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ORIGINAL PAPER

# The role of non-need factors in individual GP utilisation analysis and their implications for the pursuance of equity: a cross-country comparison

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**Abstract** A substantial amount of health care resources is allocated within the UK using formulae that relate funding to measures of population need. The aim of this paper is to demonstrate the importance of non-need factors in determining utilisation of services at an individual level and explore the implications inclusion of such factors has in the consideration of equity. In the paper we develop a utility model that accords a role to non-health factors in the determination of service use. A series of functions incorporating non-health factors as explanatory variables in GP utilisation functions are estimated using data from the British Household Panel Survey. The functions are decomposed to ascertain the role of service structure and examine the role of income across the four countries of the UK in explaining utilisation. The implications of our findings for the pursuance of equity in the NHS when individual choice has an explicit role are discussed.

**Keywords** GP services · Utility model

**JEL Classification Numbers** C3 · I1

## Introduction

A substantial amount of health care resources is currently allocated within the UK using formulae that relate funding to measures of population need [11]. The formulae are typically derived from regressions of utilisation on need where utilisation is represented by, for example, expenditure or hospital discharge rates—depending on the service being examined—and need with measures such as population demographics, standardised mortality and standardised morbidity rates [3, 10]. The approach has been criticised with respect both to its theoretical underpinnings and practical execution. In respect of theory, for example, the statistical approach has been questioned, and in relation to practical issues criticisms include the selection procedure for variables in the most parsimonious model. (See discussion in Smith et al. [11].) Critically, the proposition that utilisation is a function solely of need can itself be contested (albeit need can include factors such as deprivation).

In respect of services such as those of the general practitioner (GP), utilisation may more realistically be characterised as the outcome of a rational decision-making process in which need is a central, but not the sole determinant. In this paper GP utilisation is modelled within an individual, utility-maximising framework. The model accords a specific role as suggested by utility theory to factors other than need. Empirics employ individual data, which although advocated by most commentators, contrasts with the dominant current approach where aggregate utilisation is regressed on socio-economic variables that are introduced in an ad hoc manner [4]. The aim of the paper is to examine the role of non-need factors in explaining utilisation and comment on the complexity their consideration introduces to pursuance of equity.

The paper is developed in sections. In section ''The model'' we present a utility model of user behaviour where need, employment status and income are used to explain utilisation and generate hypotheses. In section ''Data'' data from the four countries comprising the UK are

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examined. In section ‘‘Empirical analysis’’ the results from estimates of a series of ordered probit analyses are presented. Given differences in structure among countries that may impact on utilisation, separate functions are estimated for the four countries. Results provide the basis for a comparison of utilisation patterns within the UK, which are discussed in ‘‘Discussion’’. In the final section the challenges of pursuing equity as an objective of the NHS when individual choice has an explicit role are discussed.

## The model

Within a utility-maximizing framework we postulate that the decision to visit the GP will result from a comparison of private costs and benefits (although it is possible that expectations may be inaccurate in the sense that benefits may be overestimated or underestimated). Intuitively, benefits relate to health gains where, ceteris paribus, the greater is the need of the individual the greater are the potential gains to the individual. Costs will include the opportunity cost of time. Among those in employment the opportunity cost of time will be higher than among those who are unemployed. Further it is reasonable to assume that as income rises so the opportunity cost of time will also rise. In short we expect a role to exist for individual income in determining utilisation independent of health needs that should be modelled explicitly in any utilisation function. Failure to do so could result in significant omitted variable bias and prompt erroneous conclusions based on the resulting estimated functions.

Consider a simple model where we have a single chronic condition, $Y$, that can be ameliorated, but not cured by medical intervention. Assume that treatment, $T$, is an argument of the utility function, $U$ (with $U_T > 0$, that is, as treatment increases so too does utility). $T$ is a composite of medical interventions and psycho-social benefits that accrue from a wide range of activities and may be considered as part of the ‘‘functioning’’ associated with the consumption of goods and services generally ([9] the benefits, for example, from a meal with a friend at a restaurant extend beyond nutritional intake). Given this, $T$ is taken as a function of both the visits, $v$, to the GP and the consumption of goods and services, $c$. The function is assumed to be separable in $c$ and $v$ so that income effects are central. Thus:

$$T = r(v, y) + s(c, y) \tag{1}$$

where $r$ and $s$ are strictly concave functions of $v$ and $c$, respectively, and $y$ is an index of the severity of $Y$ (we assume that the absence of the condition is always preferred to any level of treatment). The fuller the social life of the individual [and consequently the larger is $s(c)$], *ceteris paribus*, we assume the less onerous is a given condition.

