1980), Ashenfelter (1983), Moffitt (1983), Blundell, Fry and Walker (1988), Fry and Stark (1993), Duclos (1995)and Kim and Mergoupis (1997) use a static discrete choice approach concentrating on a single welfare programme, whilst Blank and Ruggles (1996) and Anderson and Meyer (1997) estimate dynamic models of movement into and out of welfare participation.

Welfare systems often involve separate but overlapping programmes, with individuals having positive entitlements to different, often multiple, elements of the system. The component programmes making up a welfare system must be then treated separately, because individuals may claim only part of their entitlements. Claim processes and the associated claim costs may also vary from programme to programme. There have so far been few attempts to model participation behaviour in the presence of overlapping welfare programmes (but see Fraker and Moffitt, 1988, and Keane and Moffitt, 1998, for some estimates for the USA).

There have been many qualitative and quantitative survey enquiries suggesting that non-participation arises from a complex of tangible and intangible factors (see Rainwater (1982), Ritchie (1988), Allin and Beebout (1989), Ritchie and Chetwynd (1997) for UK and US evidence). Croden *et.al.* (1999) summarise the typical finding: "barriers to claiming are a mixture of attitudinal resistance, lack of or 'incorrect' knowledge [...] and dislike of the procedures involved".There are various direct costs of making a welfare claim. The most straightforward in principle are monetary costs such as the expense of travelling to the local welfare office to make a claim. These costs are usually not directly observable but are likely to be small on an equivalent annual basis. More difficult are the tangible but non-monetary costs relating to the time required to complete application forms, locate supporting documentary evidence and travel to and wait at welfare offices. These are hard to express in monetary terms and the relevant expenditure of time is usually not observable. More difficult still, and arguably more important, is the idea of

stigma, defined loosely as any intangible psychological cost arising from the claiming or receipt of welfare benefits. Stigma may be an entirely private phenomenon in the form of a loss of self-esteem, or a social externality in the form of a perceived loss of social standing, possibly with roots in the resentment felt by those who ultimately meet the cost (Besley and Coates, 1992).

In this paper, we make three main contributions to the literature on welfare participation. Firstly, we model participation for UK pensioners, allowing for the existence of entitlements under multiple programmes (Income Support, Housing Benefit and Council Tax Benefit). This model differs from analogous work by Keane and Moffitt (1998) for the US by making allowance for specific features of the benefit delivery system, which are responsible for certain features of the observed outcomes which are inconsistent with standard discrete choice models.

Secondly, we distinguish explicitly two types of barrier to welfare participation: information deficits leading to incomplete awareness of entitlements; and direct claim costs, comprising such factors as 'hassle' and stigma. The possibility of imperfect information and the non-observation of awareness in available datasets implies an unusual form of heterogeneity. There has been much work on discrete choice models with heterogeneity in taste parameters (McFadden and Train, 2000; Chesher and Santos Silva, 2002) but, until now, little work has been done on discrete choice models involving heterogeneity in the decision-maker's perception of the opportunity set.[1]

The third major contribution of this paper is an extension of the existing theory of the compensating variation in discrete choice models to allow for heterogeneity in awareness, and the application of this theory to estimate separate cash-equivalent values for the welfare losses attributable to imperfect information and claim costs.

[1]Since the first draft of this paper was written, we have become aware of unpublished work by Goeree (2003) which allows for imperfect awareness in a model of advertising and product choice; and Coady and Parker (2004), dealing with programme participation in Mexico.

2 Welfare participation by pensioners in Britain

We focus on older pensioners for several reasons. In Britain, they are a group with a high poverty rate and a particularly high rate of non-take-up of income-tested benefits. There are also some technical advantages: labour force participation is rare and safely ignorable amongst those eligible for benefit; separation from the labour market means that this group also tends to have relatively stable economic circumstances so that departures from equilibrium are likely to be minor.

For retired people in Britain, there are three principal welfare programmes which are subject to an income-related entitlement test: Income Support, Housing Benefit and Council Tax Benefit.

2.1 Income Support

Income Support (IS) is a top-up scheme making a payment equal to the difference between the claimant's resources and a guaranteed minimum. Let T be the guarantee level (defined in relation to the claimant's demographic characteristics), M is assessable income and $\tau(A)$ is notional investment income calculated on the basis of the claimant's total financial assets, A. The IS entitlement is then:

$$b_{IS} = \max\left\{T - M - \tau(A)\,,\, 0\right\} \tag{1}$$

For pensioners, the 1997/8 guaranteed weekly minimum T was £68.80 for single people and £106.80 for couples, rising in the following two years to £71 and £109.90, or £75.70 and £115.15 for those aged 75-79 and 80+ respectively. In calculating resources, assets below £3000 were ignored. If assets exceed £8000, then there was no IS eligibility, irrespective of income. Otherwise, the schedule $\tau(A)$ converts assets between £3000 and £8000 at the rate of £1 weekly notional income for each £250 of assets. Actual investment income is always ignored.

2.2 Housing Benefit and Council Tax Benefit

The Housing Benefit (HB) programme is designed to assist low-income tenants with their rent. Thus home owners cannot claim HB. Anyone claiming IS is automatically entitled to an amount of HB equal to 100% of their rent

(subject to a limit designed to prevent fraud or unreasonable levels of housing expenditure). This is known as certificated HB and is paid by the central government benefit agency. Non-IS claimants may still be entitled to HB but in this non-certificated form, HB is claimed from and paid by the local authority. In addition to HB, Council Tax Benefit (CTB) is essentially a rebate on the local property tax known as Council Tax. To qualify for CTB or non-certificated HB, a claimant must have sufficiently low net income (excluding receipts of other means-tested benefits) and capital holdings. The calculation of entitlement to both benefits is almost identical. Assets below £3,000 are ignored and people with capital in excess of £16,000 are always ineligible irrespective of their other circumstances. Subject to these conditions, the HB/CTB system will pay all or part of the family's housing costs/Council Tax. Again $\tau(A)$ is notional investment income, calculated between £3,000 and a higher upper limit of £16,000. G is gross rent in the case of HB and Council Tax in the case of CTB and φ is a taper (0.65 for HB and 0.20 for CTB). The benefit formula is as follows.

$$b_{HB} \text{ or } b_{CTB} = \begin{cases} G & \text{if } T > M - \tau(A) \\ & \text{and } A < 16,000 \\ \max\{0, G - \varphi(M - \tau(A) - T)\} & \text{if } T \leq M - \tau(A) \\ & \text{and } A < 16,000 \end{cases}$$

In the case of HB entitlement becomes zero if it is less than 50 pence.

2.3 Advisory and claim mechanisms

There is no automatic delivery mechanism: all three benefits must be claimed. To receive IS, claimants must complete and take a form to their local social security office. During the period studied here, the form ran to 40 pages and required details of all sources of income, savings and relevant personal characteristics. Changes in circumstances which might affect entitlement are required to be reported immediately so that payment can be adjusted accordingly. IS claimants are automatically given claim forms for CTB and (if they are tenants) HB and all three claims will effectively be considered as one by the social security office. When IS is not claimed, all applications for HB and CTB go to the local authority's housing office. The claims process, and

the degree of support and advice available vary between LAs, who are an important source of advice, with an interest in promoting benefit take-up, since the local government funding formula is based partly on benefit dependency rates as indicators of local need. LA tenants are likely to have good access to advice and support since they are already in regular contact with their LA through the landlord-tenant relationship. Housing associations (HAs) have charitable status and generally offer wider support to their tenants than the provision of rented accommodation. Thus HA tenants are also likely to have better access to advice on social security entitlements than private tenants and home-owners.

