

**DICHOTOMOUS CHOICE VERSUS OPEN-ENDED  
AND PAYMENT-SCALE APPROACHES TO  
ELICITING WILLINGNESS TO PAY: BY HOW  
MUCH CAN THEY DIFFER?**

**By**

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## *Abstract*

There are a number of different approaches to framing contingent valuation questions. In 1993, an expert panel appointed by the National Oceanic Atmospheric Association (NOAA), recommended the use of the dichotomous choice framework as this approach minimises the bias inherent in the alternative methods.

The primary goal of this study is to directly compare three different approaches to eliciting willingness to pay (WTP) for colorectal cancer screening (dichotomous choice, open-ended and the payment scale framework).

Questionnaires with a dichotomous choice framework were administered to 800 patients in Nottingham; 263 were returned. The bid amounts were varied randomly in different subsamples, and data were collected about the subjects' socio-demographic status, attitudes towards health promotion and personal risk perceptions. Respondents were also asked for their reasons behind their 'thought process' when reaching their maximum WTP value

The dichotomous choice data will be directly compared to a previous WTP data set that adopted the open-ended and payment scale approach (2800 respondents). Both data sets have a study design that is identical apart from the framing of the WTP question. Analysis will concentrate on the variation in the response rate, the reasons behind the WTP values, and the correlation between each of the WTP distributions and variables as predicted by economic theory. Preliminary analysis suggests that the dichotomous choice framework will give rise to a demand curve for colorectal cancer screening that is quite different from the two other approaches.

## *Introduction*

In 1993, the National Oceanic Atmospheric Association (NOAA) appointed an expert panel to assess the reliability and validity of the contingent valuation method (CVM) (Arrow et al 1993). Although the recommendations from this panel focus on the assessment of environmental damages, they can be adapted to the use of CVM in the health care market. By far the most common application of CVM in health care, is the use of the willingness to pay technique, although a number of methodological issues remain unresolved (Diener et al 1998; Klose 1999). One such issue is the way in which the question is asked. The panel recommended the use of the dichotomous choice format. It was felt that the open-ended technique gives rise to strategic overstatement and the payment scale technique, i.e. presenting respondents with a set of dollar amounts from which they have to choose from, was criticised as it may lead to anchoring and other forms of bias (range bias).

Despite these guidelines, debate still exists surrounding the methodology and although these guidelines do exist, they should not be regarded as set in stone.

The results of a large contingent valuation (CV) study implemented to elicit willingness to pay values (WTP) for two different screening tests for colorectal cancer (CRC) have been reported (Frew et al 2001a) and will be discussed in the second part of this paper. In essence, the primary goal of that study was to explore a number of issues raised in the CV methodology literature. Based on a sample of almost 2800 respondents, the study compared the performance of the open-ended and payment scale technique. In the main, our results were consistent with previous research findings in the literature - that the payment scale attracts a higher response rate and yields higher positive WTP values compared to the open ended. However our results were at odds with those of Donaldson et al. (Donaldson et al 1997) who found that the open-ended format was less likely to yield preference/valuation consistency and led to perverse income effects.

The paper will be split into two parts; the first part will report on the results of the closed ended (CE) format; the second part will then make direct comparisons of these results

with the data obtained from the open-ended/ payment scale (OP/PAY) study. No other study has compared more than two question formats in the same health care setting.

## **PART 1: THE DICHOTOMOUS CHOICE FORMAT**

### *Background*

Worldwide, colorectal cancer is the second most common cancer among women and the third most common among men (Levin 1999). Given that the disease has a well behaved progressive development it is a prime candidate for mass population screening (Mulcahy et al 1997). Most research to date has concentrated on two screening protocols for general use in an asymptomatic population; faecal occult blood (FOB) testing and flexible sigmoidoscopy (FS) (Lieberman 1998; Young 1996).

Although the two screening procedures have the same outcome of ultimately detecting abnormalities in the bowel, there is a huge difference in the process of care. The FOB test is a home test that is conducted over a period of time (usually 3 days). Once the patient has completed the test, they send the kit to their local General Practitioner who sends it off for investigation. The test is done biennially from the age of fifty to seventy four years. Major randomised controlled trials of FOB screening have been undertaken in the past twenty years and their combined results suggest a relative colorectal cancer mortality reduction in the order of 16% in the screening arms (Towler et al 1998). The FS test involves a 60cm endoscope being inserted into the bowel to look for any abnormalities. This procedure is carried out in a hospital clinic and the patient is required to use an enema (laxative) for preparation. Given the relatively slow development of the disease the FS test is only required once during a life time, usually around age 60 years at about the time the person is at their highest risk. Once-only screening for persons aged around 60 years has recently been the subject of a UK multi-centre randomised controlled trial (Atkin et al 1998).

