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BIVARIATE MODELS OF DEMAND FOR UK PRIVATE HEALTH INSURANCE

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Abstract

The principal objective of this study is to test whether one-step (univariate) or two-step process (bivariate) econometric models are adequate for describing the behaviour of British families in relation to demand for private health insurance (PHI). The merit of this study lies behind the presumption that the demand function is smooth. Here, the first decision is whether to acquire PHI. The second refers to the determination of the actual level of insurance cover (which might be zero as well). Further, the study evaluates the impact of the recently introduced tax-concessions for the elderly on the demand for PHI.

The modelling strategy employs two classes of bivariate models: 1) the double-hurdle; 2) the dominance. Both allow for distinct processes determining the censoring rule and the continuous observations but have different economic implications. The sample comes from the 1991-92 Family Expenditure Survey.

Findings suggest that two-step models (the Cragg and the Complete Dominance models) perform better than one-step models (e.g., logit, probit, Tobit). Put differently, ignoring the two-stage decision process will miss the true behavioural patterns and can lead to erroneous conclusions. The analysis indicated that those who are in the upper socio-economic classes and educated and also have relatively high unearned income would tend to participate in the PHI market. Also people who get old and enjoy a comparatively high ability to pay would tend to spend more on health cover. In addition, the use of tax-incentives for the elderly had little effect on the participation or spending decisions. Throughout the study, rigorous testing is applied to ensure and strengthen the statistical validity of results.

Key words: *Double-hurdle model; Truncated and Censored Models;*
Demand for private health insurance; Family Expenditure Survey (FES).

JEL Classification: *C3, D1, I1*

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Introduction

An important aspect of the British National Health Service (NHS) is the provision of health care free at the point of delivery. This has made unavoidable the emergence of waiting lists for the non-emergency medical conditions (e.g., non-elective surgery). Private health insurance (PHI hereafter) has emerged to meet those consumer's needs that remain unsatisfied by the public provision. Recent statistics suggest that around 4.8 million people or 8.20% of the population had health cover in 1992 (Laing and Buisson 1995).

Previous research in this area has examined the self-funded PHI demand (Propper 1989, 1993; Besley et al 1996) and found that the better off, the better educated and the middle aged are more likely to acquire non-corporate cover. This analysis has mostly seen the PHI demand as a one-stage process and used the univariate logit (Propper 1987, 1989) or probit model (Besley et al 1996). The exemption is the study by Propper (1993) who looked at the PHI demand as a two-stage process where individuals first determine which options fall in their choice set and then decide to purchase health cover. The results showed that the two decision are not related.

This paper primarily seeks to examine whether one-stage (univariate) or two-stages (bivariate) stochastic models provide an adequate characterisation of the demand for health cover. The merit of this study lies behind the presumption that the demand function is smooth. As will be seen below, this may not be true in the case of private medical insurance. Moreover, the work makes an attempt to evaluate the effect of the 1990 introduced tax-reliefs for people over 60 years of age. Throughout the study, rigorous testing is applied to ensure and strengthen the statistical validity of results.

The organisation of this paper is as follows. The next section presents the private health insurance market in the UK. The third section reviews the existing work. The fourth describes the econometric method, the data and the principal variables. The fifth section interprets the regression results. The last section concludes.

The Nature of Private Health Insurance market

The value of health services offered by the private sector as a percentage of the overall expenditures moved up from 10.7% in 1987 to around 19% in 1993. The value of health care services purchased in the independent sector was estimated at £4,724 million, whilst the gross revenue and capital cost of the NHS inpatient care was at £20,430 million in 1993. This size-based comparison hides the real contribution of the independent sector into the market. 90% of males and 86% of females who went 'private' in 1992/93 had partly or fully financed the health care through PHI (Williams and Nicholl 1994). This has happened despite that the PHI market experienced a fall over the years of 1990-93 mostly because of the wide-economy recession and the industry-specific characteristic (i.e., the claims inflation) (Laing and Buisson 1995). In fact, there were 3,3 million PHI policy holders and 6,58 million persons covered with health insurance at the end of 1993.

The form of clinical activity carried out in private does not require advanced technological support. It focuses on the delivery of non-emergency (i.e., elective) surgical procedures (e.g., vasectomy) and non-surgical work (e.g., endoscopic exams). Private hospitals and NHS pay-beds provide health care to paying patients. The medical (i.e., consultants) and nursing manpower (e.g., nurses) working in private usually have an NHS contract.

Health insurance policies offer full or near full reimbursement against the monetary cost of health care. Cost-sharing devices (e.g., coinsurance), widely used in other PHI markets (e.g., USA) are rarely present in policies sold in UK. Cover is restricted to a specified range of conditions. Thus, certain forms of health care (e.g., maternity) are not covered. The main advantages of holding PHI are to avoid queues for services, access to private hospitals and physicians and have more comfort. To handle the issue of asymmetric information new policies were not widely available for elderly in the eighties. This situation was modified with the 1990 introduction of tax-reliefs for the over-60s.

