

STATED AND REVEALED PREFERENCE SURVEY OF DIGITAL TELEVISION SERVICES

Final Report

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1. INTRODUCTION

1.1 The switchover from analogue to digital television in the UK *"could start as early as 2006 and be completed in 2010"*¹. The DTI needs to update cost-benefit calculations relating to how much spectrum should be allocated to DTT (Digital Terrestrial Television), compared to competing uses such as mobile communications. In order to do this, it is necessary to show the benefits of DTT to the UK, relative to the alternative digital television platforms (cable and satellite). Furthermore, different aspects of DTT have different spectrum requirements, for instance certain interactive features where the DTT set sends a signal back to the network. Therefore, it is essential to understand the relative valuations of the different aspects of digital television services to consumers.

1.2 Steer Davies Gleave was commissioned to design and implement Revealed and Stated Preference surveys of television users. This involved:

- Designing an RP questionnaire, starting from the previous questionnaire used in 2003;
- Designing two SP exercises, with input from DTI staff to help define the attributes and levels to be included;
- Carrying out a pilot survey to test the questionnaires;
- Organising and supervising the main fieldwork;
- Analysing the data to produce a combined RP-SP model; and
- Supplying data files and command files to the DTI so that the key findings can be replicated and the models can be implemented.

Steer Davies Gleave sub-contracted the main RP and SP fieldwork to Pro-Tel Fieldwork Ltd, a company that specialises in fieldwork of this type.

1.3 This report is written to provide all the details needed to understand what was done and to understand the data that was collected. One of the requirements was that the results of the project should be fully auditable, and this document has been produced with the needs of an auditor in mind. The rest of this report is structured as follows:

- Chapter 2 outlines what was done;
- Chapter 3 presents and discusses the analysis of the RP and SP data; and
- Chapter 4 details the main conclusions from the study.

1.4 The appendices provide supporting information:

- Appendix A: Survey data tables
- Appendix B: The SP pack
- Appendix C: Technical note on methodology development and pilot analysis
- Appendix D: Data files - details of the data files that accompany this report.

¹ *Digital Television Action Plan - Version 5.1* (February 2003.)

2. METHODOLOGY

Introduction

- 2.1 The aim of the survey was to enable the estimation of the parameters of a money-metric utility equation for current and future television services. Revealed Preference and Stated Preference data on choice within and between digital TV platforms was collected in a major survey exercise that covered over 2000 UK households.
- 2.2 The core survey method was CATI (Computer Aided Telephone Interviewing), using a specialist telephone interviewing survey team. This was supplemented by mail-out questionnaires to those respondents willing to take part in the SP part of the research.
- 2.3 At the end of the RP interview, each respondent was invited to participate in the SP research, and if willing, an appointment was made for the survey team to call them back. The SP questionnaire and show-cards were mailed out by first-class post, and the SP interviews were conducted on the phone within a time period agreed with each respondent.

Revealed Preference Questionnaire

- 2.4 The RP questionnaire was developed by Steer Davies Gleave, starting from an initial list of questions used for a previous study in 2003. The RP questionnaire was reviewed by the DTI and requested changes were implemented by Steer Davies Gleave prior to the pilot survey.
- 2.5 The RP questionnaire, together with tabulations of the results, is in Appendix A. This is a Word version of the questionnaire as it was programmed into a software programme compatible with the CATI system used by the interviewers. The Word version will not show all the particular routings for the different questions, but gives an overview of the types of questions asked.

Transfer Price Questions

- 2.6 The effect of the analogue switch-off on households with multiple TV sets and multiple VCRs was of great interest, because many households where the main TV gives access to DTT, cable or satellite also have second TVs and possibly second VCRs that are analogue, and that would require modification or replacement as a consequence of switching off the analogue signal. The requirement was to quantify the cost of the required investment in new TV and video equipment, taking into account the age and value of the existing equipment. Initially the possibility of using further SP exercises was considered, however, it was decided that this question could be most effectively tackled using transfer price questions - there was no need to systematically vary packages of attributes.
- 2.7 As in the previous questionnaire and in order to minimise bias, respondents should be asked their willingness to pay for repairing their analogue TV set or VCR in the event of it breaking. Figure 2.1 below shows interviewers' instructions for the transfer price question about willingness to repair an analogue only TV set. For the majority of respondents, this would be their second TV set. The question on willingness to repair

a VCR set was framed in a similar way, with a lower starting price of £20. The results are shown in 3.8 below.

FIGURE 2.1 EXAMPLE OF INTERVIEWER INSTRUCTIONS FOR TRANSFER PRICE QUESTION

Q36 If your second most used TV set broke would you be willing to pay £30 to repair it?

Yes

No

Q36 YES - ASK REPEATEDLY, RAISING THE VALUE EACH TIME BY £10 (STARTING WITH £40) UNTIL THE ANSWER IS NO. THEN "HOME IN" BY LOWERING IT IN £2 INCREMENTS UNTIL REACHING THE MAXIMUM AMOUNT THEY WOULD PAY.

Q36 NO - ASK REPEATEDLY, LOWERING THE VALUE EACH BY £5 (STARTING WITH £25) UNTIL THE ANSWER IS NO. THEN "HOME IN" BY LOWERING IT IN £1 INCREMENTS UNTIL REACHING THE MAXIMUM AMOUNT THEY WOULD PAY. IF WOULD NOT REPAIR KEY 0

Stated Preference Questionnaire

- 2.8 Steer Davies Gleave developed the SP questionnaires starting from the previous study and a study carried out by RAND Europe. The project brief had indicated that both between- and within-platform SP games would be required. The two SP exercises were designed to complement each other, so that the results of both could be combined to produce an integrated model. The between-platform SP exercise was designed to collect the data needed to estimate a discrete choice model for the choice between the main TV platforms, with as much realism as possible and including the key attributes of monthly cost, installation cost, number of channels and details of subscription and premium channels. The requirement for realism meant that a multiple-choice format was chosen, with respondents offered choices amongst the full set of TV platforms. The within-platform SP exercise was designed to enable the estimation of the willingness-to-pay for specific features of TV channels and equipment that need not be related to specific platforms. The within-platform SP exercise used a simpler, paired choice format. The way in which the results of both these exercises were combined will be explained later (see 3.65 below).
- 2.9 Here the development of the SP pack will be summarised. The list of attributes included in each SP exercise is given in Table 2.1, together with a brief description of how the attribute featured in each exercise.






TABLE 2.1 ATTRIBUTES INCLUDED IN THE SP EXERCISES

Attribute	Between-platform SP	Within-platform SP
Platform	Analogue, DTT, Sat, Cab	Both options based on present platform
Channels	Varied for all the digital options	Fixed for each option
Quality of picture & sound	Fixed for each platform	Varied in experimental design
Interactivity	Fixed for each platform	Varied in experimental design
PC services	Fixed for each platform	Varied in experimental design
Mobility	N/A	Varied in experimental design
Premium channels	DTT cost and availability varied in experimental design. Remained fixed for the other platforms	N/A
Installation cost	Varied in experimental design (DTT, Sat, Cab)	None
Monthly cost	Varied in experimental design (DTT, Sat, Cab)	Varied in experimental design

- 2.10 In addition to varying the monthly cost for digital terrestrial, the availability of the subscription and premium channels was also varied in the between-platform SP. The full design of the within-platform SP is shown in Table 2.2, and that of the between-platform SP is shown in Table 2.3.