Through the use of the WTP technique, the aim of the study was to identify the relative preferences from the general population for the two screening protocols.

### *Method*

Eight hundred questionnaires were distributed through the use of a collaborative research network of general practitioners (GPs). The GPs were requested to offer the questionnaire to any patient over the age of 25, with no reading/language/learning difficulties and with no previous experience with colorectal cancer either with themselves or close relatives and friends.

The questionnaire contained descriptions of CRC, the principle of screening and of the two screening options, FOB and FS. The descriptions used were similar to the ones used to invite subjects to participate in the Nottingham-based, UK FOB trial (Hardcastle et al 1996) and the UK multi-centre FS trial (Atkin et al 1998)

Following these descriptions the subjects were asked if they would choose to have a colorectal screening test and, if so, which one would they prefer. We then asked them how much they would be willing to pay by use of the CE approach that asks respondents whether they would pay a specified amount (bid) for the screening tests with possible responses being 'yes' or 'no'. The bid amount is varied across the sample making it possible to trace the relationship between the price and the proportion of individuals who are WTP. Examples of the closed ended question design used in the study are provided in appendix 1.

The bid amounts were selected on the basis of the distribution obtained from the previous OP/PAY scale study. The median WTP from this study amounted to £50 so it was felt that the initial bids of £10, £25, £50, £100 and £200 would adequately cover the expected CE distribution. This range was also chosen to test for any psychometric anchoring effects as the bid level chosen in a closed ended framework may influence the response (Green et al 1997). An extreme form of anchoring is referred to as 'yea-saying' by

Mitchell and Carson and happens when respondents say 'yes' to any bid regardless of the amount (Mitchell and Carson 1989).

Subjects were asked the WTP question first for the FOB test and then for the FS test to explore the relative differences between the given values for the two tests. To help gain insight into the 'thought process' behind the WTP value, the subjects were asked for the reasons for their response.

The remainder of the questionnaire asked subjects for routine socio-demographic and economic information, including gender, age, age on leaving full time education, employment status and household income (in four bands, starting at zero, band-width £10,000, ending £30,000 and above). We also requested information on whether any one of six diseases (stomach problems, haemorrhoids, heart disease, cancer, stroke and depression) had been experienced by the subject or the immediate family, and on perceived own health status (four-point scale – poor, fair, good, excellent). The number of visits to the GP and dentist in the past one year and two years, respectively, was requested, as was any screening history of any type over the past five years. The questionnaire also asked subjects how important they believed a fruit-rich diet, regular exercise, breast screening and cervical screening was in maintaining good health (five point scale in each of the four cases – not at all, somewhat, moderately, very, extremely). These data were coded from 1 through to 5 respectively, and a mean score across the four dimensions calculated. This score was then taken as a measure of the subjects' orientation towards health promotion or 'health motivation' (Vernon 1997) where the higher the mean value the greater the health motivation.

### *Analysis*

The response to the WTP questions were assessed using regression analysis with the probit model (Greene 1997). For each model, FOB and FS, all variables were initially entered as potential predictors and then removed using a backward stepwise procedure. Only the final models are presented below. This method of analysis meant that several of the variables had to be re-coded as dummies. The WTP responses were then analysed

with respect to the reasons given by each respondent. Graphs of the proportion of respondents saying 'yes' to each bid offered for both FOB and FS were then plotted to illustrate the relative demand for the two screening procedures.

### Results

Table 1 describes the subjects' socio-economic characteristics.

Table 1: Socio-economic characteristics of sample.

