Deriving welfare estimates in Discrete Choice Experiments with multiple choice options

Mandy Ryan[1]*, Michela Tinelli[1,2], Maria Odejar[1]

[1] Health Economics Research Unit, University of Aberdeen

[2] Department of General Practice and Primary Care, University of Aberdeen

Summary

Whilst most applications of DCEs apply forced choices, the importance of allowing for multiple options is being recognised. This paper considers issues raised in estimating welfare gains with multiple choices. The implications of different nesting structures on welfare estimation compared to the standard multinomial approach are considered. The Inclusive Value (IV) parameter is used to investigate the cross-elasticity of substitution between alternatives and to estimate welfare gains. The technique is applied to extending the role of the pharmacist from prescribing only to the novel prescribing and dispensing option. The importance of identifying the pattern of substitution between alternatives via the IV parameter, and its use in the estimation of welfare gains, is demonstrated.

Keywords: welfare estimation, DCE, willingness to pay, econometric analysis

Introduction

Discrete Choice Experiments (DCEs) are a stated preference technique being increasingly used in health economics to elicit individual preferences. The technique is based on the premise that individuals derive benefit from the attributes of the good or service. Further, if a price proxy is included, willingness to pay (WTP), a monetary measure of benefit, can be estimated. Whilst most applications of DCEs apply forced choices, the importance of allowing for multiple options is being recognised.[1] The standard approach to estimating welfare with multiple alternatives, using the conditional logit model, assumes that options available are perfect substitutes. The parameters estimated from the Conditional Logit Model (CLM) are used to estimate the welfare effect of changes in the way health care is provided. If alternatives are not perfect substitutes, a partial solution is to use the Nested Logit Model (NLM). Here options are grouped such that the assumption of perfect substitution is valid within groups (or nests), but not between.

When using the NLM the researcher must specify the appropriate nesting structure. Again, the parameters estimated from the model are used to estimate welfare changes. Different nesting structures will imply different parameter estimates, and therefore different welfare estimates. This aim of this paper is to consider issues raised when using the NLM to estimate welfare changes, and well as to compare welfare estimates from the conditional and different nested models. This is discussed within the context of a DCE concerned with patient preferences for extending the role of the pharmacist. In the next section the DCE is described. Following this, the next section describes econometric analysis issues raised in the analysis of multiple option DCE data, followed by consideration of the estimation of WTP in such models. Concluding comments are then made.

The Discrete Choice Experiment: preferences for extending the role of the pharmacist

Scottish policy documents encourage appropriate use of pharmacists' skills and expertise in delivering services [7-8] and have already introduced innovative programmes of care. These include providing support for clinical developments, such as supplementary prescribing [9-12]. A DCE was conducted to elicit patient preferences for extending the role of the pharmacist to include prescribing as well as dispensing.

Based on existing literature concerned with extending the role of the pharmacists, four attributes were included in the experiment: time spent travelling to and waiting in the GP surgery; time spent travelling to and waiting in the pharmacy, chance of receiving the "best" treatment; and cost. These are shown in the upper half of Table 1, together with the associated levels, and the regression coding. The new service proposed (extending the role of the pharmacist to one of prescribing as well as dispensing) was compared to both the current situation of dispensing as well as alternative dispensing only scenarios. Before being presented with the DCE choices each subject was asked to define their current situation.

Experimental design techniques were used to design a set of choices for which preferences were elicited. Six different fractional factorial designs of 16 choices were created. Each design was used to define a different choice set. [a] [3, 13-15]. The six different designs were compared with each other in terms of their statistical properties. According to the principles of efficient choice designs[b] summarised by D-error[c], the most efficient design was chosen for the study [15-17]. An example of a choice from this design is shown in Figure 1. The questionnaire is available from the authors on request.

244 questionnaires were distributed to patients whilst at the doctors, waiting for a consultation. Subjects were asked to fill in the questionnaire whilst they were waiting (with the option of completing it after the consultation) or to complete it at home. A prepaid envelope was provided for respondents who preferred to complete the questionnaire at home. 204 returned were eligible for the analysis. Ethics problems, including no signed consent form, participation to other research projects in the last 6 months and non-eligibility for the study, explained reasons of exclusion from the analysis (57.50%), followed by uncompleted questionnaire because of the limited time available (30.00%).

More than 42% of eligible subjects (87 over 204) did not trade between the alternatives reported, always choosing the same option (at least 14 times over the 16 choices reported). More than 80% of these subjects had a constant preference for their current situation.

---

[a] Three sets of binary choices were derived using a "random approach", while the others were derived from a "cyclical approach" [3, 15]. For each sets, multiple-choice scenarios were created adding a same "constant" comparator (current situation) to each binary choices. Each patient was asked to define his or her own opt-out option before completing the DCE exercise.

b These principles are orthogonality, level balance, minimal overlap. Orthogonality: is satisfied when the levels of each attribute vary independently of one another. Level balance: is satisfied when the levels of each attribute appear with equal frequency. Minimal overlap: is satisfied when the alternatives within each choice sets have not overlapping attribute levels.

c D-score is a measure of the average variance around the parameter estimates. It is defined by D-error=| Σ|1/K where K is the no. of attributes and Σ is the covariance matrix[16].