2.4 The Family Resources Survey and benefit simulation

We use the Family Resources Survey (FRS), a regular cross-sectional survey of British households carried out on behalf of the Department for Work and Pensions (DWP) during April 1997 to March 2000. In principle, the FRS gives all information necessary to assess each FRS pensioner unit's entitlement to IS and establish whether they are receiving IS. We applied the following process of error detection and correction before using the data (and before making the sample deletions listed above). The first step was to reverse data edits and imputations made by DWP, affecting benefit receipts, private pension income and capital holdings, because we detected some inconsistencies in edits to benefit data and because some of the imputation procedures (such as substitution of sample means for missing values) are inappropriate for our purposes. The next stage involved detecting inconsistencies in benefit data and reconciling them where possible. Potential errors in recorded receipts of social security benefits are generally easier to identify than errors in other sources of income or in capital because specified benefit rates and eligibility rules allow consistency checks to be made. Missing values for benefit receipt were imputed where a correct value could be identified unambiguously. For example, some pensioners in the FRS are able to supply a breakdown of their state pension payments which helps to disentangle different benefits received as one combined payment. In other cases it is clear that a payment of IS is included in their pension payment and there is double counting if a separate amount of IS is also recorded. Where it was

not possible to correct an inconsistency or to impute a missing value on any reliable basis, the value was left missing. This was true for all missing values for private pension and capital holdings where there is no reliable way to impute an individual-specific value. Full details of this data cleaning process can be found in Hancock and Barker (2002).

Two different versions of the dataset are used, differing in the entitlement measure used. Sample 1 uses simulated entitlement for all households and makes no use of recorded benefit amounts, beyond the receipt/non-receipt distinction; sample 2 substitutes recorded benefit, where available, for simulated entitlement. We focus on older pensioners, defined as single people at least 5 years over state retirement age (60 for women and 65 for men) or couples where both partners are at least 5 years above retirement age. There are several reasons for this: they are a group with a high poverty rate; they have very little labour market involvement to complicate the welfare participation issue; and, having been retired for a relatively long time, their adjustment to post-retirement circumstances is likely to be complete.[2] This contrasts with the dynamic modeling issues faced by Blank and Ruggles (1996) and Anderson and Meyer (1997).

The subsamples used for our analysis contains 4,332 (sample 1) or 4,831 (sample 2) cases after deleting households which: had no entitlements (5,830 and 5,518 cases respectively); contained multiple benefit units (2,211); were still re-paying a mortgage (238); received allowances from an absent spouse (7); had employment or self-employment income (48); did not respond to survey questions on a core variable such as recorded IS receipt, pension or non-assessable income (2,866 or 2,735); or which gave rise to other miscellaneous data-quality concerns (360 or 267). These deletions are less serious than they might at first appear. Most are simple exclusions of pensioners known to be non-entitled, for whom participation is not an issue. Multi-unit households are excluded because of the difficulty of simulating their entitlement. We exclude the small number of earners, for whom take-up is complicated by labour supply and mortgagors because of the large measurement problems associated with the calculation of mortgage interest. The most serious of the deletions is likely to be the cases lost through item non-

[2]Small numbers of FRS respondents (around 0.6% of the sample) had claims pending. We drop these cases. There is no detectable difference in the results if they are included and treated as recipients.

response, which we assume to be ignorable. Given the careful data cleaning and sample selection, we believe that the potentially serious problem of measurement error has been avoided as far as possible in the remaining samples used for analysis.

Summary statistics of the variables used in the econometric analysis are given in Appendix Table A2. Tables 1 and 2, calculated from the samples used for model estimation, give participation rates and mean entitlements for groups defined by housing tenure and benefit entitlement.

[*** TABLES 1 & 2 HERE ***]

An appealing method of modelling the pattern of participation is to treat it as a problem in discrete choice. There are three separate welfare programmes (IS, HB, CTB) making up the global welfare system. For each component programme, there are two possible outcomes: participation and non-participation, giving a maximum of 8 possible participation regimes that could be observed. Following the approach of Keane and Moffitt (1998), we could assume programme-specific claim costs and use a model based on additively-stochastic utilities for the relevant regimes:

$$u_r = \upsilon_r + \varepsilon_r - \Gamma_r \qquad\qquad r = 0, ..., 7 \tag{2}$$

where Γ_r is the random subjective claim cost ('stigma') associated with participation in programme r and $F_\Gamma(.)$ is their joint distribution. The ε_r are random elements specific to particular combinations of benefits, distributed with joint cdf $F_\varepsilon(.)$ and $\upsilon_r = \upsilon(N_r, \mathbf{Z})$ is the systematic component of the random utility yielded by participation regime r. The utilities υ_r are subject to a common normalisation for scale. N_r is net income:

$$N_r = N_0 + \sum_{p=1}^{3} \xi_{rp} b_p \tag{3}$$

where b_p is the benefit entitlement from programme p. N_0 is original income excluding means-tested benefits but including asset returns; $\xi_{rp} = 1$ if regime r involves participation in programme p and 0 otherwise. Decision-making then proceeds by selecting the regime yielding the highest utility.

However, the patterns of participation in Tables 1 and 2 are hard to reconcile with this view of behaviour. The most obvious aspect of this is the fact

that certain participation regimes have near-zero sample frequencies. Thus cases of take-up of IS only or (for those entitled to IS, HB and CTB) IS with only one other benefit, are almost non-existent. This implies an apparent inconsistency in the impact of costs. For example, among homeowners entitled to IS and CTB, the sample frequency of CTB receipt conditional on non-take-up of IS is 0.5; conditional on IS receipt, the frequency is 0.98. This difference occurs despite the fact that the former group has more to gain from claiming CTB, both absolutely and as a proportion of income, than the latter group.

To see the implications for a choice model like (2), consider the example of an individual entitled only to IS and CTB. Assume that claim costs are additive, so that $\Gamma_{IS+CTB} = \Gamma_{IS} + \Gamma_{CTB}$ and, for the sake of illustration, assume that the ε_r are negligible. Participation in IS but not CTB will occur when: $\Gamma_{IS} < \delta_1$, $\Gamma_{CTB} > \delta_3$ and $\Gamma_{IS} - \Gamma_{CTB} < \delta_2$, where $\delta_1 ... \delta_3$ are the differences in systematic utility components illustrated in Figure 1. Figure 2 plots the contours of the joint density of Γ_{IS} and Γ_{CTB}. The region corresponding to an optimal choice of IS only is the area to the north-west of the three dashed lines in Figure 2. For the model to fit a dataset where Pr(IS only) ≈ 0 requires that the density be almost zero over this region. Since the region in question varies between individuals, this requires a near-degeneracy in the joint distribution of the latent claim costs (and, more generally, in the ε_r also).

As an example of the modelling problem, consider the following multinomial logit model with $\upsilon_r = \mathbf{Z}_r \boldsymbol{\beta}$ where $\mathbf{Z}_r$ is a vector of observed covariates:

$$\Pr\left(r \mid \mathbf{Z}_r, \boldsymbol{\eta}\right) = \frac{\eta_r \exp\left(\upsilon_r - \Gamma_r\right)}{\sum_{j=0}^{7} \eta_j \exp\left(\upsilon_j - \Gamma_j\right)} \tag{4}$$

The binary variable $\eta_r = 1$ if the individual has a positive entitlement under choose regime r and 0 otherwise.

Illustrative results are given in Table 3, for a simple specification involving log potential income per head, interacted with age, education, disability (as indicated by receipt of disability benefit) and (for renters) a dummy identifying tenants of 'social' landlords (Housing Associations and Local Authorities). The results suggest large significant negative claim costs Γ_r for regimes involving full or near-full participation. These are not plausible results and are clearly distorted by the attempt to fit a simple choice model without taking account of the 'supply side' of the welfare system - the claims

technology. Many variants of this model have been tried, including nested GEV models and heterogeneous claim costs but the problems of poor sample fit, negative claim costs and non-concavity persist.