The utility function, $U(T,c,l)$ is assumed strictly concave and separable between $T$ and what might be described as the ‘‘standard’’ component $W$ in $c$ and leisure, $l$:

$$U(T, c, l) = V(T) + W(c, l). \tag{2}$$

Both $V$ and $W$ are assumed strictly concave. Under these assumptions it is possible to express utility as a strictly concave function of $v$, $c$ and $l$. Equation (2) is maximized subject to the budget constraint.

Currently in the NHS there is no charge for a consultation with a GP though there will be costs in terms of time and effort of organising and attending an appointment. If the patient is employed these will be higher, either in the form of forgone earnings (where the individual is paid hourly) or in the disruption associated with making good time off (for the salaried worker). In both cases we can monetize these using the wage rate. Let each consultation take $t$ hours of the total $X$ available to the individual per week. Then the number of hours worked will be $H$ where $H = X - l - tv$. In addition to wages the individual receives unearned income $b$. The budget constraint where $p$ is the price of goods, $w$ the wage, then is:

$$[X - l - tv]w + b - pc \geq 0. \tag{3}$$

Being employed entails a ‘‘price’’ of $tw$ per visit. This presentation captures an essential aspect of the decision model: visiting the GP imposes a cost on the individual in terms of effort or disruption. As the wage increases so too will the expected opportunity cost. Equation (3) indicates that the individual allocates full income, $Xw + b$, among the purchase of goods $c$, leisure $l$ and visits $v$, on which $tvw$ is spent.

The effect of adding treatment to the arguments of the utility function is evident from the first order conditions of maximizing (2) subject to (3):

$$\frac{r' V_T}{tw} = \frac{s' V_T + W_c}{p} = \frac{W_l}{w}. \tag{4}$$

In the standard work-leisure decision, the marginal rate of substitution of leisure for consumption would be $p/w$. In (4) the usual marginal utility of consumption is augmented by the contribution such consumption has to treatment. More significantly there is an additional ratio of marginal utility to price, $\frac{r' V_T}{tw}$, which implies that for individuals the anticipated benefit of a visit must in equilibrium increase with the wage rate.

The central point of interest in the model is the comparative static analysis focusing on changes in the wage rate, the availability of GP services and the severity of the condition. Consider first an individual who is economically inactive and so income consists only of $b$. The income effect reduces to one of a single variable since now $pc = b$ and $X = l + tv$. Then:

$$\frac{\partial v^*}{\partial b} = \frac{W_{lc} - r's'U_{TT}}{p\left[(r')^2 V_{TT} + r'' V_T + t^2 W_{ll}\right]} < 0. \quad (5)$$

The denominator of (5) is negative and the sign follows from assuming $W_{lc} > 0$, which reflects the view that leisure is required for the enjoyment of goods. Thus visits fall as income increases for the economically inactive.

Next consider the case where the individual is working and the change in income is due to a change in the wage rate. The Slutsky decomposition is:

$$\frac{\partial v^*}{\partial w} = \left(\frac{\partial v^*}{\partial w}\right)_{\text{comp}} + H\frac{\partial v^*}{\partial b} \quad (6)$$

where $v^*$ is the optimal level of visits and the negative definiteness of the utility function ensures that $\left(\frac{\partial v^*}{\partial w}\right)_{\text{comp}} < 0$. This is reasonable since the ''price'' of a visit to the GP as well as the ''price'' of leisure have increased. Thus along the indifference curve there is a substitution of goods for visits and leisure.

The income effect in (6) can be expanded as:

$$\frac{\partial v^*}{\partial b} = wts'' V_T W_{ll} + W_{ll} V_{TT} s' w\left[ts' - \frac{r'p}{w}\right] + wt\left[W_{cc}W_{ll} - W_{cl}^2\right] + wr's'V_{TT}W_{cl}. \quad (7)$$

The first order conditions imply that the second term is negative, as is the final term; the other two are positive. Consequently the income effect (7) cannot be signed *a priori* and its determination will be an empirical matter.

Changes in the availability of GP services are accommodated in the model through changes in $t$, time taken to arrange and attend a visit (if GPs are relatively scarce individuals may find they have to wait longer for an appointment or accept an appointment at a less convenient time). The Slutsky decomposition of a change in $t$ is similar to that of (7): $\frac{\partial v^*}{\partial t} = \left(\frac{\partial v^*}{\partial t}\right)_{\text{comp}} + wv^*\frac{\partial v^*}{\partial b}$. Again, the indeterminacy of the income effect makes signing the total effect an empirical issue. It is worth noting, however, that the magnitudes of these effects are likely themselves to vary with the level of income. For example, if the number of GPs in a region was increased thus increasing the potential number of visits we would not anticipate all users to increase their visits in the same proportion.