Table 1: Service' attributes, patient characteristics and alternatives

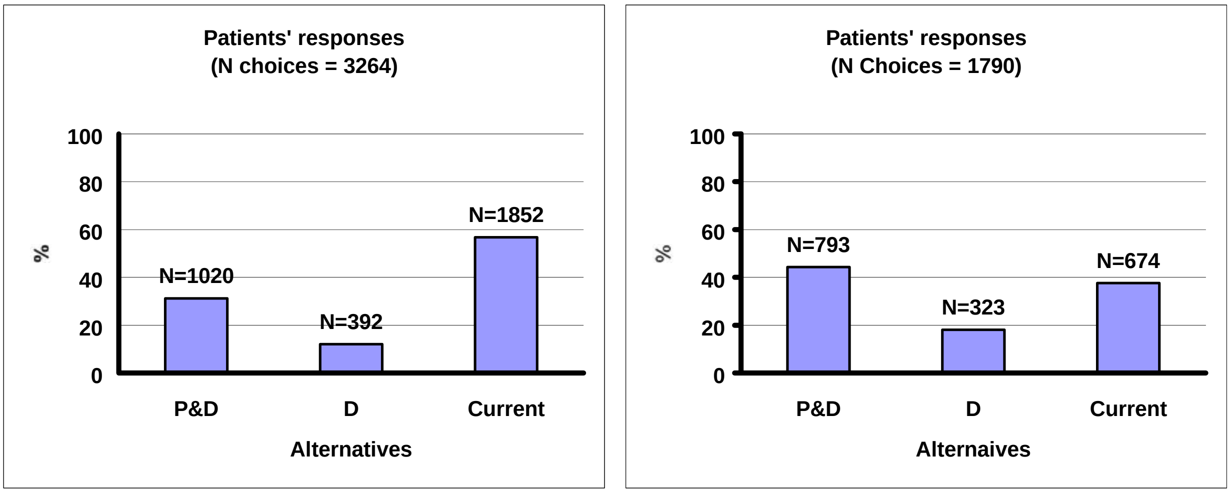
Service's Attributes	Levels for each attribute	Variable name
Time spent travelling to, waiting in the surgery, in consultation with the GP	0, 30, 50 min	GPtime
Time spent travelling to, waiting in the pharmacist, in consultation with the pharmacist	0, 20, 40 min	Phtime
Chance of receiving the "best" treatment	Low, medium, high	Chance
The amount of money you have to spend to get the drug (£) (clinical advice provided + medicine + travel)	3, 7, 12, 20 (£)	Cost
Patient's characteristics		
Quality of life (EQ-5D – VAS)	0 - 100	Eq-5D
Age	> 18 (years)	Age
Chronic disease	Yes=1	Chronic
	No= 0	Not chronic
Payment of prescription	Yes=1	Pay
	No=0	Not to pay
Alternatives	1	Prescribing & Dispensing
	2	New dispensing
	3	Current dispensing

Figure 1: Example of DCE choice

	Prescribing and dispensing pharmacist	***Dispensing pharmacist***	
GP's time	0 minutes	10 minutes	
Pharmacy's time	30 minutes	50 minutes	
Chance of receiving the best treatment	High	Low	
How much you have to pay	£7	£3	
Which situation would you prefer? ***(tick one box only)***	***Prescribing and dispensing pharmacist*** ☑	***Dispensing pharmacist*** ☐	***Current situation*** ☐

Individuals providing constant preferences for the whole choice set were dropped from subsequent analysis. The resulting sample of 115 subjects was used for analysis of preferences. Compared with the initial sample of 204 subjects, these were younger (mean age 37.7 vs 44.2 years; P<0.001, Independent sample t test) and a higher percentage of them paid for the prescription (58.82% vs 78.80%, P<0.001, Independent sample t test). Furthermore, they were more attracted by the innovative "prescribing & dispensing" scenario than by their "current" situation (Figure 2).

Figure 2: Patients' responses - 204 subjects (N choices=3264) vs 115 subjects (N choices =1790)



Econometric analysis of DCE data with multiple options

As noted above, when more than two options are included within a choice set, the Conditional Logit approach (as opposed to the binary approach) has commonly been used. This is applicable when the options available are all close substitutes. This model assumes that the ratio of probabilities for any two alternatives is independent of the attribute levels of the third alternative (cross-elasticity of substitution across alternatives or IIA assumption)[3]. However, if this assumption is not true, experimental findings may be biased and lead to incorrect predictions. Therefore it is important to examine whether some options compete with some more than with others, thereby violating the IIA assumption[18].