Sample characteristics		Sample characteristics	
<b>Sample size</b>	n=263		
<b>Gender; Female (%)</b>	65	<b>Worried about bowel cancer? (%)</b>	18
<b>Median Age (years)</b>	50	<b>Chances of getting bowel cancer higher? (%)</b>	7
<b>Median education age (age at leaving formal education)</b>	16	<b>No. of dental visits in last 2 yrs (median)</b>	4
<b>Income (%)</b>		<b>Health motivation score (mean)</b>	4
< £10,000	23	<b>Employed (%)</b>	57
£10,000 - £20,000	33	<b>Smoker (%)</b>	19
£20,000 - £30,000	13		
>£30,000	19		
<b>Missing</b>	12		

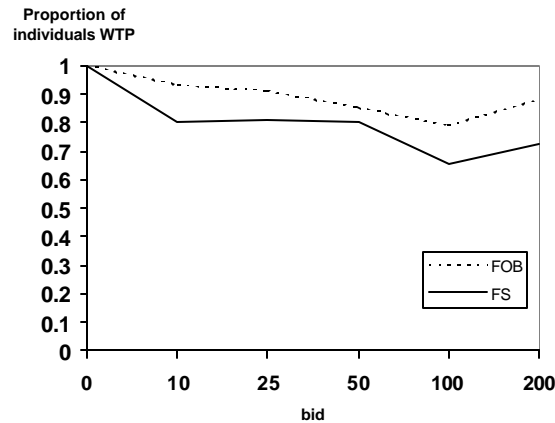
In total, 263 completed questionnaires were returned, giving a response rate of 34%<sup>1</sup>. The majority of the sample (84%) said that they would be willing to have a test, of which 41% preferred FOB, compared to 12% who would prefer the FS test. The response rates to the WTP question were 92.8% for the FOB test and 86.3% for the FS test, this difference is statistically significant ( $z = 2.422$ ).

<sup>1</sup> The overall response rate of the study was influenced by the varying response rates across the 22 practices that participated in the study. Response by practice varied enormously with some practices achieving response rates as high as 98% compared to some that only managed to achieve 3%. For a more developed discussion relating to this variation in response, see (Frew et al 2001b).

*Willingness to pay estimation*

Figure 1 displays the relationship between the bid amount and the proportion of the sample that are WTP.

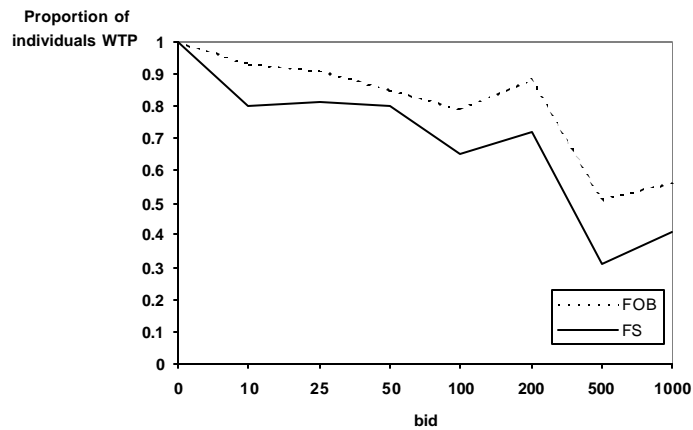
Figure 1. Proportion of individuals WTP as function of bid.



For the overall WTP to be accurately estimated, there must be a sufficient percentage of subjects saying 'no' to the highest bid (£200) (Ryan et al 1997). Figure one shows that at £200, as much as 80% of the sample were still saying 'yes'. Given this, additional questionnaires were administered using yet higher bids. A further 140 questionnaires were distributed applying the bids of £500 and £1000 with the expectation that a greater number of subjects would start to say 'no', that they were not prepared to pay at these bids. Ninety-one completed questionnaires were returned, giving a response rate of 65%. Combining this data with the original data gives a revised probability function displayed in figure 2.



Figure 2. Proportion of individuals WTP as function of bid.



At £500, the proportion of respondents saying ‘yes’ to both tests has fallen but rises again at the bid of £1000. For the FOB test, the proportion falls from 80% at the £200 bid to 51% at the £500 bid. However when presented with the bid of £1000, the proportion of respondents saying ‘yes’ rises again to 56%! Figure two illustrates that the curves have similar shapes for both tests with the WTP for FOB being greater across all bids. This is consistent with the direction of preferences reported previously (41% preferred FOB compared to 12% who preferred FS).

### *Reasons*

Reasons provided by the subjects for their response to the WTP bid were analysed using the nine broad categories of explanation that were previously created in the OP/PAY scale study. Table two summarises all reasons offered by the CE sample.

Table 2: Reasons offered by CE sample.