- 2.11 The SP pack posted out to respondents included:
- An official letter from the DTI to explain the purpose of the study and to encourage respondents to participate, thanking them in advance for their time;
 - A 4-page plus page pull-out A4 booklet of "quick reference cards", describing the attributes used in the SP games;
 - A 24-page A4 booklet containing the two SP games and the associated introductory text.
- The full set of SP pack materials can be found in Appendix B, including all attribute descriptions.
- 2.12 The official DTI logo was used on the introductory letter and the SP booklet, to emphasise the importance and the non-commercial nature of the research. This was found to be important because many people assumed at the outset, on being told over the telephone that the research was about Digital TV that the call was from a sales executive.
- 2.13 The attributes were described to respondents with the help of some carefully designed icons and a set of "quick reference cards". The quick reference cards were designed so that the respondent could refer to them at any point while completing the choice exercises. They were produced in the form of a 4-page A4 booklet, with the explanatory material laid out so that all the reference material for the within-platform SP on a separate pullout page to the between-platform SP exercise. The between-platform SP material was laid out so that all the information relating to the channels was on one side and the platform specific information was on the other side. One of the quick reference cards is shown in Figure 2.2 on the following page.

FIGURE 2.2 EXAMPLE OF QUICK REFERENCE CARD (SEE APPENDIX B FOR FULL-SIZE VERSIONS)

PICTURE AND SOUND QUALITY	Picture Quality		Sound Quality	
	Picture quality will either remain as it is now on your current TV; OR It will be similar to that of a cinema or DVD: a better quality, sharper picture.		Sound Quality will be the same as it is now on your current TV; OR It will have surround sound as in the cinema or home entertainment systems	
MOBILITY		A mobile handset will be made available to your household with subscription cost included in the monthly cost. This mobile handset will allow you to view a package of 30 channels and will come with headphones for sound. These channels will be a mixture of entertainment, news & documentaries, sports, music and children's channels. In addition, this mobile service will provide local news and travel information.		
		Option 1: Urban areas	The TV handset will only pick up the channels in UK urban areas.	
		Option 2: Anywhere	The channels will be available throughout the UK (including rural areas).	
INTERACTIVITY		Camera angles. Selected programmes with choice of camera angle or choice of view, e.g. choice of tennis court at Wimbledon.		Voting. Interactive connection suitable for voting, gambling, home shopping (e.g. Who Wants To Be A Millionaire quiz; Big Brother voting)
		Gaming. Capability to play online multi-player interactive games.		
PC SERVICES		Internet-type services allow you to use the internet and e-mail using a digital TV set with a keyboard. Just like the remote control, the keyboard can be used from the comfort of your armchair. This means that you can access a wide range of services that are available on the internet including: news, information, banking, shopping, making reservations and entertainment.		

- 2.14 Respondents were first given the SP exercise where they were asked to choose between their existing TV system with no changes, and the option of adding on a new set of digital channels with associated features and equipment (Choice Exercise 1). Then they were asked to choose between different TV platforms (Choice Exercise 2).

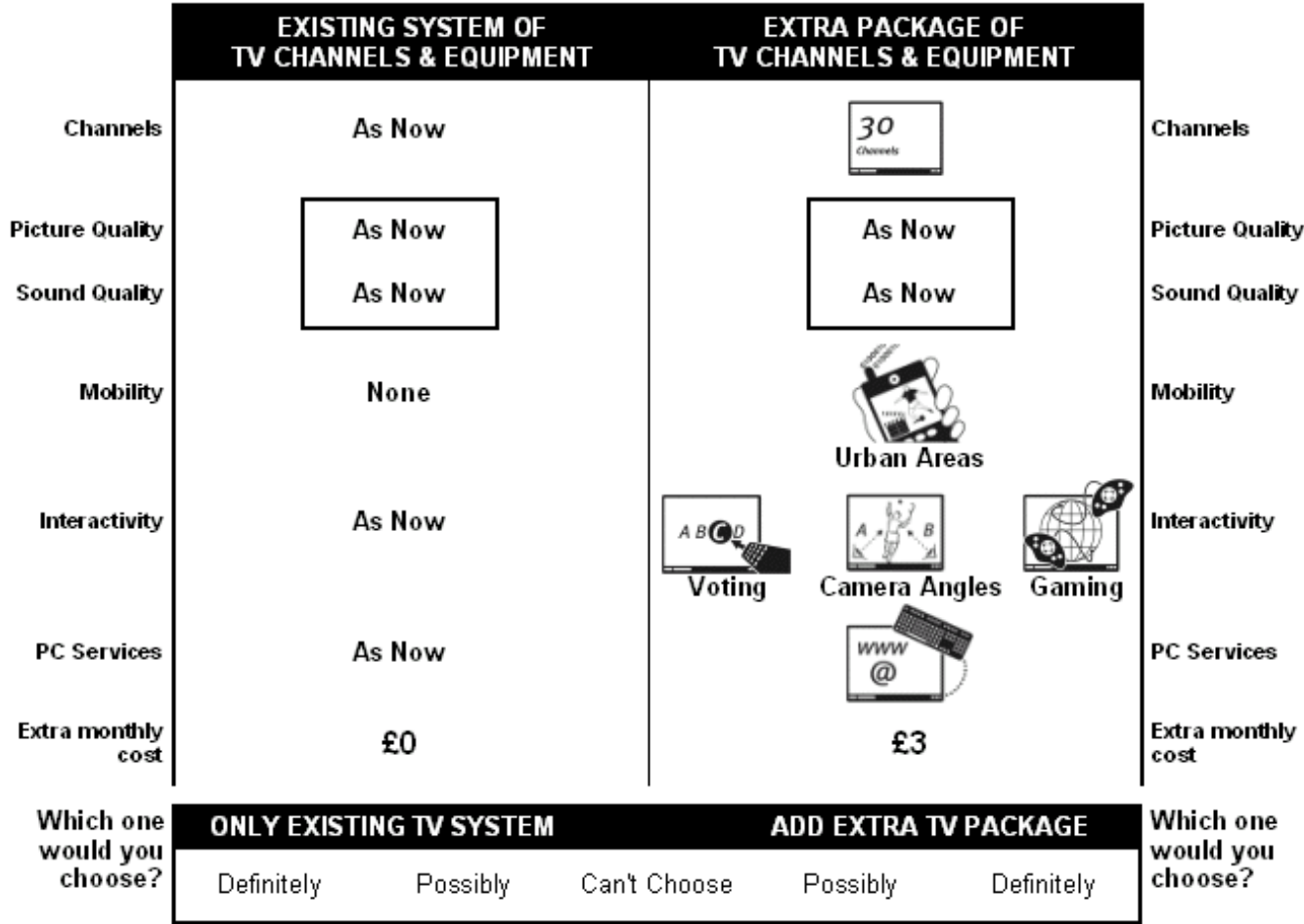
Choice Exercise 1: Within Platform Game (Choice of TV Package)