A partial solution to the IIA problem is to use a generalised extreme value distribution, which allow alternatives to be grouped in a manner that allows alternatives to be correlated within, but not between, groups. These models are generally referred as Nested Logit Models (NLM)[19]. When using the NLM the researcher must make a decision about the nesting structure, that is between the correlations between alternatives. Since economic theory has nothing to say about this nesting structure the researcher must make the decision.

For example, within the context of the current study, subjects decide which pharmaceutical service they wish to receive, with the options “Prescribing & Dispensing pharmacist”, “New Dispensing pharmacist” and “Current Dispensing pharmacist” being considered simultaneously. Three possible substitution patterns are investigated in this paper (though these are not comprehensive): all options are equal substitutes (as implied by the standard CLM); ‘dispensing’ (current and new) are closer substitutes than ‘prescribing and dispensing’ (assuming the respondent does not want to see an increased role for the pharmacist to one of prescribing as well as dispensing); or the new proposals are closer substitutes than the current one (to test for status quo bias[20]). These substitution patterns are represented, respectively, by the tree structures A, B_1 and B_3 reported in Figure 3 (alongside a number of other possible structures). As in shown in Figure 3, each pattern implies an alternative econometric method of analysis:

- **Situation A**: An increase in the probability of choosing “Prescribing & dispensing pharmacist” results in an equal proportional decrease in the probability of choosing “New Dispensing pharmacist” and “Current dispensing” (Structure A). This is based on the irrelevant alternatives (IIA) assumption and the Conditional Logic Model (CLM) is the appropriate modelling technique (θ_N= 1, see below).
- **Situation B**: “Prescribing & dispensing pharmacist” and “New Dispensing pharmacist” are closer substitutes with each other than with the current situation, but the “Current dispensing” is still seen as a substitute for them (Structure B_1). This may be the case if subjects prefer the current situation, representing status quo bias. The Nested Logit Model (NLM) is an appropriate technique to test this hypothesis ($0<\theta_N< 1$, see below).
- **Situation C**: “Prescribing & dispensing pharmacist” and “New Dispensing pharmacist” are seen as substitutes, but the “Current dispensing” doesn’t compete with them. Thus, changes in the probability of choosing “Prescribing & dispensing pharmacist” will affect the probability of choosing “New Dispensing pharmacist”, but not the probability of choosing the current situation (Structure C_1). Two Separate Binary Logit (SBL) models are appropriate ($\theta_N = 0$, see below).

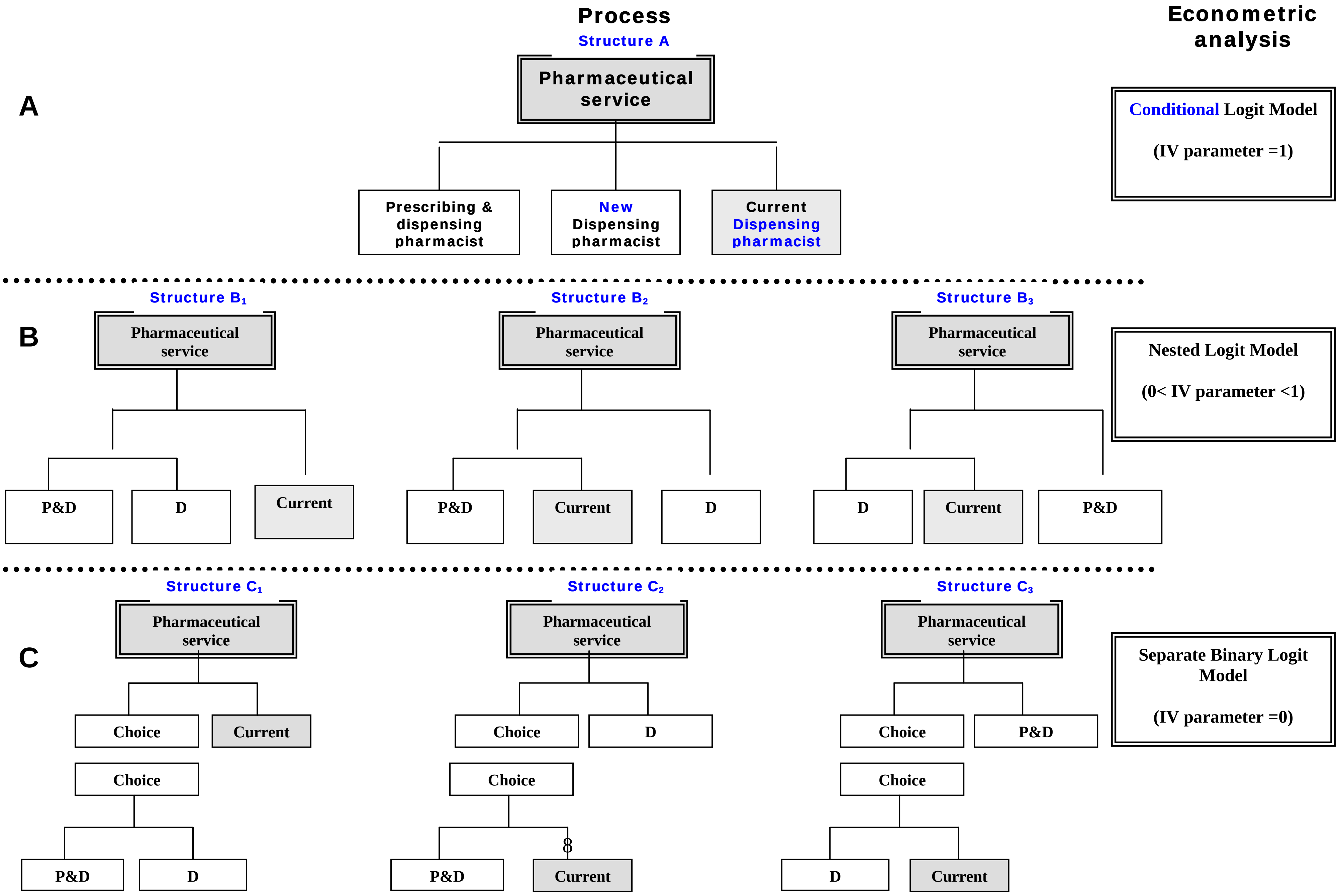
The θ_N parameter, also known as the "inclusive value (IV) parameter" or "the dissimilarity parameter", measures the degree of independence in unobserved utility among the alternatives within the nest, N, and lies between 0 and 1[d] [19, 21-24]. A higher value of θ_N means greater independence and less correlation. The statistic 1 - θ_N is a measure of correlation, in the sense that as θ_N parameter rises, indicating less correlation, this statistic falls.