Intuitively one would expect an increase in intensity ($y$) of a condition to result in an increase in the number of visits. However, in this case there is no standard Slutsky decomposition as intensity enters directly into the treatment function (1) and does not operate through the budget constraint as would prices.

## Data

Individual visits to the GP were explored using data from wave 11 of the British household panel survey (BHPS). This survey is currently in its 15th year and is designed to improve understanding of social and economic change at the individual and household level in Britain and the UK by providing data on a panel of individuals in households over time. In addition to questions on household (income, size, composition) and individual characteristics (age, education, gender and health conditions), the survey identifies utilisation of various health services by the individual including GP and out patient consultations, as well as characteristics of the individual's health status.

We used data from wave 11 (2001) of the BHPS. The sample consisted of 17,742 individuals. Households were drawn on the basis of a stratified random sample from across England (8,360 individuals); sample fractions for Wales (2,796 individuals), Scotland (3,213 individuals) and Northern Ireland (3,373 individuals) were greater though within each country the sample design was the same as in England. All responses (including those relating to health conditions) were self-reported and relate to the previous 12 months—data being collected in 2001.

In addition to information on utilisation, data was extracted on health, income, employment status and gender. A definition of the variables used is presented in Table 1. The income variable employed was annual equivalised income—that is household income adjusted for the demographic composition of the household. Each individual in the household is assigned the equivalised income, so each member of the household has the same income irrespective of their individual employment status. Equivalised income thus provides an indicator of welfare. Individual monthly earnings and hours worked were used as a measure of the opportunity cost of a visit.

In Table 2 descriptive statistics for the sample are presented. As can be seen and consistent with expectations, the percentage of the sample suffering broad chronic conditions such as ''arms, legs, etc.'' was higher than that suffering more specific conditions such as ''diabetes''.

**Table 1** Definition of variables

| Variable | |
|---|---|
| Health | |
| Morb | The sum of self-reported conditions, Hadbaby and Accident |
| Morb$^2$ | Morb squared |
| Self-reported conditions | |
| Arms | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to arms, legs, hands, etc., and zero otherwise |
| Cancer | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to cancer and zero otherwise |
| Chest | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to chest or breathing and zero otherwise |
| Depression | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to anxiety/depression and zero otherwise |
| Diabetes | Dummy variable equal to 1 if respondent reported a non-temporary health condition diabetes and zero otherwise |
| Drug | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to alcohol or drugs abuse and zero otherwise |
| Epilepsy | Dummy variable equal to 1 if respondent reported a non-temporary health condition epilepsy and zero otherwise |
| Hearing | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to hearing and zero otherwise |
| Heart | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to heart/blood pressure and zero otherwise |
| Migraine | Dummy variable equal to 1 if respondent reported a non-temporary health condition migraine and zero otherwise |
| Other | Dummy variable equal to 1 if respondent reported a non-temporary health condition other than those detailed explicitly above and zero otherwise |
| Sight | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to sight and zero otherwise |
| Skin | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to skin conditions or allergies and zero otherwise |
| Stomach | Dummy variable equal to 1 if respondent reported a non-temporary health condition related to stomach/digestion and zero otherwise |
| Stroke | Dummy variable equal to 1 if respondent reported a non-temporary health condition stroke and zero otherwise |
| Other health | |
| Accident | Dummy variable equal to 1 if the respondent had had an accident in the past 12 months and zero otherwise |
| Disable | Dummy variable equal to 1 if the respondent was registered disabled and zero otherwise |
| Hadbaby | Dummy variable equal to 1 if the respondent had had a baby in the past 12 months and zero otherwise |
| Income | |
| Decile | The decile in which the respondent's annual equivalised household income falls |
| Decile$^2$ | Decile squared |
| Earn | Natural log of monthly earnings |
| Hours | Natural log of number of hours worked per month |
| Physical | |
| Male | Dummy variable equal to 1 if the respondent was male and zero otherwise |
| Age | Respondent's age in years divided by 40 |

## Empirical analysis

Consistent with our model two key factors, health and income were used to explain GP visits. Health care is structured differently across the constituent countries of the UK. For example, while in Northern Ireland an integrated health and social services system exists and is funded from within a single budget, in England, Scotland and Wales social and