The PHI market consists of non-profit (e.g., British United Provider Association) and for-profit (e.g., Prime Health) providers whilst there are three market-segments: a) the individual, with 23% of the market in 1991 (Laing & Buisson 1995) and the policy holder should self-finance the PHI purchase; b) the occupational, with a proportion of 18% and here the subscribers are members of professional associations, trade unions or company which acts as umbrella for the provision of care but the subscriber has to pay for the PHI acquisition; c) the corporate, with 59% and here policies are fully or partially subsidised by the firm. If the health benefits are partly financed then the individual has the option to include other family members into the scheme at his or her own expense. It is worth mentioning that employer's contributions towards the provision of health cover are not favourably treated for tax-purposes as it happens in other markets (e.g., USA).

Previous Research

The theoretical work on the demand for health cover in the UK has been developed elsewhere (Propper 1989, 1993). Briefly speaking, the theory views a risk averse EU maximising agent whose utility is derived from income and healthy time (Propper 1993). PHI is purchased on the grounds of the difference in the expected utility gain (EUG) between the prospect of insurance purchase and that of no-insurance. The costs and benefits of private treatment are compared with those of the NHS and PHI is taken out if the EUG is positive (Propper 1989, 1993).

The empirical work is confined to a series of articles published by Propper (1989, 1993), Propper and Maynard (1989) and Besley et al (1996). Propper (1989) estimates a logit model of the PHI demand using the 1982 General Household Survey and the family as the unit of observation. Income and employment status are found to be the key factors of the PHI purchase.

Propper (1993) examines the demand for non-corporate cover as a two-step process. The first is the choice set formulation where the individual may or may not have considered taking out health insurance. The second relates to the actual choice between the insurance and the no-insurance prospect. Using a bivariate model with a small data-set (N=1360) collected in 1987, she finds that the decision to consider the acquisition of health cover is not associated with that of its actual purchase. Educational attainment, income, ageing and political attitudes seem to generate the choice set whilst health status, ageing and income appear to determine the actual choice. The PHI demand is shown to be inelastic in short run (Propper and Maynard 1989). Using the probit model, Besley et al (1996) found that the better-off, the better educated and the middle-aged are more likely to take out non-corporate health cover whilst the length of waiting affects directly the PHI purchase.

The discussion has shown that the demand for self-paid health insurance has largely been modelled within the single-equation framework. As noted, the exception is the study by Propper (1993) which, however, used a small sample collected before the NHS reforms. Moreover, the common feature of the literature is to proxy the PHI demand with a dichotomous variable indicating whether or not the individual has health cover. So, the value of health benefits purchased has not yet been analysed. Concurrently, little research has been done to examine the effect of changes in government policy.

The present work seeks to throw further light on demand for health cover. Its primary aim is to investigate whether one-step (univariate) or two-step process (bivariate) econometric models are proper for analysing the behaviour of British families in regard to the demand for PHI. It makes an effort to quantify the effect that key socio-economic and demographic factors have on the demand for PHI more precisely than prior studies. It also attempts to assess the impact of the 1990 introduced tax-breaks for the elderly. In addition, the paper analyses the quantitative aspect of health cover (i.e., the amount of health cover taken out), looks at the whole country and considers the post-reforms period. This is possible by utilising a nation-wide cross-sectional sample drawn from the 1991 and 1992 Family Expenditure Survey.

The Statistical Methods

As noted earlier, positive realisations of the demand for PHI are observed if the EUG between the prospect of insurance purchase and NHS is positive. It is assumed that the underlying demand for health cover, a latent unobservable variable say PHI^*, is generated by the linear index

$$PHI^* = \beta' X_i + u_i \qquad (1)$$

where X_i is a $1 \times K_i$ vector of exogenous regressors, β_i is a $1 \times K_i$ vector of parameters and $u_i \sim NID(0, \sigma_u^2)$. The observable variable PHI equals PHI^* if $PHI^* \rangle 0$. Positive outlays on PHI reflect people with a '*current affordable demand*' and hence with a positive EUG. Instead, PHI is zero when the latent variable PHI^* is negative. This is the univariate censored normal model with the next likelihood function,

$$L_T = \prod_{PHI^* \leq 0} \left\{ 1 - \Phi\left(\frac{\beta' X}{\sigma_u^2} \right) \right\} \prod_{PHI^* \rangle 0} \frac{1}{\sigma_u} \phi\left(\frac{PHI - \beta' X}{\sigma_u} \right) \tag{2}$$

where $\Phi(.)$ and $\varphi(.)$ refer to the cumulative and density normal distribution functions respectively.