Testing for $\theta_N = 1$ is equivalent to testing whether the conditional logit model is a better model specification than the more general nested logit model. These tests are usually performed with the likelihood ratio statistic[22-24]. After specifying alternative models consistent with utility theory, we can select the most appropriate comparing their likelihood ratio index. The most suitable model presents the highest likelihood ratio .

[d] According to McFadden[21] a globally sufficient condition for nested logit model to be consistent with utility maximisation is that **$0 < \theta_N < 1$**. However, Borsch-Supan[22] demonsrated that **$\theta_N > 1$** can be consistent with utility theory.

31/05/2005 12:22

Figure 3: Econometric analysis and model selection



Utility function estimation using Nested Logit Models

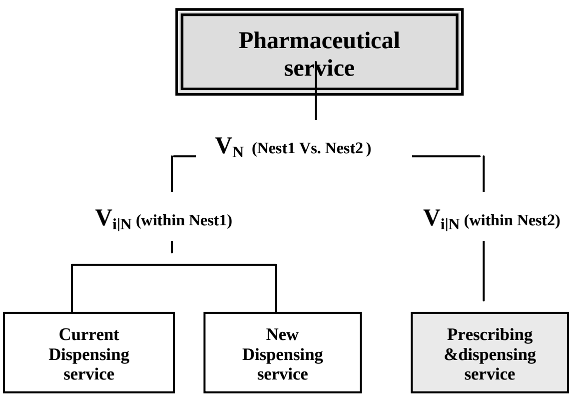
In DCE models each individual is assumed to make choices among discrete alternatives in a manner that provides the highest utility per chosen alternative. It is commonly assumed in the literature that this utility function is a linear function described in the following way:

$$U_i = V_i + \varepsilon_i$$

where U_i is the unobservable utility of offering service i; V_i is the deterministic component or observed utility**;** ε_i is the random component or unobserved utility[3]. In the present paper, more than two alternatives have been compared. The decision making process can be broken into two possible decisions. An example of a possible two-phase hierarchical decision model with their corresponding deterministic components is reported in Figure 4:

1. The decision whether or not to stay with the dispensing pharmacist (i.e. "Current Dispensing pharmacist" or "New Dispensing pharmacist") rather than the "Prescribing & Dispensing" option.
2. The decision regarding which alternative pharmaceutical service to adopt, ie "Current Dispensing pharmacist" versus "New Dispensing pharmacist" (assuming that the individual decides not to choose the innovative "Prescribing & Dispensing pharmacist").

Figure 4: Description of possible decision model (Structure B_3)



Upper model - choice of nest, N

Alternative nests: Nest 1 (*Current, New Disp*) **Vs**.
Nest 2 (*Presc&Disp*)

Utility function $\mathbf{V_N = \gamma' X_N + \theta_N IV_N}$

Lower model - choice of alternative within the nest, N

Alternatives within Nest 1: *Current* **Vs**. *New Disp*
Alternatives within Nest 2: *Presc&Disp*

Utility function $\mathbf{V_{i|N} = \beta' A_i}$

Upper model: Choice between different nests. The deterministic component of the decision whether or not to choose an alternative pharmaceutical service to the current situation (V_N) can be modelled as a function of both individual characteristics ($\gamma' X_N$) and the expected utility of the pharmaceutical service adopted (IV_N)[1-5]. The "inclusive value parameter" (θ_N) weights the contribution of the alternative attributes from the lower model ($V_{i|N}$) to the decision of whether or not move form the current situation to an alternative pharmaceutical service (V_N). The "logsum" or "inclusive value term" (IV_N) indicates the average utility the patient can expect from the alternatives within that particular nest N.