Type of explanation provided	FOB n = (%)	FS n= (%)	Total n=(%)
E1 Question deemed inapplicable	1(0.4)	3(1.3)	4(0.8)
E2 Subject expressed difficulties in estimating WTP	13(4.6)	15(6.4)	28(5.4)
E3 WTP estimate stated to based on a nominal amount	1(0.4)	1(0.4)	2(0.4)
E4 WTP reflects ability to pay (affordability)	41(14.4)	36(15.5)	77(14.9)
E5 WTP reflects a fair, acceptable or reasonable value	10(3.5)	7(3.0)	17(3.3)
E6 WTP reflects costs of screening	26(9.1)	26(11.2)	52(10.0)
E7 WTP reflects perceived benefit of screening	152(53.3)	111(47.6)	263(50.8)
E8 Reported familial experience of colorectal cancer	16(5.6)	6(2.6)	22(4.2)
E9 Protest expressed at the idea of payment	25(8.8)	28(12.0)	53(10.2)
<b>Total</b>	285 (100)	233 (100)	518(100)

Across the whole sample, 68% of subjects provided a reason for the FOB WTP question and 62% for the FS WTP question. There was no real difference in the proportion of cited reasons between the tests. The majority of reasons provided relate to the 'benefits' of the tests, as respondents perceive them, i.e. they deem screening as worthwhile given the recognised risks or they believe that screening offers reassurance and peace of mind. Fifteen percent of the sample referred to their ability to pay. Twenty subjects that responded with a protest comment for the FOB test, also did so for the FS test. Surprisingly, twelve subjects only protested to one WTP question, be it either FOB or FS, but not to the other.

### *Regression Analysis*

The results of the regression analysis for both the FOB and FS models are shown in table three. Results are presented for two types of model, the full model which includes all observations and the reduced model which excludes all subjects who 'protested' to the WTP question.

Table 3. Probit regression equations of the probability of accepting the bid value for FOB and FS.

Explanatory variable	FOB model	FS model
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	Full model	Reduced model	Full model	Reduced Model
<b>Constant</b>	2.694 (.008)	3.10 (.000)	-.460 (.498)	-.254 (.719)
<b>BID</b>	-.148 (.000)	-.164 (.000)	-.695 (.041)	-.781 (.029)
<b>EMPLOYED</b>	.520 (.056)	.608 (.069)		
<b>SMOKER</b>	-.597 (.046)	-.716 (.051)		
<b>STATED PREFERENCE FOR TEST</b>	-.958 (.002)	-1.09 (.008)		
<b>HEALTH MOTIVATION SCORE</b>			.368 (.019)	.318 (.050)
<b>CHANCES ABOVE AVERAGE</b>			1.14 (.035)	7.123 (1.00)
<b>E4 (FOB)</b>	-1.395 (.000)	-2.01 (.000)	-.908 (.000)	-.908 (.000)
<b>E9 (FS)</b>	-2.262 (.000)		-1.62 (.001)	
<b>Number of observations</b>	235	212	189	181
<b>Goodness of fit</b>				
<b>R squared</b>	0.33	0.27	0.18	.177

In both models, the probability of accepting the bid amount (i.e. responding with a 'yes') decreases significantly as the bid level rises, this is a result that one might expect. Although income failed to have a significant impact on either of the two models, the respondents who mentioned 'affordability' in their reasons were significantly less likely to agree to pay the bid amount for both tests.

For the FOB model, subjects who do not smoke and have not expressed a preference for either of the two tests were having a positive impact on the probability of a 'yes' response.

The FS model produced a different set of significant variables. As one might expect, if the subject had a high health motivation score then the probability of saying 'yes' to the bid amount was significant. If respondents thought that their chances of developing the disease were above average then they would be more likely to agree to pay the bid amount but this effect was only significant with the full FS model.

## **PART 2 - COMPARISON WITH OPEN ENDED/PAYMENT SCALE FORMAT**

The data capture instrument used in the OP/PAY study was identical to the CE study with the only difference being the format of the WTP question. 2767 subjects completed questionnaires of which approximately half were of the open-ended design and half the payment scale design.

Table 4 summarises the socio-economic characteristics of the sample gained.

Table 4: Socio-economic characteristics of the OP/PAY sample

Sample characteristics		Sample characteristics	
<b>Sample size</b>	n=2767		
<b>Gender; Female (%)</b>	69	<b>Worried about bowel cancer (%)?</b>	20
<b>Median Age (years)</b>	49	<b>Chances of getting bowel cancer higher (%)?</b>	11
<b>Median education age (age at leaving formal education)</b>	16	<b>No. of dental visits in last 2 yrs (median)</b>	3
<b>Income (%)</b>		<b>Health motivation score (mean)</b>	4.1
< £10,000	24	<b>Employed (%)</b>	57
£10,000 - £20,000	31	<b>Smoker (%)</b>	20
£20,000 - £30,000	18		
>£30,000	15		
<b>Missing</b>	12		

Eighty nine percent of the sample said that they would be willing to have a screening test. The FOB test was the most popular test (45.3%) compared to the FS test (13.4%) and subjects who had 'no preference' between tests (41.4%).