**Table 2** Sample characteristics on explanatory variables

| | Eng | Wales | Scot | NI |
|---|---|---|---|---|
| N | 8,360 | 2,796 | 3,213 | 3,373 |
| Health | | | | |
| Morb mean | 1.33 | 1.46 | 1.33 | 1.22 |
| SD | (1.44) | (1.57) | (1.44) | (1.39) |
| Self reported | | | | |
| Arms | 28.91% | 31.87% | 27.95% | 23.60% |
| Cancer | 1.29% | 1.50% | 1.37% | 1.27% |
| Chest | 13.56% | 15.92% | 13.85% | 11.24% |
| Dep | 8.05% | 10.94% | 9.68% | 9.01% |
| Diab | 3.39% | 3.51% | 3.95% | 3.41% |
| Drug | 0.47% | 0.43% | 0.78% | 0.62% |
| Epil | 0.84% | 0.86% | 1.21% | 0.74% |
| Hear | 8.47% | 9.66% | 8.00% | 6.76% |
| Heart | 16.52% | 18.17% | 17.21% | 16.93% |
| Migraine | 8.07% | 8.23% | 8.15% | 7.32% |
| Other | 1.16% | 1.90% | 1.62% | 1.72% |
| Sight | 5.06% | 6.72% | 4.48% | 4.45% |
| Skin | 12.80% | 10.62% | 11.76% | 8.36% |
| Stomach | 8.31% | 8.73% | 8.71% | 9.37% |
| Stroke | 3.66% | 3.68% | 3.11% | 4.36% |
| Other health | | | | |
| Accident | 10.38% | 11.16% | 9.49% | 10.79% |
| Disable | 6.81% | 12.12% | 7.87% | 9.28% |
| Hadbaby | 1.97% | 1.93% | 1.87% | 2.37% |
| Income | | | | |
| Earn mean | 885.20 | 659.08 | 781.45 | 655.89 |
| SD | (1206.49) | (1096.77) | (1026.75) | (949.43) |
| Hours mean | 73.44 | 60.41 | 70.53 | 61.95 |
| SD | (74.83) | (73.26) | (74.86) | (72.77) |
| Physical | | | | |
| Male | 46.18% | 45.60% | 45.22% | 42.43% |
| Age mean | 45.29 | 46.92 | 45.66 | 46.01 |
| SD | (18.73) | (18.62) | (18.33) | (18.14) |

health care are both organised and funded separately. Supply also differs markedly across the UK as can be seen from Table 7 below. Further, while similar formulae are used in respect of funding in England and Wales distinct formulae are used in Scotland and Northern Ireland. In empirical analysis account was taken of this by estimating the models separately for each national sample (no attempt was made to examine supply effects at lower levels of aggregation, for example, incorporating variations in access at a health authority level. While this is recognised as a limitation in the analysis as BHPS would not allow disaggregation within Northern Ireland, in the interests of comparability across functions it was not considered appropriate to pursue it in respect of other parts of the UK).

**Table 3** GP utilisation and outpatient use across the UK

| | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| Mean number of visits non-attenders | 2.06 | 2.18 | 2.2 | 2.31 |
| Mean number of visits attend | 5.03 | 5.53 | 5.27 | 5.5 |
| Non-attenders (%) | 60.7 | 60.7 | 60.8 | 54.7 |

GP visits were measured in BHPS using classes rather than a count; consequently the models were estimated using an ordered probit. To reflect its multidimensional nature health was specified using several variables. The basic data comprised 15 self-reported chronic conditions, the survey explicitly excluding temporary ones. The potential for endogeneity bias where self-reported health is used to explain utilisation in the context where limiting long-term illness is the sole measure of self-reported health has been discussed by Sutton et al. [12]. The potential for bias is much reduced with BHPS data where self-reported conditions are chronic and both these and visits relate to an extended time period—a year compared to a single month in Sutton. In that case (equation 2 of Sutton) physical measures of health, such as blood pressure, respond to treatment provided in visits; such simultaneity would not arise in chronic conditions to any appreciable extent with the possible exception of diagnosis.

In addition to the 15 conditions the individual also reported if they had had a baby (*HADBABY*) or an accident (*ACCIDENT*) in the past 12 months, was registered disabled (*DISABLE*) or had visited an outpatients department. For simplicity a single index measuring health would be preferable to a series of dummy variables. However, simply summing conditions to generate one would imply an equal weight for each condition and ignore the severity of individual conditions. Clearly this would be erroneous. A composite health variable (*MORB*) was specified as the sum of the various conditions detailed. The data were allowed to adjust the weight attached to individual conditions by the inclusion of 17 separate dummy variables. In addition the composite health variable was entered into the index function of the ordered probit as a quadratic to take account of possible nonlinearities in its relationship with visits.