[*** TABLE 3 HERE ***]

3 A model of participation behaviour

The preceding discussion has highlighted two special features of welfare participation: differential access to information and advice between population groups; and the role of the claims mechanism in generating particular combinations of welfare receipt. For example, a claim for IS will automatically generate an awareness and an opportunity to claim HB and CTB, so that a claim for IS can never be accompanied by ignorance of HB or CTB. Similarly, contact with a local housing authority will often initiate advice and encouragement leading to simultaneous claims for HB and other benefits. We now develop a model of participation behaviour that takes account of the nature of the claims process and the informational deficiencies that may lie behind non-participation.

We model participation as a three-stage process. At stage 1, the individual decides what steps, if any, to take to discover the existence and rules of the benefit system. At stage 2 this search for information is carried out and leads to knowledge of some or all of the relevant benefit programmes. At stage 3 a decision is made about which entitlements are to be claimed. This view of the decision process has the important implication that the set of alternatives of which the individual is aware, and from which he or she chooses, may not coincide with the full set of regimes for which there is an entitlement.

Let e be the effort an individual devotes to searching for information about the extent of welfare entitlement and define $\overline{U}(e, N_0)$ as the expected outcome, in terms of indirect utility, of searching with intensity e, given the individual's prior beliefs about the net income levels that might result as a consequence of searching with intensity e. Note that prior beliefs need not correspond at all closely to the real benefit system, since there might initially be systematic misinformation or ignorance. The properties of $\overline{U}$ will

depend on the nature of preferences and prior information, but we would normally expect $\overline{U}$ to be non-decreasing in both N_0 and e, with a negative cross-derivative $\overline{U}_{eN_0}$, since the return to search declines as N_0 rises causing expected entitlements to fall. Let the unit search cost be c. The optimal rate of search intensity $\widetilde{e}$ then satisfies:

$$\frac{\partial \overline{U}(\widetilde{e}, N_0)}{\partial \widetilde{e}} \leq c \tag{5}$$

where the equality holds for an interior solution $\widetilde{e} > 0$. At this intensive margin we have $d\widetilde{e}/dN_0 = -\overline{U}_{eN_0}/\overline{U}_{ee} \leq 0$ and $d\widetilde{e}/dc = 1/\overline{U}_{ee} < 0$. Thus, for a given level of marginal cost, high-income households will devote less effort to search because they anticipate lower entitlements and households facing high search costs will devote less effort to search. At the extensive margin, if c is unobservable to the outside observer and apparently random, the probability of $\widetilde{e} = 0$ will be increasing in N_0 and in any variables that unambiguously shift the cdf of c rightwards.

At stage 2 of the process, this search is implemented and its outcome is a state of awareness. Let $\Xi \subseteq \{0...7\}$ be the set of benefit combinations to which the individual is actually entitled.[3] The outcome of the information search process is random and described by a set of awareness probabilities where, for each $\Omega \in \Xi$, $Q(\Omega, N_\Omega | \, e, \mathbf{X})$ is the probability that a person with characteristics $\mathbf{X}$, searching with intensity e, will become aware of the combination of benefits Ω and the associated potential net income levels $N_\Omega = \{N_r : r \in \Omega\}$. Let $\widetilde{e}(N_0, c)$ be the optimal level of search effort. Then define:

$$Q(\Omega, N_\Omega | \mathbf{X}) = E\left[Q(\Omega, N_\Omega | \, \widetilde{e}(N_0, c), \mathbf{X}) | \, \mathbf{X}\right] \tag{6}$$

As an example of the interpretation of the probability (6), consider someone entitled to all three programmes; if $\Omega = \{0, 2, 3, 6\}$, then $Q(\Omega, N_\Omega | \mathbf{X})$ is the conditional probability that search of intensity e will generate an awareness of the entitlements under HB and CTB but not of the entitlement under IS.

At stage 3, the participation decision is made conditional on the awareness that results from the search undertaken at stage 2. The awareness-restricted selection probability for regime r is then:

$$P\left(r | \Omega, \mathbf{Z}\right) = \Pr\left(u_r = \max_{j \in \Omega}\{\upsilon\left(N_r, \mathbf{Z}\right) + \varepsilon_r - \Gamma_r\} \middle| \, \Omega\right) \tag{7}$$

[3]For instance, people entitled to HB and CTB but not IS have $\Xi = \{0, 2, 3, 6\}$.

The probability of regime r being observed as the actual outcome is the following probability mixture:

$$\Pi_r = \sum_{\Omega: r \in \Omega} Q(\Omega, N_\Omega | \mathbf{X}) P(r | \Omega, \mathbf{Z}) \tag{8}$$

The structure (8) is a mixture model, resulting from heterogeneous awareness. It must be implemented in a way that takes account of the special features of the claim process. The application form for IS is provided together with claim forms for HB and CTB and thus automatically alerts IS applicants to the existence of other programmes. This has implications for the structure of the awareness probabilities and is reflected in the fact that, out of the approximately 2,000 FRS respondents entitled to IS and at least one other benefit, only 10 are found to be receiving IS in isolation. Consequently, we assume that $Q(\Omega, N_\Omega | \mathbf{X}) = 0$ for any Ω containing IS but excluding CTB or (for renters) HB. The resulting structure is set out in Table 4.

[*** TABLE 4 HERE ***]

The awareness probabilities within each tenure/entitlement group (the columns of Table 4), sum to unity and are specified as multinomial logits:

$$Q_j = \frac{\exp(\mathbf{X}\alpha_j)}{1 + \sum_{k \in J} \exp(\mathbf{X}\alpha_k)}, \qquad j \in J \tag{9}$$

where $J = \{1\}$, $\{2, 3\}$, $\{4\}$, $\{5, 6, 7\}$ or $\{8...11\}$ according to the entitlement group.

People who participate in IS essentially always take up their other entitlements also. Similarly, few people entitled to both HB and CTB are observed to claim only one of the two benefits. Conventionally-specified random utility discrete choice models cannot capture this pattern of choices. Instead, we assume the following degeneracy in the stochastic utility elements:

$$\begin{aligned} u_0 &= \upsilon(N_0, \mathbf{Z}) + \varepsilon_0 \\ u_r &= \upsilon(N_r, \mathbf{Z}) + \varepsilon_1 - \Gamma_1 \quad \text{if } r \in \{2, 3, 6\} \\ u_r &= \upsilon(N_r, \mathbf{Z}) + \varepsilon_2 - \Gamma_2 \quad \text{if } r \in \{1, 4, 5, 7\} \end{aligned} \tag{10}$$

where Γ_1 is the expected claim cost for any regime involving exclusively housing-related benefits and Γ_2 is the claim cost for any regime involving IS receipt. With the eight utilities generated by three underlying stochastic terms, this specification implies that an individual who is aware of an entitlement to HB and CTB will always prefer HB+CTB to either HB or CTB alone. Similarly, an awareness of entitlement to IS and any other benefit will always imply that full take-up is preferred to take-up of IS alone.

This view of behaviour implies outcome probabilities that are mixtures of constrained choice probabilities. Consider the case of renters with full entitlement; the outcome probabilities are:

$$\begin{aligned}
\Pi_0 &= Q_8 + Q_9 P(0|\{0,2\}) + Q_{10} P(0|\{0,3\}) + Q_{11} P(0|\{0,6\}) \\
&\quad + (1 - Q_8 - Q_9 - Q_{10} - Q_{11}) P(0|\{0,6,7\}) \\
\Pi_1 &= \Pi_4 = \Pi_5 = 0 \\
\Pi_2 &= Q_9 P(2|\{0,2\}) \\
\Pi_3 &= Q_{10} P(3|\{0,3\}) \\
\Pi_6 &= Q_{11} P(6|\{0,6\}) + (1 - Q_8 - Q_9 - Q_{10} - Q_{11}) P(6|\{0,6,7\}) \\
\Pi_7 &= (1 - Q_8 - Q_9 - Q_{10} - Q_{11}) P(7|\{0,6,7\})
\end{aligned} \tag{11}$$

where, for example, $P(7|\{0,6,7\})$ is the probability that {IS+HB+CTB) is chosen, when three alternatives are considered: none, (HB+CTB) and (IS+HB+CTB). Other possible combinations of the three benefits are dominated by one of these three alternatives with probability one. Expressions simpler than (11) apply to the other four tenure/eligibility groups.