- 2.15 The within-platform SP exercise was used to estimate the willingness to pay for a range of additional services:
- camera angles;
 - voting;
 - gaming;
 - mobile TV in urban areas only;
 - mobile TV anywhere in the UK;
 - Cinema quality picture;
 - Surround sound; and
 - TV internet & e-mail.
- 2.16 Mobile TV was presented as one portable TV handset per household, roughly the size of a handheld computer, that would be included in the monthly cost, and would show the package of new channels. Figure 2.2 gives further details of how the other features were described to the respondents.
- 2.17 Particular thought was put into designing this SP exercise so that it would make sense to all respondents, regardless of their actual TV system. This was a problem because some of the features of interest would already exist on the TV systems in some households, for instance interactive features such as camera angles. The solution that was arrived at involved presenting an add-on package of new channels, features applying to these new channels, and (depending on the features included) related TV equipment; the choice being whether or not to pay extra for the add-on package. In this way, the extra package of benefits (and related cost) is offered in a way that does not interfere with the existing package of TV channels and equipment.
- 2.18 The experimental design for the within-platform SP exercise is shown in Table 2.2 on the following page. The descriptions of most of the attributes in this game are shown in Figure 2.2 above. The remaining descriptions can be found in Appendix B. Each respondent was asked to respond to half of the cards - 9 choice questions. The first eight cards were drawn from an orthogonal experimental design, the final card presented a dominated choice (the respondent was offered something for free) that was used to test for possible response bias.
- 2.19 The development of the design and the analysis of the pilot survey data underpinning the final cost levels is presented in Appendix C. In particular, following the pilot, the lower levels of the cost attribute for the optional extra package were revised downwards, in order to stimulate more trading.

TABLE 2.2 EXPERIMENTAL DESIGN OF WITHIN-PLATFORM SP EXERCISE

	Interactivity	Monthly Cost	Mobility	Quality Picture & Sound	PC Features	Block
	4 Levels	4 Levels	3 Levels	3 Levels	2 Levels	2 Levels
Card Number	V1	V2	V3	V4	V5	V6
1	No	3	nowhere	Picture is cinema quality, Sound as now	without	1
2	No	7	Urban Areas only	Picture is cinema quality, Surround Sound	Internet/ E-mail through TV	1
3	Camera Angles	15	Urban Areas only	Picture is cinema quality, Surround Sound	without	1
4	Camera Angles	30	Anywhere in UK	Picture is cinema quality, Sound as now	Internet/ E-mail through TV	1
5	Camera Angles & Voting	15	nowhere	Picture & Sound as now	Internet/ E-mail through TV	1
6	Camera Angles & Voting	30	Urban Areas only	Picture & Sound as now	without	1
7	Camera Angles & Voting & Gaming	3	Urban Areas only	Picture & Sound as now	Internet/ E-mail through TV	1
8	Camera Angles & Voting & Gaming	7	Anywhere in UK	Picture & Sound as now	without	1
9	Pack 3: Camera angles	0	Pack 2: Anywhere in UK	Pack 1: Picture is cinema quality, Sound as now	without	1
10	No	15	Anywhere in UK	Picture & Sound as now	Internet/ E-mail through TV	2
11	No	30	Urban Areas only	Picture & Sound as now	without	2
12	Camera Angles	3	Urban Areas only	Picture & Sound as now	Internet/ E-mail through TV	2
13	Camera Angles	7	nowhere	Picture & Sound as now	without	2
14	Camera Angles & Voting	3	Anywhere in UK	Picture is cinema quality, Surround Sound	without	2
15	Camera Angles & Voting	7	Urban Areas only	Picture is cinema quality, Sound as now	Internet/ E-mail through TV	2
16	Camera Angles & Voting & Gaming	15	Urban Areas only	Picture is cinema quality, Sound as now	without	2
17	Camera Angles & Voting & Gaming	30	nowhere	Picture is cinema quality, Surround Sound	Internet/ E-mail through TV	2
18	Pack 4: Voting; Pack 5: Gaming	0	nowhere	Picture & Sound as now	Pack 6: Internet/ E-mail through TV	2

FIGURE 2.3 EXAMPLE OF CARD FROM THE WITHIN-PLATFORM SP EXERCISE



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Choice Exercise 2: Between-Platform SP Exercise (Choice of TV Platform)





- 2.20 The between-platform SP exercise was used to emulate the choice between alternative TV platforms that people face in the real market. This would enable the estimation of a discrete choice model including the number of channels, monthly cost and installation cost.
- 2.21 In this SP exercise the primary choice was between five options: analogue; DTT; cable; satellite and no TV.
- 2.22 The design of the between-platform SP game is presented in the Table 2.3 below. Each respondent was asked to respond to one third of the cards - 9 choice questions.
- 2.23 For each of the multi-channel TV options, there was a further set of choices. Firstly, the respondent was asked to choose between free-to-air channels (i.e. no monthly cost) or basic subscription channels. If the respondent chose basic subscription channels they were then asked if they wanted:
- one of three optional premium channel packages; and / or
 - an optional number of stand-alone channels at a given monthly cost per channel.
- 2.24 The channels available as free-to-air, basic subscription, premium subscription and stand-alone channels were closely based on what is presently available, so that each respondent would be able to pick something that closely resembled what they presently have - if they so wished. The range of options available on specific platforms was deliberately greater than what there is at present - particularly for DTT, where premium content and stand-alone subscription channels are not presently available, and top-up TV is not yet widespread. This allows the models based on the survey data to represent both the present situation (by turning off the availability of the subscription channels for DTT, for instance) and potential future situations with a greater range of options available.
- 2.25 An example card from the SP exercise is shown in Figure 2.4. It can be appreciated from Figure 2.3 and Figure 2.4 that there was quite a lot of detail on the SP cards. Because of this, a considerable amount of effort was spent developing icons to represent the attribute levels, and integrating these icons into the quick reference cards, where they were accompanied by detailed explanations. The use of icons kept the amount of clutter on the SP cards to a minimum, as well as aiding understanding and recall of the attributes' meanings. The SP cards were printed at one per A4 page, to ensure that the icons and print would be legible to respondents of all age groups, particularly those with poor eyesight.

- 2.26 While the multinomial choice approach required careful design of the card layout and supporting material to ensure that respondents would be able to understand the choices they would be offered, it had a number of important advantages:
- the range of options closely mimicked that available on the actual market;
 - the resulting choice data is similar to the RP choice data, and consistent with the previous study;
 - the same design could be used for all respondents (regardless of what type of TV system they had);
 - every respondent could select an option that would be very close to what they had, if they so wished; and
 - respondents who chose analogue TV could be asked what they would have chosen if analogue was not an option.
- 2.27 The development of the design and the analysis of the pilot survey data underpinning the final between-platform SP is presented in Appendix C. In particular, following the pilot analysis, the between-platform SP attributes were changed in order to ensure that the monthly cost, installation cost and number of channels were varying for all the multi-channel platforms.