The severity of individual conditions was taken into account by dividing the sample between those who had attended outpatients (attenders) and those who had not (non-attenders). The rationale for this was that patients are referred to outpatients following assessment of their condition's severity by the GP [7]. In Table 3 the average number of visits by attenders and non-attenders in each of the four countries is shown. These figures were derived by taking the class mark for each interval (0, 1–2, 3–5, 6–10 visits); the class mark for final category (>10) was assumed to be 12. As can be seen attenders undertake many more visits than non-attenders and differences are apparent between countries (visits refer to those undertaken on the individual's own account and exclude those where the individual accompanied the patient). The percentage of non-attenders was virtually identical throughout Great Britain (61%) whereas in N. Ireland it was appreciably less (55%).

As the sample is divided between attenders and non-attenders, two ordered probits are used to explain visits to the GP. The model of the relevant index function (*IFGP*) is thus:

$$IFGP_i|Outpatients = j \quad = \quad \alpha_j SICK_i + \beta_j INCOME_i + \varepsilon_i^j, \quad j = 0, 1 \qquad (9)$$

where $j$ = 1 for an attender and zero for a non-attender. *SICK* consists of the index *MORB* where,

**Table 4** Regression analysis of determinants of use of GP services in attenders

| | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| Constant | 1.3986** (21.661) | 0.6284** (2.779) | 1.3101** (14.590) | 1.5949** (17.485) |
| Health | | | | |
| Morb | 0.3788** (9.498) | 0.3096** (5.715) | 0.5480** (11.609) | 0.3781** (7.041) |
| Morb$^2$ | –0.0289** (–5.734) | –0.0348** (–4.837) | –0.0349** (–5.095) | –0.0204* (–2.348) |
| Self reported conditions | | | | |
| Cancer | | | –0.3620* (–1.506) | |
| Chest | 0.1530** (2.603) | 0.1903* (2.052) | | 0.1646 (1.839) |
| Depression | 0.3211** (4.603) | 0.2730** (2.596) | | 0.3586** (3.591) |
| Diabetes | | 0.4981** (3.541) | | |
| Drug | | | | –0.6962* (–2.049) |
| Epilepsy | | | 0.8157** (3.160) | |
| Hearing | –0.1835** (–2.673) | | –0.4494** (–4.190) | |
| Heart | 0.3123** (5.446) | | | 0.2061** (2.576) |
| Migraine | | 0.2471* (2.132) | | |
| Other | | 0.4630** (2.665) | | |
| Sight | –0.1622* (–2.108) | | | –0.2815* (–2.261) |
| Skin | –0.2542** (–4.102) | | | |
| Stomach | 0.2620** (4.007) | | | |
| Stroke | 0.2372** (2.882) | 0.3001* (2.093) | | |
| Other health | | | | |
| Accident | –0.2620** (–4.534) | | –0.4747** (–5.422) | –0.3366** (–4.098) |
| Disable | 0.1915** (2.948) | 0.3127** (3.450) | | 0.4274** (4.739) |
| Hadbaby | 0.4308** (4.154) | 0.4637* (2.527) | | 0.4065** (2.751) |
| Income | | | | |
| Decile | | | | |
| Decile$^2$ | –0.0020** (–2.998) | | –0.0039** (–3.709) | –0.0039** (–3.941) |
| Earn | –0.0330** (–4.548) | –0.0444** (–3.779) | –0.0582** (–2.623) | –0.0367** (–3.561) |
| Hours | | | 0.0582** (–2.623) | |
| Physical | | | | |
| Male | –0.2378** (–6.049) | –0.1972** (–2.914) | –0.2279** (–3.618) | –0.1081 (–1.868) |
| Age | | 0.9701* (2.536) | | |
| Age$^2$ | –0.1340** (–6.422) | –0.4190** (–2.715) | | –0.1044** (–3.557) |
| Age$^3$ | | | –0.0530** (–3.879) | |
| $\mu_1$ | 1.1706** (49.749) | 1.0872** (26.947) | 1.2022** (31.176) | 1.2379** (34.175) |
| $\mu_2$ | 1.9879** (84.391) | 1.8300** (45.973) | 1.9390** (50.684) | 2.0954** (60.257) |
| $\mu_3$ | 2.6632** (90.295) | 2.3999** (50.801) | 2.5179** (54.784) | 2.7854** (64.791) |
| Log likelihood | –4611.000 | –1575.699 | –1761.952 | –2072.392 |
| *N* | 3,289 | 1,100 | 1,261 | 1,529 |