The Tobit model assumes that the same stochastic process determines both the value of continuous observations and the discrete switch at zero. This implies that all limit responses are treated as true corner solutions of an estimated smooth PHI demand equation. This is clearly a restrictive behavioural assumption. The reason being that although people may desire to acquire health cover, there are probably factors which prohibit the actual purchase of PHI. One reason is that the contracts as a rule do not insure the whole spectrum of morbidity and so certain conditions are excluded. Another one refers to that cover may be informally restricted to certain people. Thus, potential applicants may not qualify to acquire PHI. Once this observation is recognised then it is fruitful to view this issue as a two-step decision process. First, based on impediments to acquisition, the agent should decide whether or not to purchase PHI. Second, the decision-taker should decide on how much to spend on health cover. To pursue this idea, bivariate models need be used thus allowing the observation of a PHI subscriber to be a function of both the likelihood to participate in the market and the probability of the actual size of this purchase. Therefore, a second index (hurdle) is introduced to capture the possibility that some potential participants are frustrated or rationed. Let P^* denote the latent variable '*propensity to purchase PHI*' to be such as,

$$P_i^* = \alpha' W_i + e_i \tag{3}$$

where W_i is a $1 \times M_i$ vector of exogenous regressors, a_i is a $1 \times M_i$ vector of parameters and $e_i \sim NID(0, \sigma_e^2)$. In reality, the latent variable P^* cannot be observed but a dichotomous variable might be defined such as:

$$P = 1 \ iff \ P^* \rangle 0$$
$$P = 0 \ Otherwise$$

Here the potential PHI subscriber is rationed if $\alpha' W \rangle - e_i$ and spends on health cover if $\alpha' W \langle -e_i$. Following prior work (Propper 1993; Blaylock and Blisard 1992; Burton and Tomlinson 1994), the disturbances of the two processes are taken as independent and so the two decisions are not related. Technically, the Cragg model first postulates that the likelihood of a response observation is given by

$$\Pr ob(P = 0) = 1 - \Phi(\alpha' W) \tag{4}$$

It then assumes that the density of PHI conditional on being positive with mean $\beta' X$ and variance σ^2 is truncated at zero. Namely,

$$f\left(PHI_i / X_i, PHI_i \rangle 0\right) = \left\{\frac{1}{\sigma}\phi\left(\frac{PHI_i - \beta' X_i}{\sigma}\right)\right\} \circ \left\{\phi \frac{\beta' X_i}{\sigma}\right\}^{-1} \qquad (5)$$

For estimation purposes, this model only requires a probit equation to be fitted separately for the decision to obtain PHI (eq. 2) and a truncated regression form of eq. (1) to determine influences upon the size of health cover (Greene 1993, Leece 1995). The Cragg model nests the Tobit when the probability of participation is one. The Likelihood Ratio procedure can be easily used to check for the absence of an additional censoring rule.

Another class of bivariate models assumes that the error terms of the participation and spending equations (i.e., 1 and 2) are correlated but the participation decision dominates the spending decision. Here, once people decide to acquire PHI, purchase occurs and no-one is observed at a standard corner solution. As a consequence, the relationship between PHI expenditure and income is not related to the non-PHI policy holders. This model implies that $\Pr ob\left(PHI^* \rangle 0 / P = 1\right) = 1$. That is, the likelihood of non-limit responses equals one given that the individual participates. The likelihood function for the first hurdle dominant model is such as

$$L = \prod_{PHI^* \leq 0} \{1 - \Phi(\alpha' W)\} \prod_{PHI^* \rangle 0} \Phi(\alpha' W_i)\phi\left(PHI_i / e_i\rangle - \alpha' W_i\right) \qquad (6)$$

This is the Heckman's generalised Tobit or sample selectivity model. It can consistently be estimated by maximum likelihood or two-step procedures.

The dominant model is further reduced by assuming that the disturbances of the specification in equations (1) and (2) are independent (ρ=0). This is the complete dominance model. The implication is that the conditional expectation of u_i in equation (1) is zero and so the observed sample is random. As a result, the complete dominance model can be estimated by fitting a Probit for the participation and an OLS for the expenditure equation. Evidently, the Heckman's generalised Tobit nests the complete dominant model. The t-ratio on the correction coefficient (i.e., *the lambda*) indicates whether the first hurdle or the complete dominant model is a more appropriate description of the underlying data generating mechanism. Concretely, if the t-ratio, whose square value is a Lagrange multiplier test (Melino 1982), is significantly large (small) then the sample selectivity (the complete dominant) model is a better characterisation of the process generated the data.

Data and Principal Variables.

The Data

To keep comparability with prior work (Propper 1993), the data considered in this research refer to a sample of married household drawn from the 1991 and 1992 Family Expenditure Survey (FES). The FES is a continuous survey covering a total of 10,000 addresses in UK with a response of approximately 70%. The survey provides detailed information on household characteristics, income and spending on private insurance.

An inherent limitation of this work is that the FES does not adequately record the health cover outlays of those with employer-financed PHI. This means that families with fully or partly subsidised corporate cover are recorded as having zero or positive but still below the actual expenditure. Failure to take account of this aspect may have adverse effects on the vector of parameter estimates.

The current study does not take into consideration this issue for two reasons. First, the data do not contain enough information to distinguish two types of households: (a) those with company partly paid PHI from those with individually financed cover; (b) the families with employer fully funded health insurance from the ones without cover. Second, even if this information was available it is less-than-clear how to proceed in a cross-sectional framework with bivariate models. The regression results, therefore, should be examined with this in mind.

The unit of observation refers to the family. The estimation sample consists of 8,149 married households. Of these 896 have spent on PHI whilst 7,256 have reported zero outlays. This produces a sampling proportion of families with positive PHI expenditure of around 11%. This figure is broadly comparable with those found elsewhere (Besley et al 1996).