After exploring other functional forms empirically, we specify the preference function as:

$$v(N_r, \mathbf{Z}) = (1 + \mathbf{Z}\beta_1) \ln N_r + \beta_2 (\ln N_r)^2 \tag{12}$$

where $\mathbf{Z}$ is a vector of observable household characteristics. The joint distribution of the three stochastic terms is specified as a GEV distribution (McFadden, 1978) with the following cdf:

$$F(\varepsilon_0, \varepsilon_1, \varepsilon_2) = \exp\left\{-e^{-\varepsilon_0/\sigma} + \left(e^{-\varepsilon_1/\sigma\mu} + e^{-\varepsilon_2/\sigma\mu}\right)^{\mu}\right\}, \qquad 0 < \mu \leq 1 \tag{13}$$

The parameter μ governs the degree of correlation between the two groups of participation regimes and $\sigma = var(\varepsilon_j)$ is the general degree of (apparent) randomness in the participation decision. This leads to a nested logit structure:

$$P\left(r|\Omega,\mathbf{Z}\right) = \frac{\xi_r^{\Omega} e^{v_r}\ \partial G(v_0, v_1, v_2|\Omega)/\partial v_r}{G(v_0, v_1, v_2|\Omega)} \tag{14}$$

where: $v_0 = \upsilon(N_0, \mathbf{Z})/\sigma$; v_1 is the maximal value of $[\upsilon(N_r, \mathbf{Z}) - \Gamma_1]/\sigma$ over all eligible combinations r involving receipt of HB and/or CTB but not IS; and v_2 is the maximal value of $[\upsilon(N_r, \mathbf{Z}) - \Gamma_2]/\sigma$ over all eligible combinations r involving IS receipt. This implies a nested logit structure for the 3-alternative choice probability $P(r|0, 6, 7)$ and a simple MNL structure for the various 2-alternative probabilities.

4 Empirical results

In our final specification of the utility function we have used age, disability and education for the covariates in $\mathbf{Z}$. The claim costs Γ_1 and Γ_2 are specified as constants. The covariate vector $\mathbf{X}$ in the awareness probabilites contain two variables: Y = original income net of rent and Council Tax, and (for renters only) a dummy identifying those who are not LA/HA tenants. We have fitted separate models for the homeowner and renter tenure groups by maximum likelihood. The estimates of the utility parameters are set out in Table 5. Note that, for home-owners, the estimate of μ is on the boundary of the parameter space at unity.

[*** TABLE 5 HERE ***]

Full estimates of the parameters of the awareness probabilities are given in Appendix Tables A3-A5. Table 6 gives sample means and marginal responses of the awareness probabilities implied by these estimates. There are three features we would expect them to possess. Firstly, since the returns to search decrease with income N_0, the probabilities of total unawareness $(Q_1, Q_2, Q_4, Q_5, Q_8)$ and of full awareness $(1 - Q_1, 1 - Q_2 - Q_3, 1 - Q_4, 1 - Q_5 - Q_6 - Q_7, 1 - Q_8 - ... - Q_{11})$ should be respectively increasing and decreasing in N_0. Secondly, the larger the number of entitlements, the higher is

the probability that at least one will be perceived. Thus we should observe $(Q_1 > Q_2, Q_4 > Q_5 > Q_8)$. Thirdly, because of their better access to advisory services, the probability of total unawareness should be less for LA/HA tenants than for home-owners or private tenants. Table 6 shows that these a priori expectations are fully satisfied by the estimates.

[*** TABLE 6 HERE ***]

5 Welfare losses from claim costs and imperfect information

Our objective is to measure the welfare loss generated by claim costs and information deficit. In doing this, it is important to distinguish four separate concepts of welfare loss, denoted $C_1 ... C_4$, which are borne by successively wider groups of individuals. Define benefit dependency costs C_1 as those costs that are only incurred by benefit recipients and are tied specifically to the combination of welfare benefits actually received. They may include social stigma, the cost of collecting payments, the cost of renewing the claim *etc.* The second concept of welfare loss, C_2, is also attributable to claim costs, but it results from the possibility that claim costs may cause a change in the combination of benefits selected. All eligible people, including those who choose not to take up any entitlement, may suffer some welfare loss of this type. Note that C_1 is a component of C_2. The third concept of welfare loss, C_3, is due to incomplete awareness of benefit options and is also potentially found among the whole group of those who have some positive entitlement. The fourth category comprises information search costs ($C_4 = c \times e$ in the terminology of section 3), which may additionally be borne by some non-entitled people who engage in fruitless information search.

We cannot hope to evaluate C_4 since we do not observe search activity and we have no means of knowing which non-entitled pensioners have engaged in unsuccessful search. However, given our estimated model, it is possible to evaluate the other categories of cost. The valuation principle is the same for both cases: we seek the distribution of the compensating variation (V) which equates maximised utility under two different situations. Since claimants are a self-selected group, we need to condition the distribution of this compensating amount on the choice of the observed participation regime under claim

costs.

First consider actual benefit dependency costs C_1, which are conditional on the actual combination of receipt. This is given by the value V which solves the equation $v(N_r, \mathbf{Z}) - \Gamma_r + \varepsilon_r = v(N_r - V, \mathbf{Z}) + \varepsilon_r$ for $r = \widetilde{r}$. Thus:

$$C_1 = N_{\widetilde{r}} - v^{-1}\left(v(N_{\widetilde{r}}, \mathbf{Z}) - \Gamma_{\widetilde{r}}, \mathbf{Z}\right) \tag{15}$$

where $v^{-1}(., \mathbf{Z})$ is v inverted with respect to its first argument. Note that C_1 is zero for any household not receiving any welfare benefit and that $N_{\widetilde{r}} - C_1 = v^{-1}\left(v(N_{\widetilde{r}}, \mathbf{Z}) - \Gamma_{\widetilde{r}}, \mathbf{Z}\right)$ can be interpreted as actual net income adjusted for claim costs (see Pudney et. al., 2003 for a single-benefit application of this approach).

Anticipated claim costs are responsible for wider welfare losses than the direct cost C_1. To quantify the total loss due to claim costs, condition first on a given configuration of awareness. Think of $\{N_r, \Gamma_r; r \in \Omega\}$ as the *status quo* and $\{N_r, \Gamma_r = 0; r \in \Omega\}$ as a hypothetical world in which there is no stigma or claim cost. Then V_Ω is defined implicitly by the following equality:

$$\max_{r \in \Omega} v(N_r, \mathbf{Z}) - \Gamma_r + \varepsilon_r = \max_{r \in \Omega} v(N_r - V_\Omega, \mathbf{Z}) + \varepsilon_r \tag{16}$$

for any $\Omega \ni \widetilde{r}$, where $v(N_r - V_\Omega, \mathbf{Z}) = -\infty$ for $N_r \leq V_\Omega$. The resulting value conditional on the awreness set Ω is $C_2(\Omega) = V_\Omega$, which depends on the ε_r and is therefore random. Note that this value $C_2(\Omega)$ cannot exceed the net income $N_{\widetilde{r}}$ that is actually realised but it can be incurred by people who are entitled but do not participate in any of the welfare programmes.