**Table 5** Regression analysis of determinants of use of GP services in non-attenders

| | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| Constant | 0.9177** (8.606) | 0.6156** (6.024) | 0.4440** (4.470) | 0.5469** (10.261) |
| Health | | | | |
| Morb | 0.6008** (17.400) | 0.4305** (7.364) | 0.4463** (8.348) | 0.5702** (10.252) |
| $Morb^2$ | –0.0645** (–8.744) | –0.0587** (–5.145) | –0.0525** (–4.429) | –0.0552** (–4.550) |
| Self reported conditions | | | | |
| Cancer | | | 0.5986* (2.382) | |
| Chest | | 0.2554** (2.700) | 0.2347* (2.541) | |
| Depression | 0.4135** (5.528) | 0.6382** (5.618) | 0.6834** (6.251) | 0.4848** (3.992) |
| Diabetes | 0.3977** (3.153) | 0.4837 (1.949) | 0.8896** (3.812) | |
| Drug | | 1.0288 (1.786) | | |
| Epilepsy | | | | 1.1296* (2.241) |
| Hearing | –0.3551** (–4.945) | | –0.2018 (–1.707) | –0.3187* (–2.449) |
| Heart | 0.4232** (7.152) | 0.4790** (4.858) | 0.4278** (4.731) | 0.2954** (3.157) |
| Other | | | –2.4629** (–3.122) | |
| Sight | –0.2432* (–2.344) | | | –0.6020** (–3.529) |
| Skin | –0.1417* (–2.550) | | | –0.2977** (–2.718) |
| Stomach | 0.1115 (1.413) | 0.3329* (2.440) | | |
| Stroke | 0.2392* (2.152) | | 0.4074* (2.223) | |
| Other health | | | | |
| Accident | | 0.3203** (2.649) | | |
| Disable | | 0.4397** (4.043) | 0.4450** (3.985) | 0.4262** (3.167) |
| Hadbaby | 0.3478 (1.808) | | | |
| Income | | | | |
| Decile | –0.0629* (–2.573) | –0.2949** (–3.060)[a] | | |
| $Decile^2$ | 0.0049* (2.303) | –0.2318*(–2.522)[b] | | |
| Earn | –0.0428** (–4.307) | –0.0420** (–4.606) | –0.0234** (–2.782) | –0.0302** (–3.789) |
| Hours | 0.0428** (–4.307) | | | |
| Physical | | | | |
| Male | –0.3847** (–11.982) | –0.4179** (–7.565) | –0.3280** (–6.452) | –0.3662** (–6.924) |
| Age | –0.7011** (–3.894) | –0.1704* (–2.460) | –0.1212 (–1.784) | |
| $Age^2$ | 0.1969* (2.603) | | | |
| $\mu_1$ | 1.2325** (59.872) | 1.2301** (34.150) | 1.2092** (36.977) | 1.2945** (38.549) |
| $\mu_2$ | 2.0577** (75.357) | 2.1198** (44.348) | 2.0627** (47.236) | 2.0763** (48.685) |
| $\mu_3$ | 2.6740** (67.260) | 2.6483** (41.163) | 2.7278** (42.208) | 2.7997** (43.177) |
| Log likelihood | –5921.015 | –1969.685 | –2312.588 | –2220.526 |
| $N$ | 5,071 | 1,696 | 1,952 | 1,844 |

[a] The Welsh data did not permit deciles to be collapsed into a single index. This variable is decile 1

[b] The Welsh data did not permit deciles to be collapsed into a single index. This variable is decile 8

$$MORB_i = \sum_{k=1} SRC_{ik} + HADBABY_i + ACCIDENT_i, \qquad (10)$$

$MORB_i^2$,the self reported conditions together with *HADBABY* and *ACCIDENT*. Thus[1]:

$$\begin{aligned} SICK_i = \sum_{k=1}^{K} \lambda_k SRC_k + \lambda_{K+1} HADBABY_i \\ + \lambda_{K+2} ACCIDENT_i + \lambda_{K+3} DISABLE \\ + \lambda_{K+4} MORB_i + \lambda_{K+5} MORB_i^2 \end{aligned} \qquad (11)$$

*INCOME* covers two sets of variables. The first of these captures the welfare of the household, the second the opportunity cost of visiting the GP. Equivalised household

[1] The coefficient of a particular *SRC*, *k* is thus $\lambda_k + \lambda_{K+3} + \lambda_{K+4}\left(\sum SRC_j\right)$; since $\lambda_k$ is specific to the particular *SRC* its overall weight in *SICK* is determined by the data.

income was initially used directly, but its performance was found to be sensitive to the functional form. Consequently, it was divided into deciles and incorporated into the ordered probit as ten dummy variables (the constant being dropped). As this was cumbersome the validity of reducing the ten dummies to two variables, $DECILE_i$, an integer for the particular decile that the household income appears in and $DECILE_i^2$, was tested statistically using a procedure similar to that of Almon [1]. The series of restrictions on the coefficients, $d_h$, of the decile dummies, were:

$$d_{h+3} - 3d_{h+2} + 3d_{h+1} - d_h, \quad h = 1, 7. \tag{12}$$

A Wald test rejected these restrictions only in the case of the Welsh non-attenders.