The Dependent Variables

In the participation equation, the regressand is a dichotomous variable indicating whether or not the family has spent on PHI. In the various specifications of the spending equation (e.g., the truncated equation), the dependent variable refers to the amount of weekly premium spent on PHI. An advantage of this variable as an indicator of consumer demand is that differences in quality and characteristics are reflected in market prices. Health cover outlays can, therefore, be viewed as a quality-adjusted measure of demand for health cover. This is clearly not the case with prior measures of PHI demand since they did not allow for the qualitative nature of insurance.

The Explanatory Variables

The definitions of all variables used in the analysis, their means and standard deviations for the whole sample of 8149 married families, and for the non-response observations are in Table 1. For the sake of brevity, the discussion beneath revolves around the variables used to measure the effect of government policy. In the analysis, all continuous determinants are in logs whilst all monetary variables are in pounds of 1991.

Measure of government policy

This study investigates *inter alia* the effect of tax-concessions for the elderly on PHI demand. For this, I have created a categorical variable indicating whether the head or/and the spouse are over sixty years of age. Admittedly, this is a crude measure of the impact of the government policy on PHI demand. The reason being that the NHS and Community

Care Act of 1990 also allows tax-relief for policies taken out by younger people for the benefit of an elderly person. The FES, however, does not contain sufficient details to capture this particular piece of information. Given that, the focus is now shifted on the model specification and the functional form for the second equation.

In general, it is difficult to determine which variables should enter in the regression analysis of participation and spending equation (Blaylock and Blisard 1992; Pudney 1989). The conditioning variables for each equation are chosen on the grounds of previous work (Propper 1989, 1993; Besley et al 1996). Given that rationing may influence the level of PHI expenditure and the likelihood of participation being positive, a common set of variables is used in both equations (X=W). At the estimation stage, zero restrictions, wherever necessary, are applied to raise the parsimony of the multivariate analysis. Data limitations about the unique determinants of W (i.e., who is rationed and who is not) prevent to identify separately the probability index. For this, the first stage equation refers to the probability of observing a PHI subscriber. In addition, there is no theoretical justification that either the sign or sizes of coefficients on the discrete choice should be the same as those on the spending equation (Leece 1995).

Regression Analysis

This section discusses the results. This is done in three steps. First, it assesses the statistical tests done to select the proper models for the problem at hand. Second, it interprets the parameter estimates of the selected models. Third, it looks at the empirical results associated with the impact of the government policy.

Model Selection

In the development process of modelling the demand for PHI, considerable exploratory work was done so as to obtain a parsimonious model parametrisation consistent with the structure of observed data and the existing work. Selection of the models (i.e., Tobit, Cragg, First Hurdle Dominant and Complete Dominant) reported in tables 2-5 is based on the grounds of theoretical and econometric validity using various statistical tests (e.g., the log-likelihood ratio). In addition, for each model and wherever possible, it is examined whether the joint effect of equivalent earned and unearned income causes departure from the null hypotheses of homoscedasticity and normality. If the results supported the alternative then the appropriate estimator was used. Figure 1 displays the specification statistics used to examine the hypothesis whether or not a nested version of model (e.g., the Tobit) is statistically equivalent to a more general model (e.g., the Cragg).

A LR test is carried out to assess the restrictions implied by the Tobit estimator, nested within the double-hurdle model with independence. The empirical LR statistic suggests that the two decisions, (1) to participate in the PHI market and (2) how much to spend on health cover, are not based on the same decision-making process. That is, one set of parameters determines the likelihood of the non-response cases whilst another one affects the distribution of the response observations.

Looking at the dominance models, the Heckman two-stage estimator nests the complete dominant model by imposing one parameter restriction in the expenditure equation. As the figure 1 shows, the complete dominant model is an acceptable form of the bivariate probit/sample selection model. As a result, the decisions to acquire PHI and how much cover to purchase can be seen as independent; a similar qualitative outcome was obtained earlier using the double-hurdle model with independence thus confirming results found elsewhere (Propper 1993). In other words, it suggests that once the decision to buy PHI is made, the zeros (the limit cases) do not determine the demanders' behaviour and so positive purchases occur. Moreover, the LM statistic indicates that sample-selection bias is not a problem of main concern in the present data configuration.

Even though the double hurdle with independence and the complete dominant models are not nested in each other, they both seem to be generating compatible information about economic behaviour. They both suggest that the disturbances for participation and expenditure equations are not related. Namely, the decisions to obtain PHI and how much to purchase are independent. Yet, both have different implications about economic behaviour. The Cragg model suggests that zeros can be generated by non-purchase (Blaylock and Blisard 1991). It also implies that the market demand for private health cover should be defined over the non-limit observations. The complete dominant model suggests that once the purchase decision is made, every household lies upon a smooth PHI demand curve and thus positive purchases are observed. The parameter estimates of the participation and spending equation fortunately share the same algebraic sign across the Cragg and complete dominant models. This perhaps is an indication that both are equally close to the underlying data-generating mechanism. Therefore, both are seen as two different but otherwise equivalent ways of modelling the decision-making process of demand for private health insurance.