Now consider the welfare loss from imperfect information. The compensating variation V_Ω now solves the following equation:

$$\max_{r \in \Omega} v(N_r, \mathbf{Z}) - \Gamma_r + \varepsilon_r = \max_{r \in \{0...7\}} v(N_r - V_\Omega, \mathbf{Z}) - \Gamma_r + \varepsilon_r \tag{17}$$

In this case, the value $C_3(\Omega) = V_\Omega$ may exceed the realised net income $N_{\widetilde{r}}$. For example, if someone has a small CTB entitlement and a large HB entitlement, they may engage in costly information search that, by chance, reveals the former but not the latter. In that case, the welfare loss from the lack of success of search may in principle exceed their realised net income.

In each of the two cases C_2 and C_3, we require the distribution of $V(\Omega)$ conditional on the observed choice $\widetilde{r}$ and on $\mathbf{N} = (N_0...N_7)$ and $\mathbf{Z}$. To achieve

this, we adapt a result due to de Palma and Kilani (2002). First, write (17) in the equivalent form:

$$\max_{r\in\{0...7\}} \upsilon(N_r, \mathbf{Z}) - \Gamma_r^* + \varepsilon_r = \max_{r\in\{0...7\}} \upsilon(N_r - V, \mathbf{Z}) - \Gamma_r + \varepsilon_r \tag{18}$$

where $\Gamma_r^* = \Gamma_r$ if $r \in \Omega$ and $\Gamma_r^* = \infty$ if $r \notin \Omega$. Conditioning on Ω, the de Palma-Kilani result is that the conditional cdf of V_Ω can be written:

$$F(V_\Omega \,|\, \widetilde{r}, \mathbf{N}, \mathbf{Z}, \Omega) = \begin{cases} \frac{P_{\widetilde{r}}(\boldsymbol{\upsilon}^*(V_\Omega))}{P_{\widetilde{r}}(\boldsymbol{\upsilon}^0)} & V_\Omega \geq C_1 \\ \\ 0 & V_\Omega < C_1 \end{cases} \tag{19}$$

where C_1 is the direct claim cost given by (15) and $P_r(\boldsymbol{\upsilon}^0)$ is the choice probability expressed as a function of the vector of post-search mean utilities $\boldsymbol{\upsilon}^0 = [\upsilon(N_0, \mathbf{Z}), \upsilon(N_1, \mathbf{Z}) - \Gamma_1^*, ..., \upsilon(N_7, \mathbf{Z}) - \Gamma_7^*]$. The vector $\boldsymbol{\upsilon}^*(V_\Omega)$ has rth element:

$$\upsilon_r^*(V_\Omega) = \max\left\{\upsilon(N_r, \mathbf{Z}) - \Gamma_r^*, \upsilon(N_r - V_\Omega, \mathbf{Z})\right\} \tag{20}$$

Now marginalise with respect to the unobserved awareness set Ω to get the unconditional distribution of the overall compensating variation V:

$$\overline{F}(V \,|\, \widetilde{r}, \mathbf{N}, \mathbf{Z}) = \frac{\sum_{\Omega:\widetilde{r}\in\Omega} Q(\Omega, N_\Omega|\mathbf{X}) F(V \,|\, \widetilde{r}, \mathbf{N}, \mathbf{Z}, \Omega)}{\sum_{\Omega:\widetilde{r}\in\Omega} Q(\Omega, N_\Omega|\mathbf{X})} \tag{21}$$

This distribution function can then be used to estimate the expected welfare losses for any individual.

$$E\left[V \,|\, \widetilde{r}, \mathbf{N}, \mathbf{Z}\right] = \frac{\sum_{\Omega:\widetilde{r}\in\Omega} \left\{ Q(\Omega, N_\Omega|\mathbf{X}) \left[\phi_\Omega^+ - \int_{\phi_{\widetilde{r}}}^{\phi_\Omega^+} F(V \,|\, \widetilde{r}, \mathbf{N}, \mathbf{Z}, \Omega) dV\right]\right\}}{\sum_{\Omega:\widetilde{r}\in\Omega} Q(\Omega, N_\Omega|\mathbf{X})} \tag{22}$$

where $\phi^+ = \max_{r\in\{0...7\}} \phi_r$ and ϕ_r is the solution of the equation $\upsilon(N_r, \mathbf{Z}) - \Gamma_r = \upsilon(N_r - \phi_r, \mathbf{Z})$. Expression (22) is found by integrating by parts the usual definition of a mean in terms of the density of V.

Table 7 summarises the expected welfare losses implied by the estimated model. For each sampled household (whether receiving benefit or not), we evaluate expressions like (22) for C_1 and C_2 and average the results over all

households within groups classified by their combination of entitlements and housing tenure. Note that C_1 is identically zero for households that take up none of their entitlements and also for all renters, since $\widehat{\Gamma}_1$ and $\widehat{\Gamma}_2$ were insignificant for renters and have been dropped from the model.

For homeowners, welfare losses stemming directly or indirectly from claim costs are particularly high for homeowners entitled to IS in addition to CTB (around £4-5 per week). The estimates for sample 1 implies that three-quarters of this loss is attributable to the direct costs entailed by the combination of benefits actually received (C_1); in contrast, the sample 2 results imply that only 43% of of the loss is due to direct costs, the remaining 57% being attributable to the distortion of choice caused by the existence of potential claim costs. Welfare losses attributable to imperfect information about entitlements are considerably smaller than losses due to claim costs, except for low-income homeowners who are entitled to IS in addition to CTB - a group generally thought to have relatively poor access to information and advice on the welfare system. Welfare losses for home renters appear to be negligible in relation to the average size of benefit entitlement (see Appendix Table A1), whereas the welfare losses for homeowners are substantial.

[*** TABLE 7 HERE ***]

6 Conclusions

In this paper we have introduced a new class of discrete choice models for welfare participation in a multi-programme setting. The model is based on the idea that the acquisition of information about welfare eligibility is costly and that, as a consequence, some individuals are only partially informed about the opportunities open to them when making the participation decision. Since awareness is not observable, this leads to a new type of heterogeneous discrete choice model with heterogeneity in awareness of the opportunity set rather than in taste parameters. We have estimated a simple model of participation by UK pensioners in multiple overlapping welfare programmes and found results that are consistent with the information search view of behaviour, thus demonstrating the potential importance of this type of heterogeneity. We have extended the theory of the compensating variation for discrete choice

models to allow for the possibility of unobserved heterogeneity in awareness of entitlements and implemented that approach to estimate three components of the welfare loss that is associated with income-testing. Welfare losses experienced by home renters are small on average but are much more significant for low-income homeowners. Direct losses in the form of claim costs borne by benefit recipients and indirect losses resulting from the choice distortions induced by potential claim costs can be high (around 10-20% of entitlements on average for homeowners with entitlement to IS and CTB),

One of the problems in this area is that it is difficult to distinguish empirically the processes of information, cognition and decision making from observed outcomes without direct observation on individuals' state of awareness. As Dominitz *et. al.* (2003) have argued in a slightly different context, significant progress beyond this point will require major innovation in survey design.

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Table 1 Simulated homeowners' entitlement and participation[1]

Homeowners entitled to CTB only				
Take-up rate	43%	1132	52%	1348
Non-claimants' mean original income[2]	£121	643	£121	643
Non-claimants' mean CTB entitlement	£4	643	£4	643
Claimants' mean original income[2]	£110	489	£126	705
Caimants' mean CTB entitlement	£7	489	£6	705
Homeowners entitled to IS and CTB				
Non-participation rate	25%	651	24%	687
IS-only take-up rate	1%	651	1%	687
CTB-only take-up rate	25%	651	24%	687
IS+CTB take-up rate	48%	651	51%	687
Non-claimants: mean original income[2]	£91	164	£91	164
Non-claimants: mean IS entitlement	£15	164	£15	164
Non-claimants: mean CTB entitlement	£10	164	£10	164
IS-only claimants: mean original income[2]	£86	9	£93	10
IS-only claimants: mean IS entitlement	£34	9	£33	10
IS-only claimants: mean CTB entitlement	£8	9	£8	10
CTB-only claimants: mean original income[2]	£93	163	£93	163
CTB-only claimants: mean IS entitlement	£16	163	£16	163
CTB-only claimants: mean CTB entitlement	£10	163	£8	163
IS+CTB claimants: mean original income[2]	£79	315	£82	350
IS+CTB claimants: mean IS entitlement	£21	315	£22	350
IS+CTB claimants: mean CTB entitlement	£9	315	£9	350

[1] Figures may not add up to totals due to rounding error.