The second set of income variables measures the opportunity cost of visiting the GP. These consist of the log of earnings, *EARN*, and hours worked, *HOURS*, in the past month. For individuals who were not economically active the variables were set to zero.

Tables 4 and 5 report the results of the ordered probits. *MORB* and $MORB^2$ are highly significant across all of the regressions. The pattern of significant *SRCs* differs between countries and between attenders and non-attenders. As might be anticipated *ACCIDENT* and *HADBABY* appear much more likely to be significant among the attenders. With the exception of Northern Ireland attenders, *MALE* is a highly significant and negative determinant of visits. Crucially *EARN* is seen to be significant and negative across all models. *HOURS* is significant only for the Scottish attenders and English non-attenders; in both these cases the data fail to reject that the sum of the coefficients of *HOURS* and *EARN* equal zero (that is, the wage rate rather than earnings is the significant variable). *DECILE* and $DECILE^2$ (which as noted captures household welfare) do not exhibit a consistent pattern in terms of significance. This suggests that for instance among Scottish and Northern Irish non-attenders the only effect of income relates to those in employment.

## Discussion

Computing the predicted number of visits using the functions reported in Tables 4 and 5 generates the principal diagonal in Table 6. Thus for the English case we have:

$$\overline{\hat{v}^E} = F\left(\hat{\beta}^E, X^E\right)$$

where $\overline{\hat{v}^E}$ is the average number of visits predicted over the English sample, $X^E$, using the estimated coefficients, $\hat{\beta}^E$ from the ordered probit model, $F$, for England. The difference between the average number of visits in England and Scotland, for example, $\overline{v^E} - \overline{v^S}$, can be decomposed into that due to the differences in sample characteristics, $F\left(\hat{\beta}^E, X^E\right) - F\left(\hat{\beta}^E, X^S\right)$, and that due to residual factors. This is a nonlinear extension of the familiar Blinder–Oaxaca decomposition (see [6]). When used in labour economics the residual factor is generally associated with discrimination. However, if there are substantial differences in structure here between England and Scotland the above decomposition will give radically different results from $F\left(\hat{\beta}^S, X^S\right) - F\left(\hat{\beta}^S, X^E\right)$. In such circumstances the effect of differences in sample characteristics is not identified.

As noted above differences in structure do exist among the four constituent countries. Differences include list size, the percentage of single as opposed to multi-handed practices, the employment of specific practice staff as well as practice staff in general (all shown in Table 7), spending on prescribed medications per capita, spending on general medical services per capita [2], the structure of primary care groups [13], and as noted above, the integration of health and social services in Northern Ireland compared with their separation elsewhere in the UK.

In Table 6 the column for England consists of $\overline{\hat{v}^k} = F\left(\hat{\beta}^E, X^k\right)$ where $k$ indexes the countries of the UK. Similarly the English row consists of $\overline{\hat{v}^k} = F\left(\hat{\beta}^k, X^E\right)$. The range in the actual average number of visits is 0.25 for the non-attenders and 0.5 for the attenders. A discrepancy between the predicted and actual average number of visits of greater than 20% of the range was taken as an arbitrary indicator of the existence of structural difference. Where such differences do not exist the entry is marked in bold in Table 6.

The most dramatic example of structural difference is provided by Northern Ireland. For non-attenders the model predicts accurately the average number of visits in Northern

**Table 6** Actual and predicted visits to GP by country model and sample

| | Actual | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|---|
| Non-attenders | | | | | |
| England | 2.06 | **2.06** | 1.98 | **2.08** | 2.32 |
| Wales | 2.18 | **2.17** | **2.18** | 2.24 | 2.53 |
| Scotland | 2.20 | **2.16** | 2.11 | **2.19** | 2.47 |
| Northern Ireland | 2.31 | 2.00 | 1.99 | 2.05 | **2.31** |
| Attenders | | | | | |
| England | 5.03 | **5.04** | 5.18 | 5.26 | 5.57 |
| Wales | 5.53 | 5.33 | **5.54** | 5.47 | 5.94 |
| Scotland | 5.27 | 5.03 | **5.23** | **5.28** | 5.56 |
| Northern Ireland | 5.50 | 5.04 | 5.24 | 5.11 | **5.49** |

**Table 7** Structure of health care in four countries of UK

| Country | Patients per GP[a] | Percentage of practices single handed[b] | Practice nurses WTE per 10 GPs[b] | Direct patient care per 10 GPs WTE[b,c] | Total practice staff per 10 GPs WTE[b] |
|---|---|---|---|---|---|
| England | 1,601 | 29 | 4.0 | 0.9 | 21.2 |
| Wales | 1,523 | 21 | 4.0 | 0.6 | 21.3 |
| Scotland | 1,220 | 17 | 3.4 | 0.2 | 20.5 |
| Northern Ireland | 1,499 | 19 | NA | NA | NA |