Parameter Estimates

With these in mind, the coefficient estimates can be now interpreted. Tables 3 and 5 contain the regression results of the participation and spending processes. For ease, the parameter estimates of participation and spending equations are below examined separately. The interpretation centres around the impact of related sets of determinants such as: (1) income and social status factors; (2) demographic variables; (3) employment status determinants; (4) other related variables.

The Participation Equation

Income and social status determinants. Unearned income has a significantly negative effect on the propensity to purchase health cover only for the relatively well. This means that families with relatively high non-earned income are less likely to purchase PHI. This result may refer to those who would prefer to go private if and when this becomes necessary. Earned income has a significantly positive impact on the participation decision only for those with relatively high income. This means that households with relatively high earned income are more likely to consider the PHI purchase. The two dummies indicating whether or not the household is in the first or second social group (DSC1, DSC2) are significant and affect directly the participation decision. Previous work has also found similar qualitative results (Propper 1993, 1989).

Demographic variables. Age seems to have a non-linear association with participation. Families whose head is in the first two age-groups (DCHRT1, DCHRT 2) are less likely to think about the PHI purchase in comparison with the reference group. A similar picture appears regarding to those in the last two cohorts. Families whose head is either 51-64 years of age or 65 years old and more (DCHRT4, DCHRT5) are more unlikely to consider the PHI acquisition. This result should not take us by surprise. As noted earlier, the advantage of bivariate models lies on their ability to distinguish those factors affecting separately the decision to purchase PHI from the spending one. People in the early part of their life-time presumably are in better health and so less likely to anticipate relatively high health care outlays. On the contrary, families in their 50s and 60s may face higher barriers to participate in the market. For instance, the insurance contracts do not cover pre-existing conditions and life-threatening diseases. In other words, these families may be frustrated or rationed in the process of thinking to acquire PHI.

Employment status determinants. Being paid employee raises the chances for the family to consider the PHI purchase. A plausible reason is that these people have greater incentives to participate in the market. This result may also reflect an uncaptured income effect for the paid employees tend to face less variation in their income stream thus having a relatively high ability to pay. The self-employment dummy has a significantly negative impact on the chances to participate in the market.

Working as part or full time employee makes less likely the household to take part in the PHI market. The coefficient on part-work may underline the ones who are less likely to be relatively well off. As a result, these families are more likely to be high-risks for the insurance suppliers and so more likely to be captive in the NHS (Propper 1993). The parameter estimate of full-time employees may refer to those with an above-average labour supply. This possibly points to those on the lower part of social ladder. Careful examination of the raw data revealed indeed that the majority of full-time employees with an increased labour supply were those in lower social groups.

Other related variables. The age at which the head left full-education (LMLS) is significant and has a positive effect on the likelihood to purchase PHI. This outcome indicates that the longer the time spent on full education by the head the more likely the family to appreciate the benefits of private medicine and participate in the market; a finding which accords with past work (Propper 1993).

The Expenditure Regression

Main socio-economic determinants. The parameter estimates of earned and unearned income are all significant. The results indicate that the decision of spending on PHI is a convex function of the earned income. This implies that households with relatively high labour earnings tend to spend more on health cover. Unearned income has a positive non-linear impact upon the amount of health risks insured. Being in the first or second socio-economic class has a significantly positive effect on the spending amount. Phrased differently, these households tend to take out a larger amount of health cover.

Other associated variables. The self-employment dummy (OWNJOB) has a significantly positive effect on the amount of expenditure devoted to PHI. This suggests that once these families decide to take part in the market then they will tend to take out a relatively high amount of cover. This result relates to that self-employment is more risky than paid employment and also requires a great amount of physical and mental inputs (Besley et al 1996; Rees and Shah 1986).

The head's age has a linearly positive and an important, on statistical grounds, effect on the spending decision. This suggests that as people get older they tend to spend more on health cover. The age variable may also have acted as a proxy for the experience gained within the NHS health care facilities and so reflect the willingness to opt for private medicine, conditional on the budget constraint.

Evidence on the Government Policy

This section discusses the empirical results concerning the impact of the 1990 NHS and Community Act on the demand for PHI. Tables 3 and 5 show that the proxy (OVER60) for the government policy does not affect systematically the decisions to take part in the market and spend on PHI. On the whole, the results suggest that the provision of tax-reliefs to the elderly had little effect on the demand for health cover, an outcome consistent with other sources (Laing and Buisson 1995).

CONCLUSIONS

This study has examined whether one-step (univariate) or two-step process (bivariate) econometric models are better at describing the demand for private health insurance (PHI) by British families. Here, the first decision is whether to acquire PHI. The second refers to the determination of the actual level of insurance cover. The study examined the effect that key socio-economic and demographic factors had on these two processes, and investigated the impact of the recently introduced tax-concessions for the elderly on the PHI demand.

The modelling strategy used two classes of bivariate models: 1) the double-hurdle; 2) the dominance. Both allow for distinct processes determining the censoring rule and the continuous observations but have different economic implications. The sample came from the 1991 and 1992 FES.