TABLE 2.3 EXPERIMENTAL DESIGN OF BETWEEN-PLATFORM SP EXERCISE

	DTT - Basic Sub Cost (30 channels more)	DTT - Install'n Cost	DTT - Cost Premium Channels	Cable - Cost Basic Sub	Cable Basic Channels	Cable - Install'n Cost	Satellite - basic Channels	Satellite - Cost basic channels	Satellite Install'n Cost	Block
Card Number	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	N/A	50	N/A	15	60 Channels	50	100 Channels	20	75	1
2	10	50	£5 / £10 / £15	25	60 Channels	75	200 Channels	20	125	1
3	10	75	N/A	20	80 Channels	75	200 Channels	30	75	1
4	10	100	£15 / £20 / £25	15	100 Channels	75	200 Channels	25	100	1
5	15	50	£15 / £20 / £25	20	60 Channels	100	150 Channels	20	100	1
6	15	75	£5 / £10 / £15	15	80 Channels	100	150 Channels	30	125	1
7	15	100	N/A	25	100 Channels	100	150 Channels	25	75	1
8	N/A	75	£15 / £20 / £25	25	80 Channels	50	100 Channels	30	100	1
9	N/A	100	£5 / £10 / £15	20	100 Channels	50	100 Channels	25	125	1
10	10	50	N/A	20	80 Channels	50	150 Channels	25	100	2
11	10	75	£15 / £20 / £25	15	100 Channels	50	150 Channels	20	125	2
12	10	100	£5 / £10 / £15	25	60 Channels	50	150 Channels	30	75	2
13	15	50	£5 / £10 / £15	15	80 Channels	75	100 Channels	25	75	2
14	15	75	N/A	25	100 Channels	75	100 Channels	20	100	2
15	15	100	£15 / £20 / £25	20	60 Channels	75	100 Channels	30	125	2
16	N/A	50	£15 / £20 / £25	25	80 Channels	100	200 Channels	25	125	2
17	N/A	75	£5 / £10 / £15	20	100 Channels	100	200 Channels	20	75	2
18	N/A	100	N/A	15	60 Channels	100	200 Channels	30	100	2
19	10	50	£15 / £20 / £25	15	100 Channels	100	100 Channels	30	75	3
20	10	75	£5 / £10 / £15	25	60 Channels	100	100 Channels	25	100	3
21	10	100	N/A	20	80 Channels	100	100 Channels	20	125	3
22	15	50	N/A	25	100 Channels	50	200 Channels	30	125	3
23	N/A	50	£5 / £10 / £15	20	100 Channels	75	150 Channels	30	100	3
24	15	75	£15 / £20 / £25	20	60 Channels	50	200 Channels	25	75	3
25	15	100	£5 / £10 / £15	15	80 Channels	50	200 Channels	20	100	3
26	N/A	75	N/A	15	60 Channels	75	150 Channels	25	125	3
27	N/A	100	£15 / £20 / £25	25	80 Channels	75	150 Channels	20	75	3

FIGURE 2.4 EXAMPLE OF CARD FROM BETWEEN-PLATFORM SP EXERCISE

Characteristics of the options available				Digital Terrestrial	Satellite	Cable	Standard TV	No TV	
1: Essentials and Free To Air	TV Signal								
	Free to Air channels			Pack 1: 5	Pack 1: 5		Pack 1: 5		
Installation cost (lasts 10 years)				£50	£125	£75	£0		
2: Subscription Channels	Basic Subscription Channels			Pack 3: 30	Pack 3: 30 Pack 4: 40 Pack 5: 50 Pack 6: 50	Pack 1: 5 Pack 2: 25 Pack 3: 30			
	Monthly Cost of Basic Subscription			£10	£20	£25			
3: Optional Premium	Monthly cost of premium channels	Sports	5 channels	£5	£15	£15			
		Movies	10 channels	£10	£20	£20			
		Sports + Movies	20 channels	£15	£25	£25			
Stand-alone channels (see Show Card 5)				Available	Available	Available			
What would you choose?	Choices			Digital Terrestrial	Satellite	Cable	Standard TV	No TV	
	(1):	Free to Air channels only					N/A		
	(2):	Basic subscription							
	(3):	(2) + Premium channels and / or + Stand-alone channels			+	+	+		
				+£	+£	+£			

Pilot Survey

- 2.28 The sample was recruited on-street in Tamworth on Tuesday 27th April and over two days in Stafford, Friday 30th April and Saturday 1st May. Interviews were carried out on each occasion at a nearby hall, using lap-top computers with the same questionnaire software (Askia) that would be used for the main CATI survey.
- 2.29 Ninety-four people were interviewed as part of the pilot survey, each completing both the RP and SP parts of the questionnaire, giving a useful data set for testing the SP designs and the analysis procedures. The profile of the pilot survey respondents in terms of TV platform is shown in Table 2.4 below. The sample proportions are quite close to the actual national market shares - there are some differences, but for the purposes of the pilot survey, the sample profile is quite satisfactory.

TABLE 2.4 PILOT SURVEY SAMPLE PROFILE BY TV PLATFORM

Main TV platform	Respondents	Proportion of sample	Actual market shares
Digital terrestrial	9	10%	14%
Cable	11	12%	14%
Satellite	36	38%	29%
Analogue	38	40%	43%
Total	94	100%	100%

- 2.30 Detailed results from the pilot survey analysis are given in Appendix C.

Improvements to the SP Pack

- 2.31 The issues identified as a result of the pilot survey and the actions taken are summarised in Table 2.5 below.

TABLE 2.5 ISSUES IDENTIFIED FROM PILOT SURVEY RESULTS AND ACTIONS TAKEN

Issue	Action Taken
Information on show-cards needed checking	Show-cards reviewed by DTI experts and requested amendments made by SDG.
Askia questionnaire implementation of SP exercises	Sequence of questions required for the SP between exercise was automated, taking into account the varying availability of DTT subscription and premium channels.
Within SP - low level of trading	The lower levels of the cost attribute for the optional extra package were revised downwards to stimulate more trading
Within SP - need to be able to identify illogical responses	A card offering a dominated choice (where they are offered something for nothing) was included in each of the 6 SP packs. Each of the 6 packs had the dominated choice set up in terms of a different attribute (mobility, PC features, etc.), to make the overall effect independent of the attribute used to formulate the dominated choice.
Miscellaneous improvements to the questionnaire	Many small revisions and improvements were made

Main Survey

- 2.32 The numbers achieved compared to the quotas for each segment are shown in Table 2.6. After data cleaning, the overall quotas were achieved and the quotas for segments were achieved in 6 out of 8 instances; the analogue RP and cable SP segments are 6 and 1 interview short respectively.