[2] Income defined as assessable income plus disregarded income including investment returns.

Table 2 Simulated renters' entitlement and participation[1,2]

Renters entitled to HB only				
Take-up rate	55%	150	60%	169
Non-claimants' mean original income	£138	67	£138	67
Non-claimants' mean HB entitlement	£13	67	£13	67
Claimants' mean original income	£128	83	£134	102
Claimants' mean HB entitlement	£20	83	£18	102
Renters entitled to HB and CTB only				
Non-participation rate	10%	1129	9%	1286
HB-only take-up rate	4%	1129	3%	1286
CTB-only take-up rate	2%	1129	2%	1286
HB+CTB take-up rate	85%	1129	86%	1286
Non-claimants: mean original income	£120	116	£120	116
Non-claimants: mean HB entitlement	£23	116	£23	116
Non-claimants: mean CTB entitlement	£4	116	£4	116
HB-only claimants: mean original income	£107	40	£107	40
HB-only claimants: mean HB entitlement	£26	40	£18	40
HB-only claimants: mean CTB entitlement	£3	40	£3	40
CTB-only claimants: mean original income	£104	18	£107	21
CTB-only claimants: mean HB entitlement	£20	18	£18	21
CTB-only claimants: mean CTB entitlement	£7	18	£4	21
HB+CTB claimants: mean original income	£104	955	£113	1109
HB+CTB claimants: mean HB entitlement	£33	955	£31	1109
HB+CTB claimants: mean CTB entitlement	£6	955	£6	1109

[1] Figures may not add up to totals due to rounding error.

[2] Renters entitled to CTB only are excluded from the table since there are only 18 observations in the first sample and 40 in the second

Table 2 (continued) Simulated renters' entitlement and participation

Renters entitled to IS+HB+CTB[1]				
Non-participation rate	3%	1286	2%	1360
IS-only take-up rate	0%	1286	0%	1360
HB-only take-up rate	1%	1286	1%	1360
CTB-only take-up rate	1%	1286	1%	1360
IS+HB-only take-up rate	0%	1286	0%	1360
IS+CTB-only take-up rate	-	1286	1%	1360
HB+CTB-only take-up rate	22%	1286	21%	1360
IS+HB+CTB take-up rate	73%	1286	74%	1360
Non-claimants: mean original income	£87	33	£87	33
Non-claimants: mean IS entitlement	£21	33	£21	33
Non-claimants: mean HB entitlement	£31	33	£31	33
Non-claimants: mean CTB entitlement	£8	33	£8	33
HB-only claimants: mean original income	£55	7	£55	7
HB-only claimants: mean IS entitlement	£28	7	£28	7
HB-only claimants: mean HB entitlement	£39	7	£35	7
HB-only claimants: mean CTB entitlement	£8	7	£8	7
CTB-only claimants: mean original income	£82	14	£82	14
CTB-only claimants: mean IS entitlement	£6	14	£6	14
CTB-only claimants: mean HB entitlement	£31	14	£31	14
CTB-only claimants: mean CTB entitlement	£8	14	£6	14
IS+CTB claimants: mean original income	£72	6	£76	7
IS+CTB claimants: mean IS entitlement	£17	6	£23	7
IS+CTB claimants: mean HB entitlement	£27	6	£31	7
IS+CTB claimants: mean CTB entitlement	£8	6	£9	7
HB+CTB claimants: mean original income	£95	285	£95	285
HB+CTB claimants: mean IS entitlement	£15	285	£15	285
HB+CTB claimants: mean HB entitlement	£41	285	£37	285
HB+CTB claimants: mean CTB entitlement	£8	285	£7	285
IS+HB+CTB claimants: mean original income	£76	940	£78	1012
IS+HB+CTB claimants: mean IS entitlement	£21	940	£21	1012
IS+HB+CTB claimants: mean HB entitlement	£43	940	£42	1012
IS+HB+CTB claimants: mean CTB entitlement	£8	940	£8	1012

[1] There is only one IS-only claimant in both samples and one IS+HB claimant in sample 2.