#### *Response rate to WTP question*

The response rate to each of the WTP questions in both studies is summarised in table 5.

Table5: Response to the WTP question

	FOB (%)	FS (%)	Total
<b>Open-ended</b>	954 (70)	894 (65)	1366

<b>Payment scale</b>	1200 (86)	1083 (77)	1401
<b>Closed-ended</b>	316 (89)	294 (83)	354

The FOB question received more replies than did the FS question across all three question formats. Consistently, the CE question design produced the most favourable response followed by the payment scale and then the open-ended design.

### *Reasons*

The reasons behind the WTP response rate provide an invaluable insight into how well the WTP question has been understood. Therefore an interesting method of comparing the question formats is to compare the types of reason provided for each design. Table 6 summarises all the reasons offered by the sample answering the OP/PAY question. 1,523 (55%) subjects provided reasons in the OP/PAY study.

Table 6: Reasons provided by OP/PAY sample

<b>Type of explanation provided</b>	<b>Open-ended n = (%)</b>	<b>Payment scale n= (%)</b>
<b>E1 Question deemed inapplicable</b>	32(3.4)	43(3.8)
<b>E2 Subject expressed difficulties in estimating WTP</b>	114(12)	96(8.5)
<b>E3 WTP estimate stated to based on a nominal amount</b>	43(4.5)	21(1.9)
<b>E4 WTP reflects ability to pay (affordability)</b>	237(24.9)	399(35.2)
<b>E5 WTP reflects a fair, acceptable or reasonable value</b>	85(8.9)	95(8.4)
<b>E6 WTP reflects costs of screening</b>	117(12.3)	98(8.6)
<b>E7 WTP reflects perceived benefit of screening</b>	139(14.6)	108(9.5)
<b>E8 Reported familial experience of colorectal cancer</b>	36(3.8)	29(2.6)
<b>E9 Protest expressed at the idea of payment</b>	149(15.7)	246(21.7)
<b>Total</b>	952 (100)	1135 (100)

The most obvious difference between the reasons provided with the CE format (Table 2) compared to both the open and payment scale method is the amount of individuals referring to the 'benefits' as they perceive them, of each test. As much as half the sample mentioned the benefits of the tests in the CE format compared to only 14.6% for open-

ended and 9.5% for the payment scale. The OP/PAY study also received more 'protest comments'. A greater proportion of respondents expressed difficulty in answering the open-ended (12%) and payment scale design (8.5%) than the CE question design (5.4%).

*Demand Curves*

Figures 3 and 4 represent the proportion WTP for FOB and FS for all three question formats.

Figure 3 - Willingness to pay for FOB test

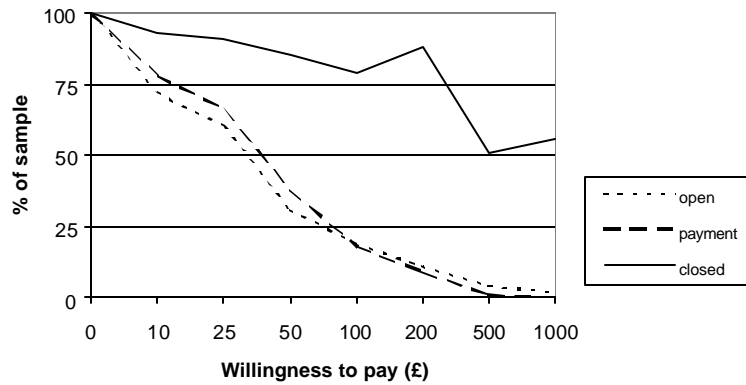
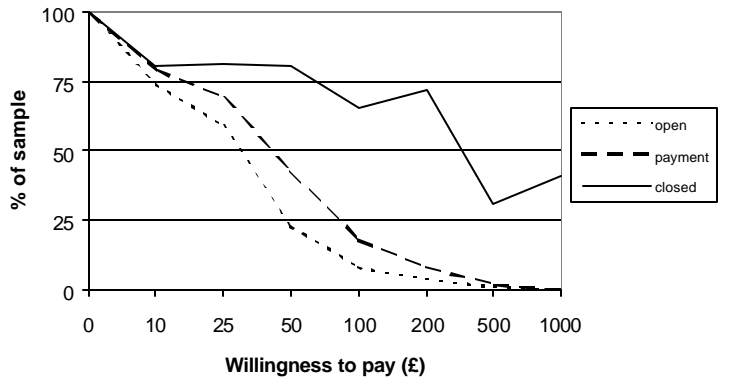