TABLE 2.6 MAIN SURVEY QUOTAS AND NUMBERS ACHIEVED

Segment	RP Quota	RP done	SP Quota	SP done
Analogue only	800	794	100	102
Digital Terrestrial	400	404	100	102
Satellite	400	416	100	100
Cable	400	405	100	99
Total	2000	2019	400	403

Data Processing

- 2.33 The data was supplied to the DTI in three formats, as specified in the brief:
- Survey data format: one record per respondent;
 - Long format: one record per respondent-SP card;
 - Conditional Logit format: one record per respondent-SP card-SP alternative.
- 2.34 To be more precise, three separate Stata files were provided with the data from the RP survey and the two SP exercises. Stata syntax files containing the code to run the models as well as additional files containing the relevant choices for each of the exercises accompanied these files.

3. RESULTS

RP Data Analysis

- 3.1 The fieldwork team recruited respondents randomly using a randomly-generated list of telephone numbers². When the interviewers reached a specified target, they continued to contact respondents randomly, but only interviewed those who met the revised quota specifications.
- 3.2 The table below shows the distribution of respondents by the type(s) of TV service on their main TV.

TABLE 3.1 TYPE OF TV SERVICE ON MAIN TV

	Frequency	Percent
Cable	405	20.1
Digital Terrestrial	404	20.0
Satellite	416	20.6
Terrestrial Only	794	39.3
Total	2,019	100

Costs

- 3.3 The tables below show the ranges of installation costs, subscription costs and the number of channels reported excluding, any outliers. Therefore, the maximum value shown in each table is the maximum value used in calculating the average value. Where the respondent answered using a range, the middle value of the range was used. For example, if the respondent said that the installation cost was between £50 and £74, it was assumed for these calculations that the installation cost was £62.
- 3.4 Figure 3.1, Figure 3.2 and Figure 3.3 show the cumulative distributions of the installation cost, subscription cost and number of channels respectively. These show the full ranges reported by all the respondents..

² A telephone list of 20,000 numbers was sourced from Sample Answers. The list was built up by Random Digit Dialling (RDD) starting from "seed" numbers taken from the Sample_Home lifestyle database (containing approximately 4,000,000 records in the UK). These seed numbers were used to generate the random telephone numbers within the realm of numbers that actually exist and are in use. The realm of possible numbers included those provided by cable companies and, importantly, households with no land line (only mobile phones) - it is estimated that this latter category now represents approximately 7% of UK households. Another important advantage of using an RDD sample of telephone numbers was that interviews would be randomly spread across the country, including Northern Ireland. See <http://www.sampleanswers.com/uk/about.asp> for more information.

TABLE 3.2 INSTALLATION COSTS

TV Service	Minimum	Average	Maximum
Satellite services (Sky)	0	44.3	175
Cable services (NTL / Telewest)	0	19.6	70
Freeview	0	60.6	175

FIGURE 3.1 CUMULATIVE DISTRIBUTIONS OF INSTALLATION COST FOR SATELLITE, CABLE AND FREEVIEW

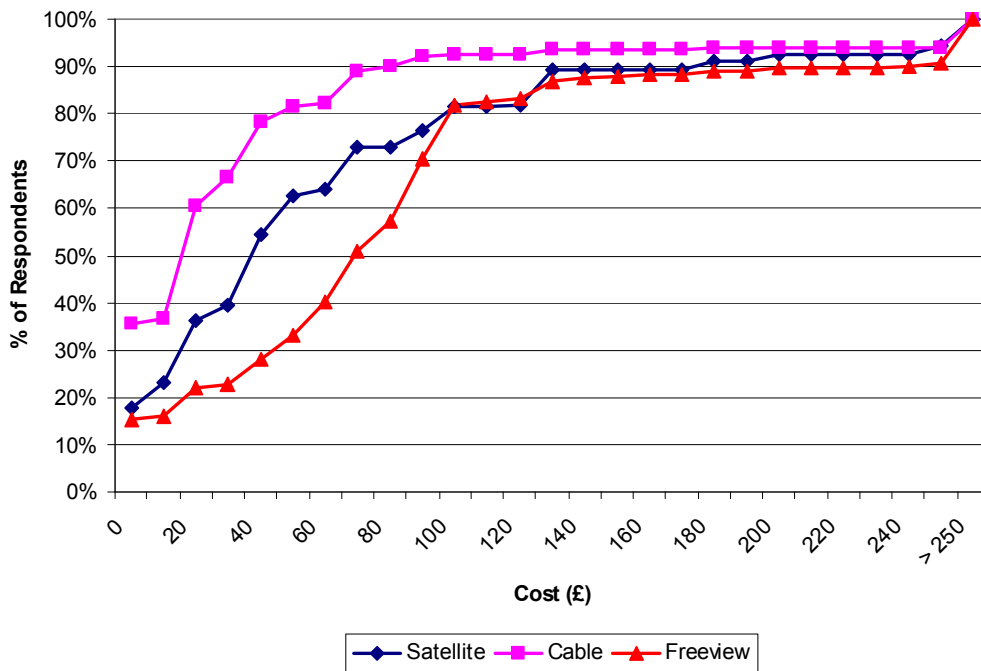


TABLE 3.3 SUBSCRIPTION COSTS

TV Service	Minimum	Average	Maximum
Satellite services (Sky)	15	33.2	60
Cable services (NTL / Telewest)	10	30.6	70