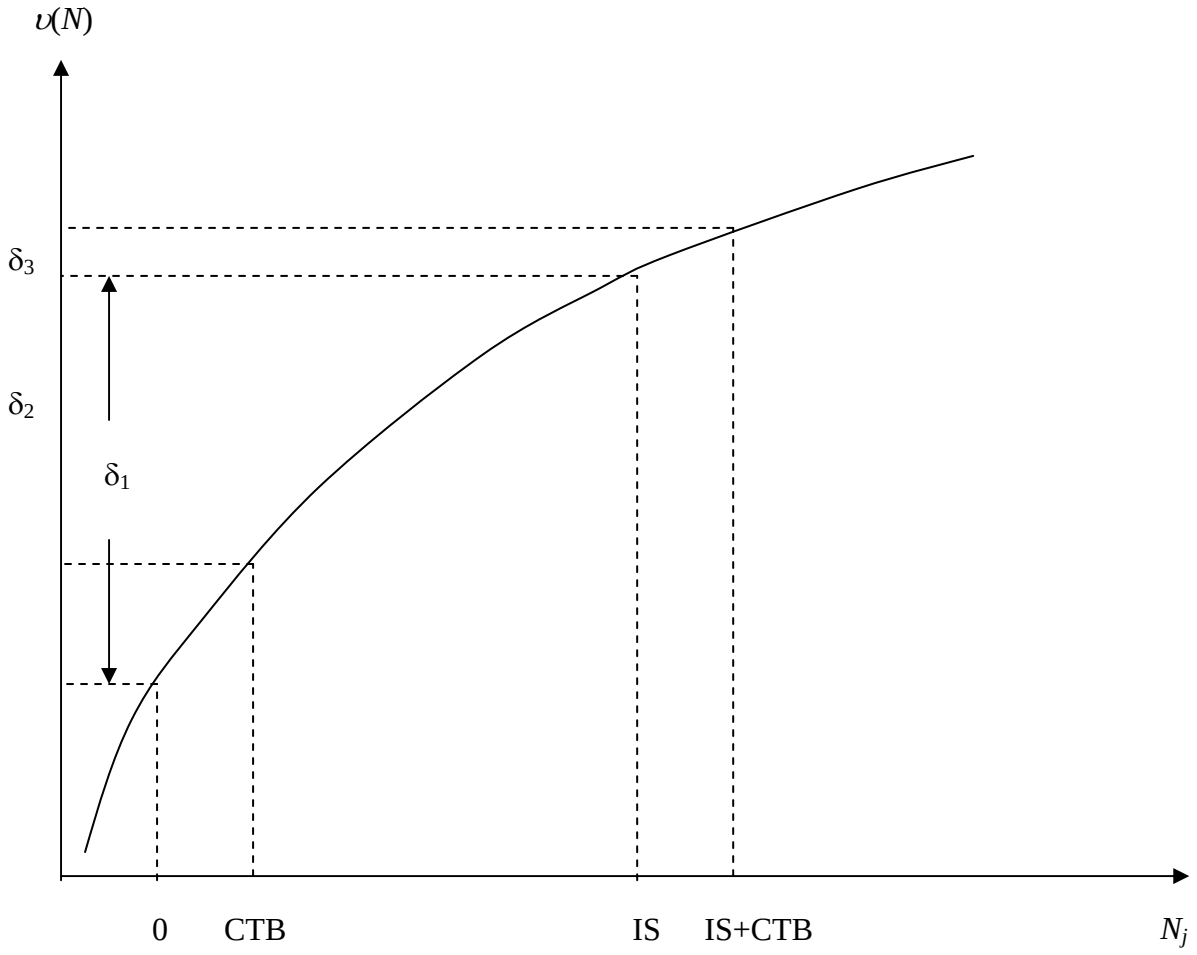

Figure 1 The choice problem for an individual entitled to IS and CTB

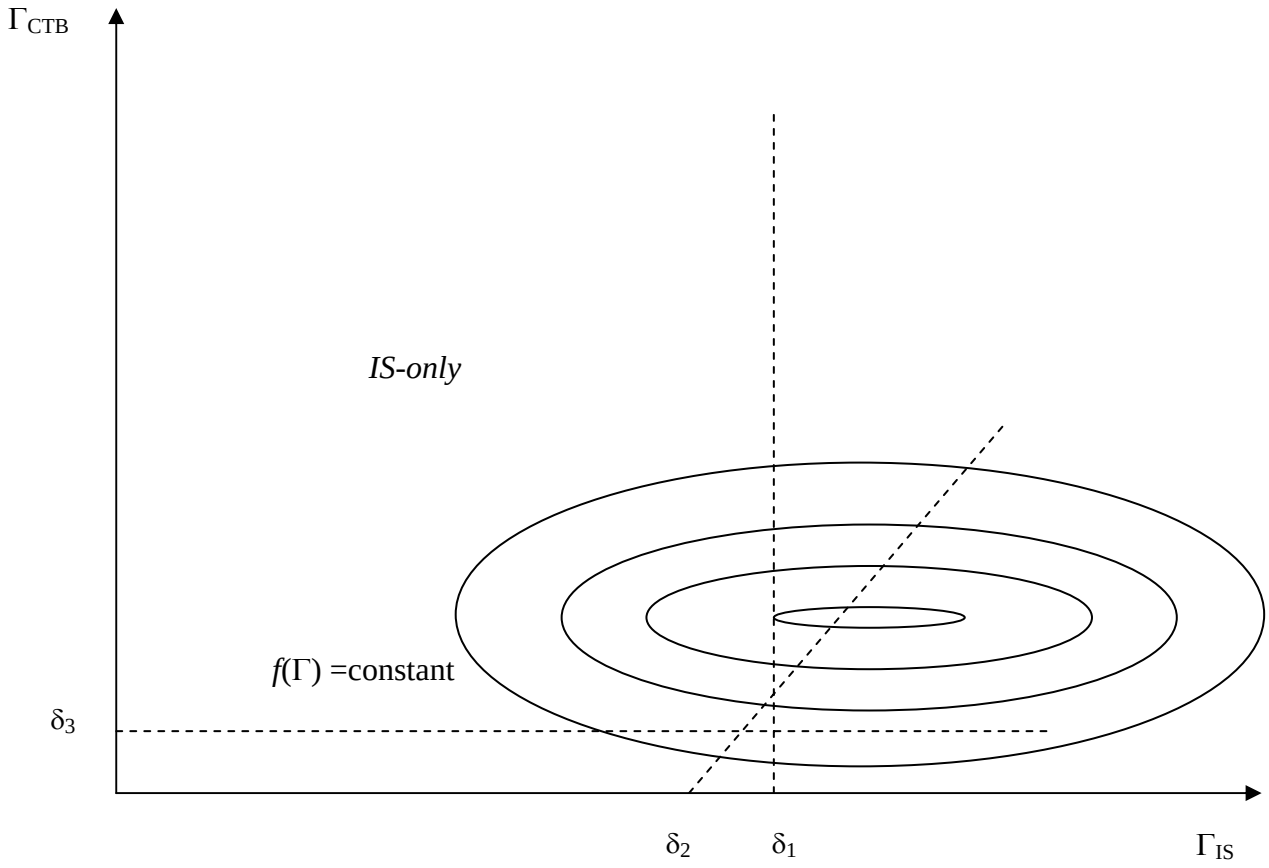

Figure 2 The probability of selection of the IS-only option

Table 3 Estimated MNL model with regime-specific claim costs (Sample 2)

Coefficient	Homeowners ($n = 3515$)		Renters ($n = 4547$)	
	Estimate	Std.err.	Estimate	Std.err.
$\ln N_r$	2.121	(0.398)	-0.996	(0.677)
$\ln N_r \times$ age	-0.964	(0.241)	-1.235	(0.204)
$\ln N_r \times$ educated past 14	-1.156	(0.296)	-0.091	(0.314)
$\ln N_r \times$ receiving AA/DLA	0.412	(0.430)	-1.324	(0.356)
$\ln N_r \times$ HA/LA tenant	-		1.536	(0.349)
$(\ln N_r)^2$	0.028	(0.049)	0.367	(0.096)
Γ_1: IS-only	3.241	(0.242)	3.387	(0.711)
Γ_2: HB-only	-		1.213	(0.096)
Γ_3: CTB-only	0.274	(0.041)	1.161	(0.126)
Γ_4: IS and HB	-		4.396	(0.717)
Γ_5: IS and CTB	-0.077	(0.093)	1.728	(0.288)
Γ_6: HB and CTB	-		-1.387	(0.088)
Γ_7: IS, HB and CTB	-		-2.091	(0.121)

Notes: Homeowners are not entitled to HB. Age is measured in decades from an origin of 77. N_r is regime-specific net income.

Table 4 The structure of awareness probabilities

r	Regime	Awareness probability $Q(\Omega, N_\Omega \mid \mathbf{X})$				
		Owners entitled to ...		Renters entitled to ...		
		CTB	IS+CTB	HB	HB+CTB	IS+HB+CTB
0	None	Q_1	Q_2	Q_4	Q_5	Q_8
1	IS		0			0
2	HB			$1 - Q_4$	Q_6	Q_9
3	CTB	$1 - Q_1$	Q_3		Q_7	Q_{10}
4	IS+HB					0
5	IS+CTB		$1 - Q_2$ $-Q_3$			0
6	HB+CTB				$1 - Q_5$ $-Q_6 - Q_7$	Q_{11}
7	IS+HB+CTB					$1 - Q_8 - Q_9$ $-Q_{10} - Q_{11}$

Table 5 Estimates of utility and subjective claim costs
(standard errors in parentheses)

	Sample 1		Sample 2	
Parameter	Owners	Renters[1]	Owners	Renters
ln N_r × age	-0.240	-0.325	-0.080	-0.380
	(0.057)	(0.043)	(0.106)	(0.050)
ln N_r × disabled	0.570	0.371	0.531	0.430
	(0.175)	(0.120)	(0.341)	(0.189)
ln N_r × education	-0.429	-0.185	-0.121	-0.151
	(0.064)	(0.066)	(0.131)	(0.088)
$(\ln N_r)^2$	-0.622	-0.262	0.069	0.073
	(0.158)	(0.072)	(0.048)	(0.080)
Γ_1	0.037	0.043	0.009	-
	(0.005)	(0.010)	(0.003)	
Γ_2	0.068	0.043	0.037	-
	(0.008)	(0.010)	(0.005)	
μ	1	0.367	1	0.376
		(0.061)		(0.054)
σ	0.031	0.067	0.020	0.076
	(0.004)	(0.008)	(0.003)	(0.007)
n	3132	4121	3496	4477

Note: age is measured in decades from an origin of 77

[1]We have restricted Γ_1 and Γ_2 to be equal.