Findings suggest that two-step models (the Cragg and the Complete Dominance models) perform better than one-step models (e.g., logit, probit, Tobit). Put differently, ignoring the two-stage decision process will miss the true behavioural patterns and can lead to erroneous conclusions. The analysis indicated that those who are in the upper socio-economic classes and educated and also have relatively high unearned income would tend to participate in the PHI market. Also people who get old and enjoy a comparatively high ability to pay would tend to spend more on health cover. In addition, the use of tax-incentives for the elderly had little effect on the participation or spending decisions.

To the extent that inferences about inter-temporal changes can be made from a cross-sectional sample, this analysis also has policy implications. As this analysis indicated, the tax-breaks for the elderly did little to increase the volume of PHI demand. If public policy aims to improve the existing picture of equity in health care provision then the present tax-reliefs need be abolished. Instead, tax-incentives for the under-60s or/and other forms of care (e.g., long-term care) should be designed and introduced. The use of such a measure is possible to encourage a relatively large number of new subscribers to enjoy the tax-benefits of holding PHI. In addition, if this move would target on the lower social classes (e.g., through a critical income threshold) it would most probably promote equity in terms of equal access to health care for those in equal need or ability to benefit (horizontal equity). The reason being that the majority of currently insureds are the relatively better off and better educated (Besley et al 1996). These proposals fit well with the policy of self-reliance introduced by the new government.

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Table Ia
Definition of Variables

Variable	Variable Definition	Whole sample (N=8149)	Non-limit cases (N=896)
	Dependent Variables		
DPMI	The family has spent on health insurance (Yes=1, No=0)	0.11 (0.312)	1.00 (0.00)
PREMIA	The weekly family premium, in pounds.	0.77 (3.08)	7.06 (6.50)
	Independent Variables		
	1. Income Variables		
EARNED	The annual equalised family earned income, in pounds.	6095 (6546)	9468 (12370)
UNEARNED	The annual equalised family unearned income, in pounds.	1471 (4816)	3271 (11290)
	2. Socio-economic Group Variables ('C.V.'= SC3-SC5)		
DSC1	The Hoh is in the 1st social class. (Yes =1, No=0)	0.07 (0.25)	0.143 (0.35)
DSC2	The Hoh is in the 2nd social class. (Yes =1, No=0)	0.21 (0.41)	0.33 (0.47)
	3. Demographic Variables. ('C.V.' = The Hoh is 41-50)		
DCHRT1	The Hoh is between 19-30	0.11 (0.32)	0.08 (0.26)
DCHRT2	The Hoh is between 31-40	0.11 (0.32)	0.21 (0.40)
DCHRT4	The Hoh is between 51-64	0.22 (0.42)	0.28 (0.45)
DCHRT5	The Hoh is 65+	0.19 (0.40)	0.143 (0.35)
AGE	The age of Hoh in years.	49.10 (15.30)	48.95 (13.18)
	4. Employment Status Group Variables (Yes =1, No=0)		
OWNJOB	The Hoh is self employed.	0.12 (0.33)	0.16 (0.37)
PAIDJOB	The Hoh is paid employee.	0.54 (0.50)	0.60 (0.49)
PTIME	The Hoh spends between 1-24 hrs/wk.	0.013 (0.11)	0.014 (0.12)
FTIME	The Hoh spends more than 24 hrs/wk.	0.55 (0.50)	0.60 (0.49)

Notes: Means and Standard deviations in brackets. C.V. stand for Control Variable. All monetary variables are in 1991 pounds.

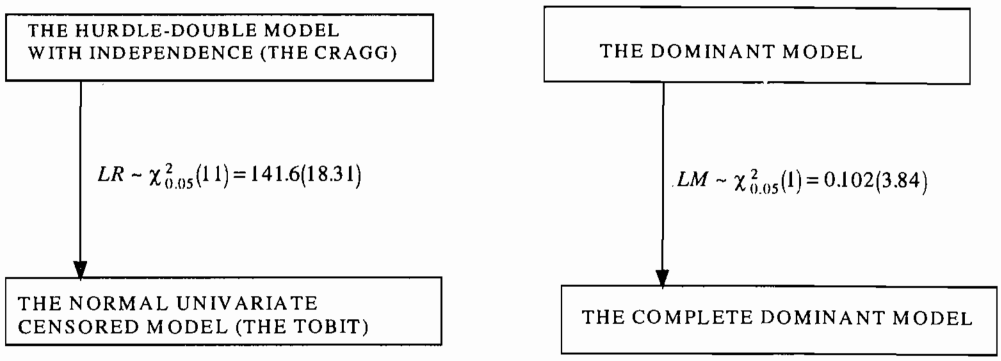
Independent Variables (contd)