$$V_N = \gamma' X_N + \theta_N IV_N$$

$$IV_N = ln \sum_{i=1}^{i_N} e^{\beta' A_i}$$

where X_N represents the characteristics of the individual and γ' a vector of parameters to be estimated (Table 1). For the study here, $\gamma' X_N$ is defined as:

$$\gamma_0 + \gamma_1 EQ5D_N + \gamma_2 Age_N + \gamma_3 Chronic_N + \gamma_4 Pay_N$$

where EQ5D indicates current health status on a thermometer from 0-100, where 0 is worst imaginable health state and 1 is best imaginable health state; age is a continuous variable representing age in years of respondents; Chronic is whether the subject has a chronic disease and Pay is whether or not the respondent pays for their NHS prescription (see lower part of Table 1). Assuming that individual characteristics are different across different nests and constant within each nest, their change affects the choice of nest (or marginal probability) and not the choice of alternatives within the nest (or conditional probability) [23].

Lower model: choice within a particular nest. In the present example, for the decision regarding which alternative pharmaceutical service to adopt, the deterministic component of utility is defined as a function of the service attributes:

$V_{i|N} = \beta' A_i$

where i represents the dispensing service chosen ("Current Dispensing pharmacist" or "New Dispensing pharmacist") given a decision has been made not to choose an innovative "Prescribing & Dispensing pharmacist". A_i represents the vector of attributes of the pharmaceutical service provided, and β' the parameters of the model to be estimated (Table 1).

$V_{i|N} = \beta' A_i = \beta_0 PHtime + \beta_1 GPtime + \beta_2 chance + \beta_3 cost$

Results from the analysis are reported in Table 2 for 115 selected responders without constant preferences. The conditional logit model is presented together with two alternative nested model structures. The Hausman test, with a highly significant chi-square value, $\chi^2 = 36.48$, indicates that the IIA assumption is violated and a nested logit model is more appropriate. Moreover, the IV parameter associated with the nested models structures are statistically significantly different from zero at the 1% level and less than 2, indicating rejection of the IIA hypothesis[29].

The first nested logit model (Structure B_1) has a slightly better goodness-of-fit in terms of a higher log-likelihood and thus higher likelihood ratio index of 0.2087 compared to 0.1609 for the second nested logit model (Structure B_3). The conditional logit model has the lowest log-likelihood and smallest likelihood ratio index of 0.0158 .

For the nesting structures the influence of individual characteristics on choice over alternative pharmaceutical services is considered. However, the signs of the coefficients differ, depending on the nesting structures, and the magnitudes of the coefficients are slightly different. The coefficients in the branch (lower model) and alternative specific constants differ, reflecting the alternative substitution patterns implied by the different nesting structures. Consequently, these differences are translated in the WTP estimates for improvement in service attributes and more conspicuously on the welfare measures or difference in maximum expected utilities in monetary terms from changes in the pharmacist service attributes including cost.

Nested logit model B_1

The substitution pattern presented in B_1 is that the two proposed alternatives 'prescribing and dispensing' and 'new dispensing' are closer substitutes than the current service. The IV value between 0-2 implies that it is compatible with random utility maximisation theory [21]. Most individual specific and service coefficients are significant at the 10% level, suggesting that both these are important when deciding what system to choose.

Upper model – choice between different nests (Table 2). Both patients' characteristics and services' attributes influence the choice of the novel services (IV parameter > 0). The contribution of the service attributes to the upper model is weighted by the IV parameter (1.27). This indicates that the decision about what service to use is influenced by the characteristics of the service. Within patients characteristics, paying for prescriptions and chronic health status have a greater absolute impact on choice. The positive signs of chronic state and EQ-5D show, respectively, that people that experienced a chronic disease or value more their health state prefer their pharmacist to provide a "prescribing and dispensing service" or "new dispensing only" rather than the current service. The negative signs on the age and pay attributes suggest that younger people and those who don't pay for their prescription are willing to move to the innovative "prescribing and dispensing" and new dispensing pharmacist, while older people and those who pay for their prescription prefer the current situation (status quo bias).

Lower model – choice within a particular nest (Table 2). The positive and significant ASC indicate that having chosen to move from the current pharmacist service, people prefer the innovative prescribing and dispensing to the new dispensing only pharmacist service.

The choice of a particular pharmacist service is influenced by the characteristics of that service. The magnitude of the coefficients shows that the chance of receiving the best treatment and the cost attribute have the largest marginal impact on the choice. The signs of the coefficients show that people prefer a service with lower cost, a higher chance of appropriate treatment and reduced waiting times. The trade-off between attributes show that respondents are willing to pay: -0.7466/-0.0650 = £12 for % increase in chance of receiving the best treatment; -(-0.0038)/(-0.0650) = £0.58 3 for a 10 minute reduction in GP time; and –(-0.0062)/(-0.0650) = £2 for a 10 minute reduction in travel and waiting time at the pharmacist.