FIGURE 3.2 CUMULATIVE DISTRIBUTION OF MONTHLY SUBSCRIPTION COST FOR SATELLITE AND CABLE

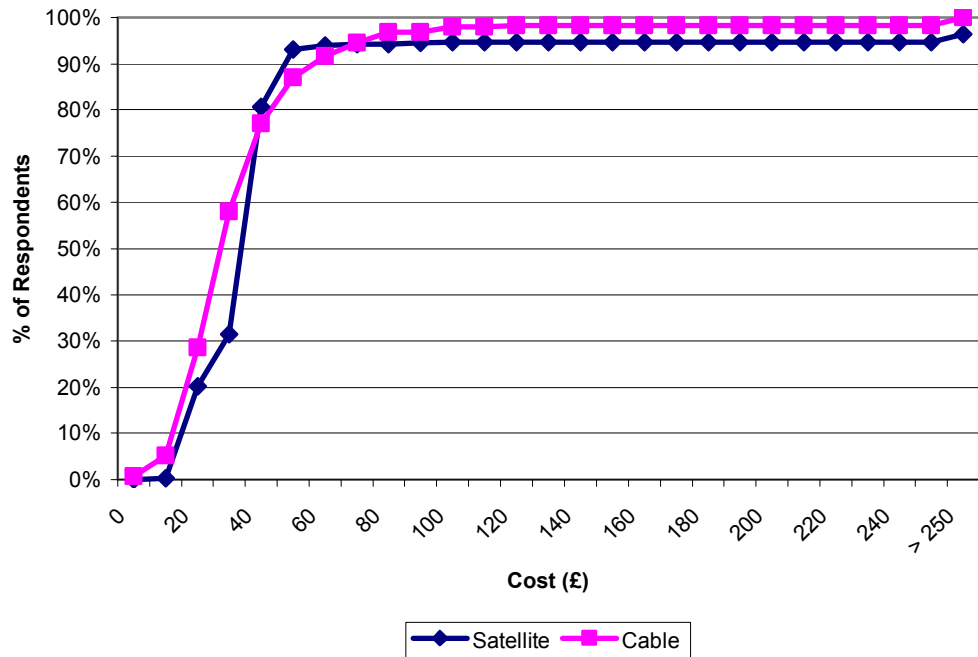
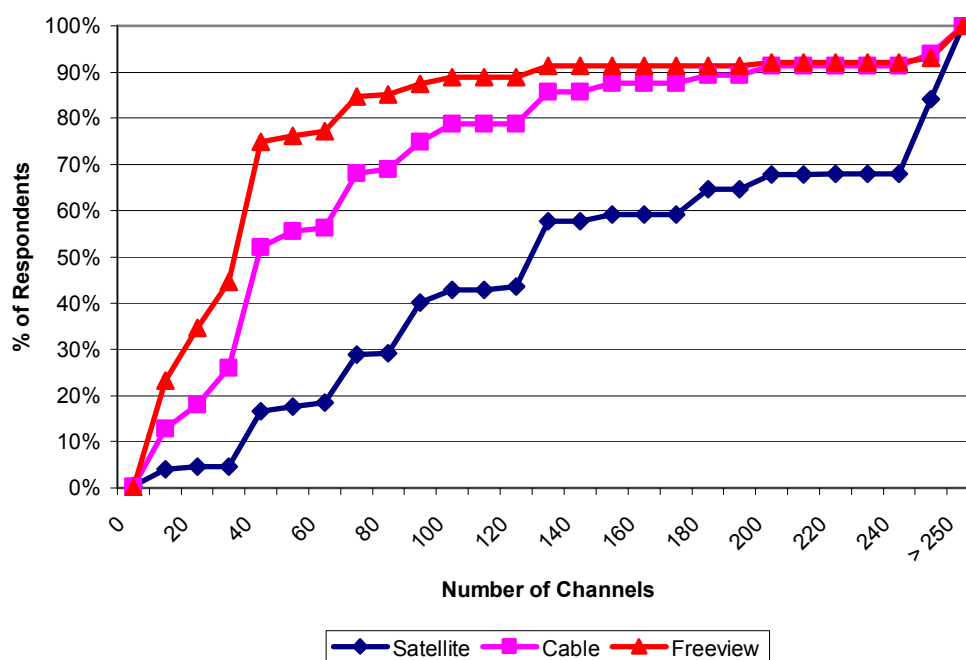


TABLE 3.4 NUMBER OF CHANNELS

TV Service	Minimum	Average	Maximum
Satellite services (Sky)	35	140.7	500
Cable services (NTL / Telewest)	10	57.6	200
Freeview	10	29.0	80

FIGURE 3.3 CUMULATIVE DISTRIBUTION OF THE NUMBER OF CHANNELS FOR SATELLITE, CABLE AND FREEVIEW



Type of Package

3.5 Table 3.5 shows the types of TV services that respondents with multi-channel sets had. Over 90% of respondents with DTT did not subscribe to additional channels. The majority of cable users had standard subscription channels only, while almost two thirds of satellite respondents subscribed to additional premium channels.

TABLE 3.5 TYPE OF TV PACKAGE

	Type of Package			Total
	Free to Air	Standard Subscription Only	Subscription with Premium Channels	
DTT	93%	7%	-	100%
Satellite	4%	38%	59%	100%
Cable	-	71%	29%	100%

3.6 71% of cable users had additional facilities included in their package, such as telephone or broadband Internet.

Willingness to Pay to Repair TV Sets and VCRs

- 3.7 The following evaluations were obtained for all those with a TV set with just analogue reception (not necessarily their main TV), using a transfer price approach. This involves asking the respondent "would you pay £30...?" and then systematically changing the price upwards or downwards in increments of £5 or £10, to find the point at which they transfer. Once this point is reached, the interviewer homes in on the willingness to pay using smaller price increments.
- 3.8 The average willingness to pay (WTP) to repair a TV was £25; while for a VCR it was £12. These values are compared with those from the 2003 survey in Table 3.6.

TABLE 3.6 WILLINGNESS TO PAY TO REPAIR ANALOGUE TVS AND VCERS

Year	Variable	Mean	Std. Dev.	Obs
2004	TV repair WTP (£)	25.6	35.7	1592
2003	TV repair WTP (£)	21.4	28.9	1448
2004	VCR repair WTP (£)	12.5	20.1	1830
2003	VCR repair WTP (£)	12.1	16.7	712

- 3.9 Figure 3.4 and Figure 3.5 show the cumulative distributions of willingness to pay observations for analogue TV sets and VCRs respectively.