Table 6 Mean and median awareness probabilities

Homeowners				
	Sample 1		Sample 2	
Awareness probability	Mean	marginal response income	Mean	marginal response income
Q_1	0.326	0.152	0.414	-0.128**
$1 - Q_1$	0.674	-0.152	0.586	0.128**
Q_2	0.243	-0.107*	0.279	0.015
Q_3	0.212	0.302***	0.190	0.157***
$1 - Q_2 - Q_3$	0.545	-0.195***	0.531	-0.172***

Renters						
Awareness		marginal response			marginal response	
probability	Mean	income	not LA/HA	Mean	income	not LA/HA
Q_4	0.367	-0.755***	-0.126	0.308	-0.261	-0.072
$1 - Q_4$	0.633	0.755***	0.126	0.692	0.261	0.072
Q_5	0.032	-0.010	0.067*	0.039	-0.003	0.069**
Q_6	0.041	0.074***	0.006	0.036	0.004	0.000
Q_7	0.027	0.065***	0.059*	0.022	0.008	0.044*
$1 - ... - Q_7$	0.900	-0.129***	-0.132***	0.903	-0.009	-0.113***
Q_8	0.022	0.005	0.023	0.026	0.027**	0.051*
Q_9	0.006	0.002	0.001	0.006	0.001	0.000
Q_{10}	0.017	0.036***	0.095***	0.014	0.023**	0.066**
Q_{11}	0.178	0.351***	-0.031	0.177	0.282***	-0.044
$1 - ... - Q_{11}$	0.777	-0.394***	-0.088*	0.751	-0.332***	-0.073*

* = significant at 10% level; ** = significant at 5% level; *** = significant at 1% level;

Table 7 Mean estimated welfare losses for benefit recipients

Entitled to...	*Sample 1* Home-owners	*Sample 1* LA/HA tenants	*Sample 1* Other tenants	*Sample 2* Home-owners	*Sample 2* LA/HA tenants	*Sample 2* Other tenants
Direct benefit dependency costs C_1						
CTB only	1.93	-	-	0.60	-	-
	(0.07)			(0.02)		
IS+CTB	5.21	-	-	2.18	-	-
	(0.16)			(0.06)		
HB only	-	3.85	6.43	-	-	-
		(0.34)	(1.43)			
HB+CTB	-	6.19	7.58	-	-	-
		(0.08)	(0.46)			
IS+HB+CTB	-	7.76	8.81	-	-	-
		(0.08)	(0.43)			
Welfare loss due to claim costs C_2						
CTB only	2.34	-	-	0.66	-	-
	(0.06)			(0.01)		
IS+CTB	7.06	-	-	5.59	-	-
	(0.15)			(0.30)		
HB only	-	4.29	7.07	-	-	-
		(0.32)	(1.34)			
HB+CTB	-	6.68	8.62	-	-	-
		(0.07)	(0.43)			
IS+HB+CTB	-	8.01	9.41	-	-	-
		(0.08)	(0.39)			
Welfare loss through imperfect information C_3						
CTB only	1.45	-	-	0.57	-	-
	(0.03)			(0.03)		
IS+CTB	4.41	-	-	3.45	-	-
	(0.20)			(0.39)		
HB only	-	0.31	0.18	-	0.42	0.32
		(0.08)	(0.15)		(0.09)	(0.26)
HB+CTB	-	0.04	0.32	-	0.04	0.28
		(0.01)	(0.13)		(0.00)	(0.11)
IS+HB+CTB	-	0.17	0.11	-	0.15	0.08
		(0.04)	(0.07)		(0.03)	(0.05)

Standard errors in parentheses

Appendix
Data characteristics and parameter estimates

Table A1 Variable definitions and sample means
(standard errors in parentheses)

Variable	Definition	Sample 1 mean		Sample 2 mean	
		Owners	Renters	Owners	Renters
N_0	Per capita income, excluding	91.75	88.56	96.81	92.30
	means-tested benefits	(0.50)	(0.45)	(0.66)	(0.56)
N_1	Net per capita income including	99.00	99.41	103.86	102.63
	entitlement to IS	(0.54)	(0.50)	(0.68)	(0.59)
N_2	Net per capita income including	-	124.04	-	125.82
	entitlement to HB		(0.50)		(0.60)
N_3	Net per capita income including	98.55	95.22	103.22	98.70
	entitlement to CTB	(0.49)	(0.43)	(0.65)	(0.56)
N_4	Net per capita income including	-	134.88	-	136.16
	entitlements to IS+HB		(0.59)		(0.66)
N_5	Net per capita income including	105.81	106.06	110.26	109.04
	entitlements to IS+CTB	(0.54)	(0.50)	(0.68)	(0.59)
N_6	Net per capita income including	-	130.69	-	132.23
	entitlements to HB+CTB		(0.50)		(0.61)
N_7	Net per capita income including	-	141.53	-	142.56
	entitlements to IS+HB+CTB		(0.60)		(0.67)
Age	Age of the household head	77.77	76.56	77.75	76.59
		(0.11)	(0.10)	(0.10)	(0.08)
Disabled	Dummy = 1 if any household	0.18	0.22	0.18	0.22
	member receives AA or DLA	(0.01)	(0.01)	(0.01)	(0.01)
Education	Dummy = 1 if household head	0.27	0.18	0.28	0.18
	left school aged 15 or more	(0.01)	(0.01)	(0.01)	(0.01)
Y	Per capita original income	82.36	38.71	87.34	42.64
	less rent and council tax	(0.49)	(0.51)	(0.65)	(0.60)
non LA/HA	Dummy = 1 if not an LA/HA	-	0.08	-	0.08
	tenant		(0.00)		(0.00)

Note: the income variables $N_0 ... N_7, Y$ are in £ per week per head

Table A2 Estimates of search outcome probabilities (standard errors in parentheses)

	Homeowners entitled to:		
	CTB	IS+CTB	
MNL parameter	Q_1	Q_2	Q_3
Sample 1			
Intercept	-1.309	-0.741	-2.568
	(0.377)	(0.249)	(0.267)
Income	0.698	-0.085	1.882
	(0.469)	(0.377)	(0.305)
Sample 2			
Intercept	0.110	-0.975	-2.110
	(0.192)	(0.180)	(0.231)
Income	-0.530	0.388	1.195
	(0.229)	(0.231)	(0.247)

Table A3 Estimates of search outcome probabilities
(standard errors in parentheses)

	Renters entitled to:			
	HB	HB+CTB		
MNL parameter	Q_4	Q_5	Q_6	Q_7
Sample 1				
Intercept	0.955	-3.464	-4.090	-5.080
	(0.897)	(0.400)	(0.368)	(0.490)
Income	-4.122	-0.164	2.059	2.755
	(1.853)	(1.100)	(0.626)	(0.744)
non-LA/HA tenant	-0.749	1.410	0.330	1.493
	(0.956)	(0.460)	(0.481)	(0.507)
Sample 2				
Intercept	-0.284	-3.269	-3.279	-4.036
	(0.635)	(0.343)	(0.364)	(0.468)
Income	-1.271	-0.061	0.123	0.355
	(0.978)	(0.654)	(0.620)	(0.700)
non-LA/HA tenant	-0.371	1.247	0.144	1.330
	(0.707)	(0.398)	(0.476)	(0.468)

Table A4 Estimates of search outcome probabilities
(standard errors in parentheses)

	Renters entitled to IS+HB+CTB			
MNL parameter	Q_8	Q_9	Q_{10}	Q_{11}
Sample 1				
Intercept	-3.956	-5.203	-5.732	-2.737
	(0.249)	(0.426)	(0.370)	(0.198)
Income	0.801	0.871	3.008	2.766
	(0.751)	(0.837)	(0.594)	(0.271)
non-LA/HA tenant	0.900	0.236	2.497	-0.016
	(0.536)	(1.135)	(0.502)	(0.362)
Sample 2				
Intercept	-4.266	-5.199	-5.588	-2.579
	(0.239)	(0.426)	(0.364)	(0.180)
Income	1.601	0.648	2.346	2.263
	(0.473)	(0.836)	(0.567)	(0.236)
non-LA/HA tenant	1.307	0.157	2.225	-0.143
	(0.425)	(1.135)	(0.505)	(0.340)