*NA* not available

[a] Source: GP figures Department of Health General and Personal Medical Services Statistics NHS workforce census data30 September 2001, published 2002 reference number 2002/0059. Department of Health London. Population figures: http://www.statistics.gov.uk/census2001/pop2001

[b] http://www.rcgp.org. uk/information/publications/information/PDFInfo/02-Jun04.pdf

[c] Direct patient care refers to physiotherapists, chiropodists, counselors, etc

**Table 8** Predicted visits the GP by country including and excluding income

| | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|
| Attenders | | | | |
| Full prediction | 5.04 | 5.54 | 5.28 | 5.49 |
| Adjusted prediction | 5.62 | 5.96 | 5.99 | 6.29 |
| Ratio of full to adjusted | 1.12 | 1.08 | 1.13 | 1.15 |
| Non-attenders | | | | |
| Full prediction | 2.06 | 2.18 | 2.19 | 2.31 |
| Adjusted prediction | 2.40 | 2.57 | 2.38 | 2.54 |
| Ratio of full to adjusted | 1.17 | 1.18 | 1.09 | 1.10 |

Ireland, as indeed is the case for the principal diagonals of both attenders and non-attenders. However, as can be seen in the table the Northern Ireland non-attender model substantially over predicts visits in each of the other countries. Similarly each of the other models substantially under predicts the average number of visits in Northern Ireland. The same pattern is observed among attenders. It follows that structural differences such as the integration of health and social services in Northern Ireland have a major impact upon utilisation. Given the number of GPs relative to population in Northern Ireland is similar to that of Wales (see Table 7), lying between England and Scotland, the emphatic pattern cannot be attributed to differences in supply.

The English case is less straightforward. Among attenders the evidence for structural distinction is as strong as for Northern Ireland, but for non-attenders the English, Scottish and Welsh models are relatively more homogenous in structural terms. In fact using our criterion it is possible to attribute between 72.5 and 86.4% of the difference in utilisation between English and Scottish non-attenders to sample characteristics alone. This is despite the fact that the widest disparity in supply is observed between England and Scotland. Thus structure is seen to have important dimensions beyond supply; to model these adequately would require analysis at a much more disaggregated level than contained in this preliminary analysis. The existence of structural diversity, however, supports the use of separate formulae across the UK.

The use of separate formulae per se though fails to address the critical explicit omission from these of factors other than need as determinants of utilisation. The predicted values used in Table 6 include the effect of non-need factors, principally income. The effect on predictions of omitting such factors is shown in Table 8.[2] Given that income is a measure of opportunity cost, it is unsurprising that its omission leads to a sharp increase in these predicted values. If the rationale of allocation formulae is to achieve ''equal access for equal need'' then the correct measure of utilisation is given in row 2 of Table 8 where the influence of non-need factors is removed. Thus given two individuals with the same need, the employed one will be allocated the same funds (access) as an economically inactive one, despite the fact that the former will choose to visit less. The consequence of such an allocation on an area basis would be that the additional supply would be utilised disproportionately by those on lower incomes or the economically inactive. Thus, in practice the formulae would result in inefficiency, though the magnitude of this cannot be determined a priori.

## Conclusions

This paper demonstrates the importance of factors other than need in determining use of GP services. The importance of factors such as income highlights the need to employ individual data—a practice more honoured in the breach than in the observance. Even were individual data to

[2] The values in Table 8 were computed by using the ordered probits above but setting the income parameters, $\beta^{Y}$, to zero and the decile variable to that associated with the highest number of visits.

be used, however, incorporating such effects into resource allocation formulae need not on its own further equity goals. Resource allocation at the regional level may be accurately informed by regional needs but equity of access must also take account of the intermediation of structure on the one hand and the expression of individual choice on the other. Resource allocation at the regional level may accurately reflect relative health needs but, as actual utilisation varies by social type (income), particular social groups could very well experience differential access across regions, depending on the intermediation of non-need factors and structure. Thus, given the role identified for these factors, simply adjusting resources to take account of greater need in one area relative to another may not address inequity as the resources may not necessarily reach the intended target. This underscores the difficulties policy makers face in addressing by aggregate resource decisions alone inequities that potentially arise from differential utilisation due to the role of non need factors. While we offer no solution here, acknowledging the difficulties is perhaps a more constructive step to finding a solution than producing ever more elaborate resource allocation formulae based on aggregate data.

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