Table Ib
Definition of Variables

Variable	Variable Definition	Whole sample (N=8149)	Non-limit cases (N=896)
5. Regional Variables ('C. V.' = Wales, Scotland and North Ireland)			
LONDON	Standard Region London (Yes =1, No=0)	0.08 (0.28)	0.10 (0.3)
SOUTH	Standard Region South East (Yes =1, No=0)	0.20 (0.40)	0.27 (0.44)
YORK	Standard Region Yorkshire (Yes =1, No=0)	0.087 (0.28)	0.09 (0.287)
NOWEST	Standard Region North West (Yes =1, No=0)	0.10 (0.30)	0.11 (0.32)
EASTMID	Standard Region East Midlands (Yes =1, No=0)	0.08 (0.27)	0.074 (0.26)
WESTMID	Standard Region West Midlands (Yes =1, No=0)	0.10 (0.29)	0.083 (0.27)
EASTAG	Standard Region East Anglia (Yes =1, No=0)	0.40 (0.20)	0.038 (0.19)
SW	Standard Region South West (Yes =1, No=0)	0.09 (0.28)	0.10 (0.31)
	6. Additional Variables.		
MLS	The age at which the Hoh left the school.	16.14 (2.80)	17.12 (3.33)
DYEAR	The Survey Year is 1991 (Yes=1, No=0).	0.512 (0.50)	0.477 (0.50)
	8. Measure of government policy		
OVER60	The Hoh and the spouse are 60+ (Yes=1, No=0).	0.14 (0.35)	0.094 (0.293)

Notes: Means and Standard deviations in brackets. C.V. stand for Control Variable. All monetary variables are in 1991 pounds.

Figure 1
Tests of Model Specification



LR and LM refer ro Likelihood Ratio and Lagrange Multiplier statistical test (d.f. and critical chi-square values in brackets).

Table 2

The Univariate Normal Censored Model (Tobit)

Variable	Expected Mean Coefficient	Skedastic Function Coefficient
LEARN	0.31 (1.50)	-0.01 (-1.40)
$LEARN^2$	0.27 (5.70)***	-0.0023 (-0.93)
LUNEARN	-0.186 (-1.50)	0.033 (3.44)***
$LUNEARN^2$	-0.006 (-0.30)	0.006 (5.16)***
DSC1	3.50 (4.60)***	
DSC2	2.16 (4.10)***	
LMLS	0.49 (0.53)	
PAIDJOB	3.38 (1.75)*	
OWNJOB	-1.886 (-0.96)	
PTIME	-4.22 (-1.40)	
FTIME	-5.86 (-2.65)***	
DCHRT1	-3.08 (-3.96)***	
DCHRT2	-1.24 (-2.20)**	
DCHRT4	-0.828 (-1.30)	
DCHRT5	-1.14 (-0.65)	
LONDON	3.22 (3.77)***	
SOUTH	3.56 (4.92)***	
YORK	3.62 (3.86)***	
NOWEST	3.63 (4.21)***	
EASTMID	3.10 (3.53)***	
WESTMID	3.30 (3.71)***	
EASTAG	2.45 (1.90)**	
SW	3.12 (3.40)***	
OVER60	-1.06 (-0.70)	
CONSTANT	-37.60 (-9.46)	
σ	10.26 (6.20)***	
LogL	-5,118.1	
Heteroscedasticity	$LRT = 81(9.49)$	

Notes: t-ratios in brackets. *** Significant at the 99% level, ** at the 95% level, *at the 90% level (d.f. and critical chi square values in brackets). LRT is the Likelihood Ratio Test.

Table 3

The Independent Double Hurdle Model (Cragg)

	PARTICIPATION		EXPENDITURE#
	Expected Mean	Skedastic Function	Expected Mean
Variable	Coefficient		The Demand equation
LEARN	0.036 (1.11)	-0.0011 (-0.13)	-0.62 (-2.52)**
$LEARN^2$	-0.048 (-2.28)	0.026 (9.48)***	0.11 (1.60)
LUNEARN	0.10 (1.21)	0.0002 (0.02)	1.00 (2.34)**
$LUNEARN^2$	0.075 (4.90)***	-0.006 (-4.02)***	0.14 (2.90)***
DSC1	1.23 (2.41)***		9.25 (3.20)***
DSC2	1.08 (2.87)***		7.23 (3.01)***
LMLS	1.22 (2.65)***		--
OWNJOB	-1.01 (-2.33)**		8.11 (3.63)***
PAIDJOB	2.04 (1.74)*		--
PTIME	-3.19 (-2.24)**		--
FTIME	-3.62 (-2.62)***		--
DCHRT1	-2.28 (-3.18)***		--
DCHRT2	-0.95 (-2.40)***		--
DCHRT4	-0.61 (-1.68)*		--
DCHRT5	-0.77 (-1.66)*		--
LHDAGE	--		8.96 (1.98)*
DYEAR	-0.165 (-0.93)		--
LONDON	1.22 (2.82)***		10.62 (3.98)***
EASTMID	1.34 (2.89)***		8.31 (2.72)***
SOUTH	1.77 (4.00)***		4.09 (2.14)**
YORK	1.55 (3.25)***		--
NOWEST	1.53 (3.37)***		--
WESTMID	1.34 (2.85)***		--
EASTAG	1.26 (2.47)***		--
SW	1.60 (3.66)***		--
OVER60	-0.35 (-1.11)		1.33 (0.50)
CONSTANT	-10.23 (-5.94)***		-70.15 (-3.43)***
σ	--		11.66 (11.95)***
LogL	-2495.1		-2552.2
Heteroscedasticity	$LRT = 103(9.49)$		
Normality	$ESS = 4.29(2,599)$		
RESET	$LRT = 1.40(3.84)$		

Notes: #Dependent variable is Weekly Premium spent on PHI conditional on having non-zero expenditures. t-ratios in brackets. *** Significant at the 99% level, ** at the 95% level, *at the 90% level. ESS (= the explained sum of squares) is Chesher and Irish score test statistic, (df. and critical chi square values in brackets). RESET is the Ramsey's RESET mis-specification test (Horowitz 1994).