FIGURE 3.4 WILLINGNESS TO PAY TO REPAIR TV SET

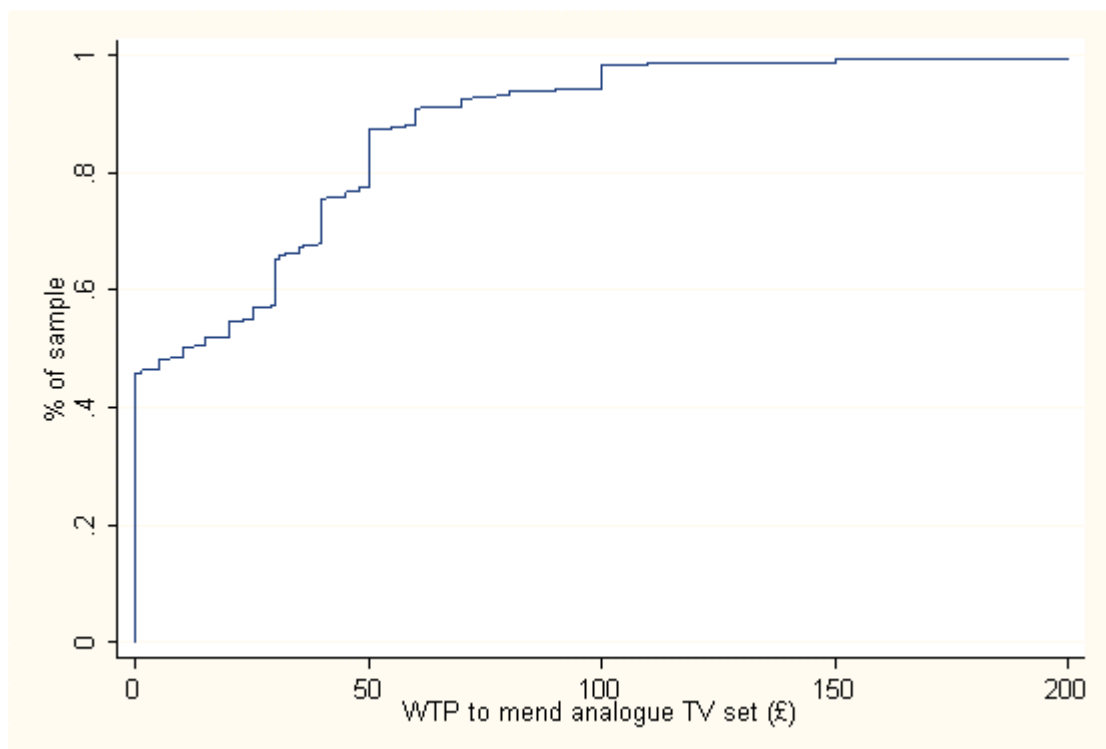
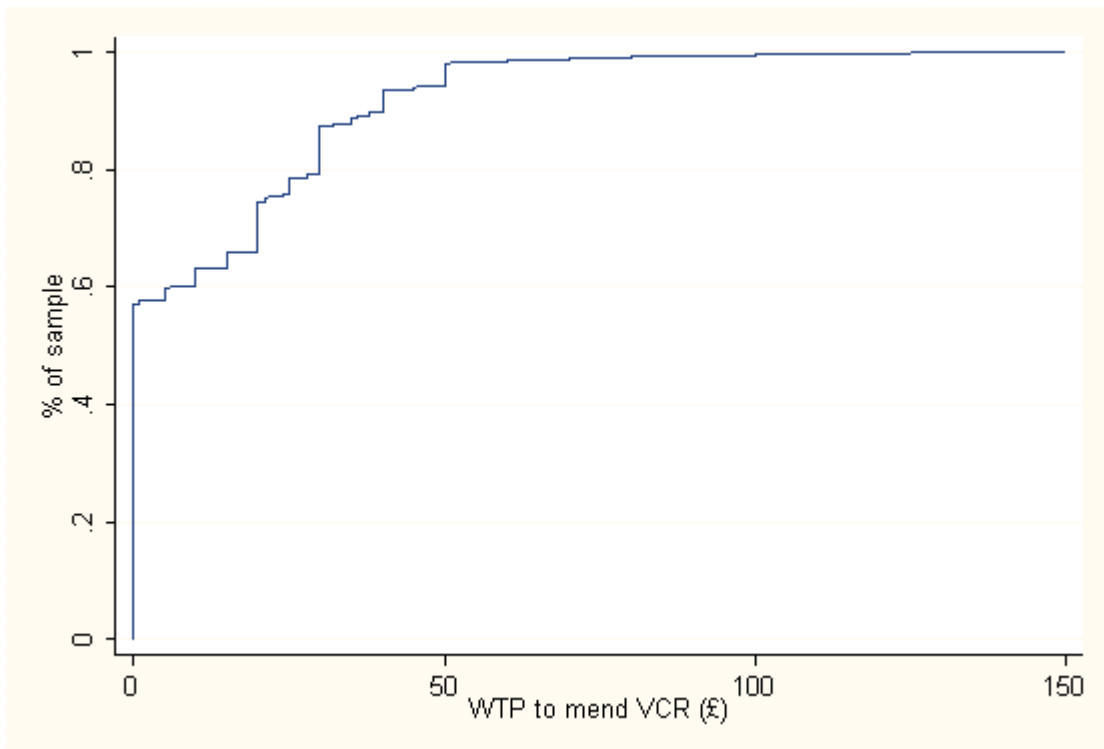


FIGURE 3.5 WILLINGNESS TO PAY TO REPAIR VCR

3.10 The information collected from respondents about the age and the life expectancy of their TV equipment is summarised in Table 3.7 below.

TABLE 3.7 TV EQUIPMENT: AGE, LIFE EXPECTANCY AND LIFE EXPECTANCY ONCE REPAIRED

Variable	Mean	Std. Dev.	Obs
Age of analogue TV (years)	5.7	5.0	1593
Analogue TV life expectancy (years)	5.9	4.6	1593
Analogue TV life expectancy if repaired (years)	3.9	3.4	862
VCR life expectancy if repaired (years)	3.4	3.0	787

3.11 As one would expect, the willingness to pay to repair an analogue TV set is related to the age of the set; as shown in Table 3.8.

TABLE 3.8 AGE OF ANALOGUE TV AND REPAIR VALUE

Age of TV	Mean WTP to Repair (£)	Std. Dev.	N
Less than 10 years	28.9	37.8	1228
10 to less than 20 years	15.5	25.2	310
20 to 30 years	9.4	15.8	54

Sample Profile

3.12 The following tables show the sample profile of the respondents. In general, there was a good representation of each of the different categories.

TABLE 3.9 GENDER OF RESPONDENTS

Gender	Number of Respondents	Percentage of Respondents
Male	960	47.6
Female	1,059	52.5
Total	2,019	100

TABLE 3.10 AGE OF HEAD OF HOUSEHOLD

Age	Number of Respondents	Percentage of Respondents
16-19	3	0.2
20-29	98	4.9
30-39	312	15.5
40-49	403	20.0
50-59	446	22.1
60-69	410	20.3
70+	347	17.2
Total	2,019	100

TABLE 3.11 ANNUAL HOUSEHOLD INCOME

Annual Household Income	Number of Respondents	Percentage of Respondents
up to £5000	83	4.1
£5001-10,000	139	6.9
£10,001-15,000	180	8.9
£15,001-20,000	177	8.8
£20,001-30,000	276	13.7
£30,001-40,000	197	9.8
£40,001-50,000	92	4.6
£50,001-60,000	39	1.9
Over £60,000	91	4.5
Don't know	196	9.7
Declined	549	27.2
Total	2019	100

TABLE 3.12 SOCIAL ECONOMIC GROUP

Social Economic Group	Number of Respondents	Percentage of Respondents
A	28	1.4
B	352	17.4
C1	660	32.7
C2	458	22.7
D	311	15.4
E	210	10.4
Total	2,019	100

Income

- 3.13 We expect there to be a relation between household income and tendency to adopt multi-channel TV. As can be seen in Table 3.11, 36.9% of respondents did not know or refused to state their annual household income. Household income is a key variable to be used in the RP and SP modelling, so it was decided that the missing income data should be imputed using a model based on other income-related variables that were reported.
- 3.14 Table 3.13 shows the number of respondents within each socio-economic group and income group. The table shows that there is a lot of variation of income within each socio-economic group. It was felt that using the average income of each socio-economic group would not be realistic, so an ordered logit model was used in order to estimate the annual household incomes for the respondents who did not answer the question.

TABLE 3.13 NUMBER OF RESPONDENTS BY EACH SOCIO-ECONOMIC GROUP AND ANNUAL HOUSEHOLD INCOME

Income	Socio-Economic Group						Total
	A	B	C1	C2	D	E	
up to £5000	0	3	14	10	17	39	83
£5001-10,000	0	9	22	34	36	38	139
£10,001-15,000	0	19	50	54	47	10	180
£15,001-20,000	0	33	58	56	29	1	177
£20,001-30,000	2	45	107	87	35	0	276
£30,001-40,000	4	52	89	39	13	0	197
£40,001-50,000	2	34	39	15	2	0	92
£50,001-60,000	3	14	18	3	1	0	39
Over £60,000	9	45	27	9	1	0	91
Don't Know	3	21	57	36	47	32	196
Declined	5	77	179	115	83	90	549
Total	28	352	660	458	311	210	2,019