Table 2: Modelling results

	Conditional logit model A		Nested logit model B_1		Nested logit model B_3	
Attribute	**Coefficient (standard error)**	**P value**	**Coefficient (standard error)**	**P value**	**Coefficient (standard error)**	**P value**
			Upper model: choice of nest (marginal probability)			
ASC	-	-	0.2523 (0.04354)	0.5622	1.1309 (0.4179)	0.0068
EQ-5D	-	-	0.0059 (0.0035)	0.0920	-0.0152 (0.0035)	0.0000
Age	-	-	-0.0090 (0.0041)	0.0262	0.0096 (0.0039)	0.0150
Chronic	-	-	0.3576 (0.1402)	0.0108	-0.6685 (0.1341)	0.0000
Pay prescription	-	-	-1.4136 (0.1539)	0.0000	0.4073 (0.1347)	0.0025
			Lower model: choice of alternative within the nest (conditional probability)			
ASC Dispensing	-0.2465 (0.0818)	0.0026	-		-0.2389 (0.0841)	0.0045
ASC Presc. & Disp.	0.3754 (0.0951)	0.0001	0.6500 (0.1076)	0.0000	-	-
GP time	-0.0047 (0.0025)	0.0628	-0.0038 (0.0025)	0.1286	-0.0060 (0.0029)	0.0361
PH time	-0.0048 (0.0027)	0.0663	-0.0062 (0.0030)	0.0158	-0.0067 (0.0029)	0.0230
Chance	0.7531 (0.0445)	0.0000	0.7466 (0.0475)	0.0000	0.8579 (0.0530)	0.0000
Cost	-0.0524 (0.0062)	0.0000	-0.0650 (0.0068)	0.0000	-0.0608 (0.0067)	0.0000
No. observations	1790		1790		1790	
Log likelihood ratio index	0.15806		0.2087		0.1609	
IV value	-	-	1.2695 (0.1439)	0.0000	.5190 (0.1323)	0.0001

Nested logit model B_3

Upper model – choice between different nests (Table 2). The positive and significant ASC shows that, generally, people are likely to choose the more conventional “dispensing only” to the innovative “prescribing and dispensing service”. Both patients’ characteristics and services’ attributes influence choice (IV parameter > 0). The size of their contribution to the upper model is weighted by the IV parameter (0.519). This again indicates that the decision about what service to use is influenced by the characteristics of the service. Within patients’ characteristics, the need to pay for prescription and the presence of a chronic disease have the greatest absolute impact on choice. The negative signs of chronic state and EQ-5D show, respectively, that people that experienced a chronic disease or value more their health state prefer their pharmacist to provide a “prescribing and dispensing service” rather than a “dispensing only”. The positive signs of the age and pay attributes show that younger people and those who do not pay for their prescription are willing to move to the innovative “prescribing and dispensing” pharmacist, while older people and those who pay for their prescription prefer the dispensing only pharmacist.

Lower model – choice within a particular nest (Table 2). The negative ASC shows that having chosen not to move to the “prescribing and dispensing” pharmacist, people prefer their current situation to an alternative new dispensing scenario. The choice of a particular pharmacist service is influenced by the characteristics of the particular services. The size of the coefficients shows that the chance of receiving the best treatment and the cost attribute have largest marginal impact on choice. The signs of the coefficients show that people prefer a service with decreased cost, higher chance of appropriate treatment and reduced waiting times. The trade-offs between attributes show that respondents are willing to pay: -0.8579/-0.0608 = £14 for a % increase in chance of receiving the best treatment; -(-0.0060)/(-0.0608) = £1 for a 10 minute reduction in GP time; and –(-0.0067)/(-0.0608)=£1 for a 10 minute reduction in travel and waiting time to the pharmacist.

Welfare estimates with multiple choice options

Ongoing discussion refers to the use of DCEs in deriving welfare estimations.[25-28] The coefficient estimates from the selected model can be used to construct welfare gains. Welfare estimate after a change in the service attributes provided can be expressed as[5]:

$$\textbf{\textit{Welfare change}} = -\frac{1}{\beta_{cost}}\left\{ ln\sum_{N=1}^{2}\sum_{i=1}^{I_N} e^{V_{iN}^{(1)}} - ln\sum_{N=1}^{2}\sum_{i=1}^{I_N} e^{V_{iN}^{(0)}} \right\}$$

where $V_{iN} = V_{i/N} + V_N = \gamma' X_N + \theta_N IV_N + \beta' A_i$

where β_{cost} is the price coefficient; N refers to the nest N; i refers to the alternative i of the nest N. The superscript on V_{iN} refers to whether the attributes levels are set at the new level (subscript 1) or at the original level (subscript 0). This measures the difference in expected maximum utilities in monetary terms (by dividing by the cost coefficient) assuming no income effects. No income effect implies that individual budget does not influence the choice probabilities so that WTP is constrained not to vary with income.