Table 4

The Dominant Model (Heckman's Estimator)

MODEL	PROBIT	EXPENDITURE
LEARN	-0.0008 (-0.130)	-0.16 (-2.50)**
$LEARN^2$	0.02 (8.18)***	0.028 (0.95)
LUNEARN	0.027 (4.94)***	0.12 (1.55)
$LUNEARN^2$	0.0086 (8.30)***	0.042 (2.62)***
DSC1	0.23 (3.18)***	1.61 (1.56)
DSC2	0.187 (3.67)***	1.28 (2.24)**
LMLS	0.17 (1.71)*	--
OWNJOB	-0.13 (-1.37)	2.26 (4.07)***
PAIDJOB	0.33 (2.05)**	--
PTIME	-0.444 (-1.867)*	--
FTIME	-0.55 (-3.10)***	--
DCHRT1	-0.24 (-3.26)***	--
DCHRT2	-0.11 (-2.00)**	--
DCHRT4	-0.07 (-1.20)	--
DCHRT5	-0.15 (-1.34)	--
LHDAGE	--	1.61 (1.56)
DYEAR	-0.07 (-1.78)*	--
LONDON	0.25 (3.10)***	2.90 (4.26)***
EASTMID	0.296 (3.43)***	2.00 (2.60)***
SOUTH	0.39 (6.03)***	0.78 (1.60)
YORK	0.37 (4.55)***	--
NOWEST	0.37 (4.84)***	--
WESTMID	0.32 (3.96)***	--
EASTAG	0.285 (2.585)***	--
SW	0.366 (4.60)***	--
OVER60	-0.13 (-1.37)	0.81 (1.60)
CONSTANT	-3.63 (-12.05)***	-3.91 (-0.50)
λ		-0.57 (-0.32)
ρ	-0.096	
LogL	-2546.6	-2849.8

Notes: #Dependent variable is Weekly Premium spent on PHI conditional on having non-zero expenditures. λ is the inverse Mill's ratio. t-ratios in brackets. *** Significant at the 99% level, ** at the 95% level, *at the 90% level.

Table 5

The Complete Dominant Model

	PARTICIPATION		EXPENDITURE#
	Expected Mean	Skedastic Function	Expected Mean
Variable	Coefficient		Demand Equation+
LEARN	0.036 (1.11)	-0.0011 (-0.13)	-0.16 (-1.84)*
$LEARN^2$	-0.048 (-2.28)	0.026 (9.48)***	0.032 (1.99)*
LUNEARN	0.10 (1.21)	0.0002 (0.02)	0.13 (3.19)***
$LUNEARN^2$	0.075 (4.90)***	-0.006 (-4.02)***	0.046 (5.27)***
DSC1	1.23 (2.41)***		2.25 (3.35)***
DSC2	1.08 (2.87)***		1.38 (3.17)***
LMLS	1.22 (2.65)***		--
OWNJOB	-1.01 (-2.33)**		2.30 (4.12)***
PAIDJOB	2.04 (1.74)*		--
PTIME	-3.19 (-2.24)**		--
FTIME	-3.62 (-2.62)***		--
DCHRT1	-2.28 (-3.18)***		--
DCHRT2	-0.95 (-2.40)***		--
DCHRT4	-0.61 (-1.68)*		--
DCHRT5	-0.77 (-1.66)*		--
LHDAGE	--		1.70 (2.25)**
DYEAR	-0.165 (-0.93)		--
LONDON	1.22 (2.82)***		2.90 (3.20)***
EASTMID	1.34 (2.89)***		2.01 (2.40)***
SOUTH	1.77 (4.00)***		0.83 (1.76)*
YORK	1.55 (3.25)***		--
NOWEST	1.53 (3.37)***		--
WESTMID	1.34 (2.85)***		--
EASTAG	1.26 (2.47)***		--
SW	1.60 (3.66)***		--
OVER60	-0.35 (-1.11)		0.77 (0.74)
CONSTANT	-10.23 (-5.94)***		-6.01 (-1.92)*
LogL	-2495.1		-2857.0
Heteroscedasticity	$LRT = 103(9.49)$		$BP = 234.32(21.03)$
Normality	$ESS = 4.29(2.59)$		
RESET	$LRT = 1.40(3.84)$		$WALD = 3.01(3.84)$

Notes: #Dependent variable is Weekly Premium spent on PHI conditional on having non-zero expenditures. +The White Estimator is used. BP is the Breusch-Pagan score test. (d.f. and critical chi square values in brackets). t-ratios in brackets. *** Significant at the 99% level, ** at the 95% level, *at the 90% level. ESS (= the explained sum of squares) is Chesher and Irish score test statistic. RESET is the Ramsey's RESET mis-specifciation test (Horowitz 1994).