Figure 4 - Willingness to pay for FS



The demand curves reveal the different ways in which the question formats have performed. The OP/PAY curves are moving in the same way and have a shape that is common with most demand curves observed for normal goods. The demand curve produced from the CE study is quite different. According to the CE curves subjects are WTP a lot more for both tests compared to the OP/PAY demand curves.

### *Discussion*

NOAA recommends the use of the CE question design on the grounds that it resembles a 'real-life' situation, i.e. mimics market behaviour, where the respondent is presented with a price (bid) and decides whether to accept or reject it. The bids initially chosen for the CE study were estimated on the distribution obtained from the OP/PAY study however it became obvious that the WTP was much higher in the CE study as respondents kept saying 'yes' to the highest bid, £200. Consequently, we had to distribute more questionnaires using higher bids to obtain a true demand function.

The OP/PAY study found that respondents were giving the same value for both test (possible embedding effect) and this value was only influenced by the question design. The payment scale question produced a higher median WTP compared to the open-ended (£50 *vs.* £30). However the payment scale results may have been influenced by the 'range' of values chosen (Newmann and Johansson 1994). This range bias is currently being investigated; more questionnaires have been completed with a different range of values in the question to see the effect this has on the overall results. Nevertheless, this study has shown that the CE question produced a median WTP that was in excess of £200. When the bid was raised as high as £1000, 56% (FOB) and 41% (FS) still said 'yes' compared to 1.5% (FOB) and 0.2% (FS) who answered the open-ended design with values  $\geq$  £1000 and 0.3% (FOB) and 0.1% (FS) for the payment scale format. This is a surprising result given that NOAA disregard the use of the open ended format as it provides incentive for strategic overstatement (Arrow et al 1993). In this study, the open-ended has produced the lowest WTP values. Perhaps this finding is a result of the potential 'yea-saying' phenomenon inherent in the CE format.

The results are in accordance with the hypothesis that respondents find the CE question easier to understand. For both tests, the CE design produced the highest response rate. Also, less individuals in the CE sample expressed difficulties in answering the WTP question compared to the open ended and payment scale.

The FOB WTP question received more replies than the FS WTP question across all three question formats. This may have been down to an ordering effect. The FOB question was always the first WTP question to be asked. It would be interesting to see if the same result would have occurred if the sequence of the WTP question had been randomly varied.

The WTP questions are designed to try and estimate the 'value' people place on these tests. A lot of reasons cited referred to 'affordability', 'resource use', and 'protest' comments. These reasons could be taken as a misunderstanding of the aim of the WTP technique. However the CE question design performed better than the other two designs as it produced more subjects citing 'benefits' of the tests. If they have explicitly thought about these benefits then they are placing their WTP value on that instead of estimated cost or affordability issues. The CE design also produced the lowest number of protestors and affordability comments.

The CVM is based on a hypothetical situation and it is clear that the choice of question design can produce different results (especially between the CE and either the open-ended or payment scale). Without knowing how the subjects behave under real-life situations that involve the two colorectal cancer screening tests it is difficult to know which question design has produced the most valid results.

The authors would appreciate assistance in the following issues:

- Given the distribution of WTP values obtained from the CE format, is the probit regression the appropriate form of analysis?, What do we do about an upward sloping demand curve from £500 - 1000 bids?



- Why have subjects provided a different portfolio of reasons for the CE format compared to the OP/PAY format?
- Given the wide variation of results obtained, which question design is the appropriate one to adopt when eliciting willingness to pay values?
- What is the 'reasoning' behind the yea-saying phenomenon. Why do subjects continually say 'yes' regardless of the bid value in the CE format?

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**APPENDICES**

*Appendix one*

Would you be WTP £ (bid amount) for having the complete series of FOB tests from the age of 50 until the age of 74?

Yes

No

Would you be WTP £ (bid amount) for the one-off Flexi-Scope test at the age of 60?

Yes

No