When the options available are all close substitutes (θ_N =1 and N =1, therefore $\Sigma_{N=1}$ and $V_{iN} = V_i$) the model can be simplified to the most common used equation for "multiple alternative model"[26]:

$$\textbf{\textit{Welfare change}} = -\frac{1}{\beta_{cost}}\left\{ ln\sum_{i=1}^{I} e^{V_i^{(1)}} - ln\sum_{i=1}^{I} e^{V_i^{(0)}} \right\}$$

where $V_i = \beta' A_i$

In this study welfare is estimated for 2 situations: moving from the "current dispensing pharmacist" to either the innovative "prescribing & dispensing pharmacist" or "alternative dispensing only" scenario. Welfare measures are evaluated from the coefficient values of the services' attributes (Table 2) and the mean levels of individual characteristics and attributes reported for each alternative (Table 3). Results are presented in Table 4.

Table 3: Mean attributes' levels reported for each alternative scenario (from the selected nested model)

	Prescribing and Dispensing Mean (SD)	**Dispensing** Mean (SD)	**Current** Mean (SD)
GP time (minutes)	0.000 (0.000)	28.346 (21.260)	30.861 (12.138)
PH time (minutes)	20.000 (12.574)	28.189 (12.997)	17.512 (13.139)
Chance (1-3)	2.636 (0.578)	2.464 (0.721)	2.311 (0.464)
Cost (£)	8.842 (5.935)	9.173 (5.369)	6.615 (4.100)
Age	35.758 (14.544)	36.740 (16.198)	36.402 (12.539)
EQ-5D	77.087 (19.089)	72.402 (21.435)	80.479 (11.234)
Chronic	0.212 (0.409)	0.118 (0.324)	0.086 (0.281)
Pay prescription	0.714 (0.453)	0.646 (0.480)	0.947 (0.224)

Conditional logit model A

For the conditional logit model the welfare measure for moving from the current situation to the innovative "prescribing and dispensing" is £8.31, while for moving from the current to the "alternative dispensing only" service is £-3.37 (i.e. they are worse off).

Table 3: Marginal WTP and welfare estimates

Estimates	**Structure A**	**Structure B_1**	**Structure B_3**
Marginal WTP…			
…to have a unit increase in the % of receiving the best treatment	£14.37	£11.49	£14.11
… *to have decreased in GP time of 10 minutes*	£0.90	£0.58	£0.99
… *to have decreased in PH time of 10 minutes*	£0.92	£0.95	£0.99
Welfare Measures			
WTP for moving from current to the innovative "prescribing and dispensing pharmacist"	£8.31 (CI = 7.11 , 9.77)	£23.12 (CI = 21.45 , 23.70)	-£8.56 (CI = -9.16 , -8.08)
WTP for moving from current to the "new dispensing pharmacist"	-£3.37 (CI = -3.59,-2.71)	£11.58 (CI = 9.13 , 13.24)	-£4.46 (CI = -6.11 , -2.10)

CI = confidence intervals, estimated using bootstrapping techniques

Nested logit model B_1

For nested logit model B_1, welfare measures indicated a preference for the proposed services rather than the current pharmacist role and preference for the innovative prescribing and dispensing over the new dispensing only pharmacist role. The monetary value of moving from the current situation to the innovative "prescribing and dispensing" is £23.12, while for moving from the current to the "new dispensing only" service is £11.58.

Nested logit model B_3

Welfare measures for the nested logit model B_3 imply that people prefer the dispensing only conventional role of pharmacist whether current or new dispensing only service to the proposed prescribing and dispensing role. The monetary value of moving from the current situation to the innovative "prescribing and dispensing" is -£8.56, while for moving from the current to the "new dispensing only" service is £-4.46.

Some comments

Sensitivity analysis on alternative modelling structures suggests that respondent's welfare estimates are sensitive to the model adopted. More specifically, adopting the conditional logit model indicated that respondents preferred the prescribing and dispensing pharmacist to the current situation, but preferred the current situation to an alternative dispensing system. In comparison, the NLM B_1 suggested a stronger preference for moving from the current to prescribing and dispensing, but also a preference to move from current to the new dispensing pharmacist. In contrast, NLM B_2 found the current situation to be preferred to both alternatives. Econometric measures of goodness of fit led to rejection of the conditional logit model (based on the Hausmann test and IV parameters). Comparing the alternative nested logit models suggested that NLM B_1 was preferred i.e. prescribing and dispensing and an alternative dispensing were seen as closer substitutes than the current situation. Interestingly, these results suggest the opposite to status quo bias (a common found occurrence in health care), with subjects preferring to move away from the current situation. This suggest some level of dissatisfaction with the current provision of pharmaceutical services.

This is very much work in progress and the results may not be generalisable. A useful avenue for future research would be to examine the sensitivity of welfare estimates in other data sets to the specification of the nested structure. However, the results from this study support the findings of others regarding the sensitivity of welfare estimates to modelling of responses[29], thus emphasising the importance of sensitivity analysis, measures of goodness of fit and judgement when estimating welfare measures for use at the policy level.

References

1. Ryan M, Skatun D. Modelling non-demanders in choice experiments. Health Economics Letters 2004; 13: 397-402.
2. Hensher D, Greene W. Specification and Estimation of Nested Logit Models, Transportation Research 2001; 36: 1–17.
3. Louviere JJ, Hensher DA, Swait JD. Stated Choice methods. Analysis and application. 2000 Cambridge University Press.
4. Knapp T, White N, Clark D. A nested logit approach to household mobility, Journal of Regional Science 2001; 41: 1-22.
5. Hanemann, W. Michael. Welfare Analysis with Discrete Choice Models. In Valuing Recreation and the Environment: Revealed Preference Methods in Theory and Practices, edited by Cathy Kling and Joe Herriges. Cheltenham, U.K.: Edward Elgar, 1999.
6. Puig-Junoy J, Saez M, Martinez-Garcia E. Why do patients prefer hospital emergency visits? A nested multinomial logit analysis for patient-initiated contacts. Health care Management Science J 1998; 1: 39-52.
7. The right medicine: a strategy for pharmaceutical care in Scotland NHS Scotland Scottish Executive, 2002 (http://www.scotland.gov.uk/library3/health/pcis-04.asp; Last visited June 2004).
8. Public Health Institute of Scotland. Pharmacy for Health: The Way Forward for Pharmaceutical Public Health in Scotland. Glasgow. Public Health Institute of Scotland, 2002 (www.phis.org.uk ; Last visited June 2004).
9. Medicines Control Agency & Department of Health. Supplementary Prescribing. Amendments to the Prescription Only Medicines (Human Use) Order 1997 and Proposals for Supplementary Prescribing by Nurses and Pharmacists. London: Medicines Control Agency, 2002 (Consultation Letter MLX 284).
10. RPSGB. First report of the RPSGB pharmacist prescribing task group on supplementary prescribing. London: RPSGB, 2002.
11. The National Prescribing Centre. ‘Maintaining competency in prescribing: an outline framework to help pharmacist supplementary prescribers. (http://www.npc.nhs.uk; Last visited June 2003).
12. Supplementary Prescribing by Nurses and Pharmacists within the NHS in England (http://www.doh.gov.uk/supplementaryprescribing ; Last visited June 2003).
13. Ryan M. and Gerard, K. using discrete choice experiments to value health care: current practice and future prospects. Applied Health Economics and Policy Analysis. 2003;2:55-64.
14. Hanley N, Mourato S and Wright R “Choice modelling: a superior alternative for environmental valuation?” Journal of Economic Surveys, 2001; 15:435-462.
15. Carlsson F, Martinsson P. Design techniques for stated reference methods in health economics. Health Economics 2003; 12: 281-294.
16. Maddala T, Phillips KT, Reed J F. An experiment of simplifying conjoint analysis designs for measuring preferences. Health economics 2003; 12: 1035-1047.
17. Zwerina K, Huber J, Kuhfeld WF. A general method for constructing efficient choice designs. Working paper, Fuqua School of Business, Duke University, 1996.
18. Dhar R, Simonson I. The effect of forced choice on choice. Journal of Marketing Research 2003; 40: 146-160.

19. Manski CF, McFadden DL. Structural analysis of discrete data and econometric applications. Cambridge: the MIT Press1981.
20. Salkeld G, Ryan M, and Short L. The veil of experience: do consumers prefer what they know best? Health Economics Letters 2000; 9: 267-270.
21. Borsh-Supan A. On the compatibility of nested logit models with utility maximisation. Econometrics 1990; 43: 373-88.
22. McFadden, D. 'Modeling the choice of residential location', in A. Karlqvist, L. Lundqvist, F. Snickars, and J. Weibull, eds., Spatial Interaction Theory and Planning Models, North-Holland, Amsterdam, 1978 pp. 75–96.
23. Train K. Discrete choice methods with simulation. Cambridge University Press 2003.
24. Greene W. Econometric analysis. New York: Pearson Education, 2003.
25. Lancsar E, Savage E. Deriving welfare measures from discrete choice experiments: inconsistency between current methods and random utility and welfare theory. Health Economics Letters 2004; 8: 3-9.
26. Ryan M. Deriving welfare measures from discrete choice experiments: a comment to Lancsar and Savage (1) Health Economics Letters 2004; 8: 10-13.
27. Santos Silva JMC. Deriving welfare measures from discrete choice experiments: a comment to Lancsar and Savage (2). Health Economics Letters 2004; 8: 14-19.
28. Lancsar E, Savage E. Deriving welfare measures from discrete choice experiments: a response to Ryan and Santos Silva. Health Economics Letters 2004; 8: 20-25.
29. Smith V. Desvousges W. and Fisher A. A comparison of direct and indirect methods for estimating environmental benefits. American Journal of Agricultural Economics 1986; 68: 280-290.