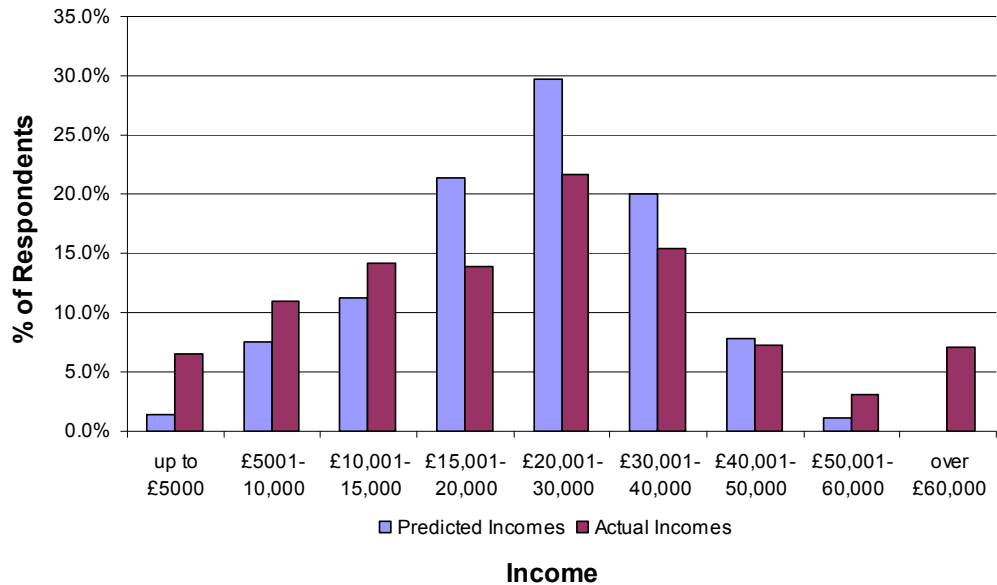
- 3.15 The ordered logit model was based on the respondents' socio-economic group, the age of the chief wage earner, whether or not the household had children and the type of house that the respondent lived in.
- 3.16 Table 3.14 shows the coefficients for each of the variables used in the ordered logit model.

TABLE 3.14 ORDERED LOGIT TO ESTIMATE ANNUAL HOUSEHOLD INCOME

Description	Coef.	Std. Err.	Z
Rented - Private	-0.963	0.263	-3.66
Rented - Council or Housing Association	-1.342	0.182	-7.4
Rented - Free (e.g. employer pays rent)	-0.821	0.530	-1.55
Not Specified	-1.433	0.297	-4.82
Children in HH	0.536	0.132	4.08
SEG - B	-1.788	0.381	-4.7
SEG - C1	-2.766	0.370	-7.47
SEG - C2	-3.511	0.378	-9.29
SEG - D	-4.402	0.395	-11.15
SEG - E	-5.982	0.431	-13.88
Age of HoH - 20-29	1.423	0.262	5.43
Age of HoH - 30-39	1.058	0.200	5.29
Age of HoH - 40-49	1.361	0.196	6.96
Age of HoH - 50-59	0.876	0.174	5.02
Age of HoH - 60-69	-0.445	0.199	-2.24
Age of HoH - 70+	-1.193	0.196	-6.1

- 3.17 Figure 3.6 shows the values predicted by the model compared with the actual values stated by respondents. The distribution of actual incomes was recalculated with only the respondents who stated their income. The graph shows a reasonable fit between the estimated incomes and the actual incomes. The model over-estimates the number of people with annual household incomes of £15,000 - £30,000 and completely under-estimates the number of people with incomes over £60,000.

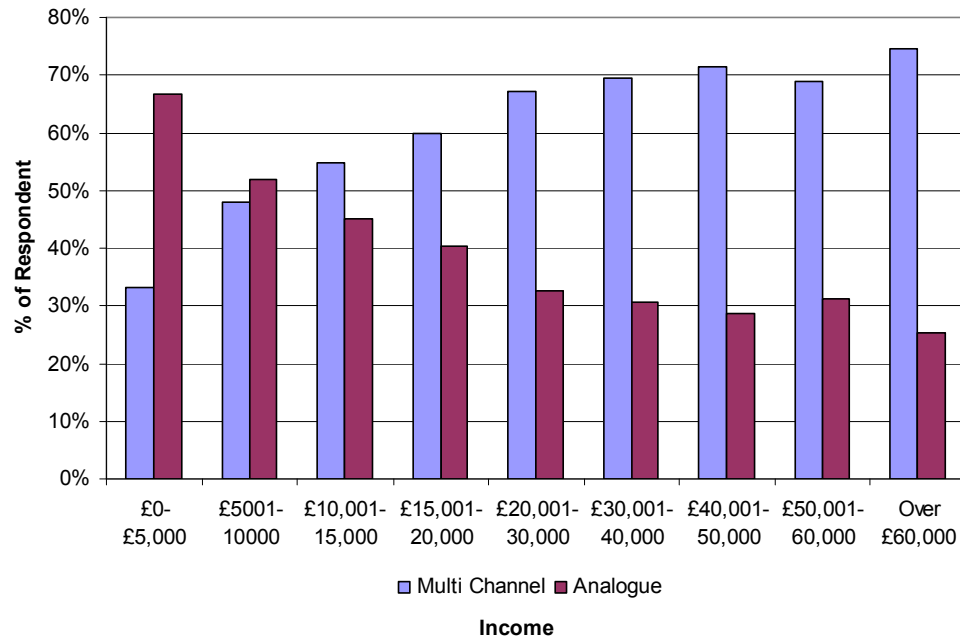
FIGURE 3.6 PREDICTED INCOMES COMPARED WITH THE ACTUAL INCOMES



- 3.18 However, as the model was only used to determine the incomes of 745 respondents, and as there was no other way to accurately estimate these incomes, it was felt that the model estimates were reasonable for the purpose of imputing the missing values for income.

- 3.19 Figure 3.7 shows the relationship between household income and adoption of multi-channel TV, using the post-imputation income variable.

FIGURE 3.7 RELATION BETWEEN HOUSEHOLD INCOME AND ADOPTION OF MULTI-CHANNEL TV



Discrete Choice Analysis

- 3.20 The discrete choice analysis was carried out by fitting logit models to the choice data. The logit model is written as:

EQUATION 1 THE LOGIT MODEL

$$P_{nit} = \frac{\exp(\beta' x_{nit})}{\sum_{j=1}^J \exp(\beta' x_{njt})}$$

- 3.21 Where P_{nit} is the probability of alternative i out of a set of J alternatives being chosen, and $\beta' x_{njt}$ is the deterministic element of utility for alternative j , calculated as the sum product of the vectors of the model coefficients (the β) and the corresponding variables (the x). The subscript n relates to individuals in the sample, and t relates to choice situations (cards in the context of the SP exercises), where each respondent is observed to make several choices.
- 3.22 The results in the following sections were produced after re-weighting the survey data so that the sample market shares were consistent with the actual market shares, as shown in Table 3.15.

TABLE 3.15 ACTUAL (2004 Q1) AND SAMPLE MARKET SHARES OF TV PLATFORMS

Segment	Actual households	Actual %	RP sample %	SP sample %	RP weight	SP weight
Satellite	7,187,000	29.1%	21%	25%	1.41	1.17
Cable	3,325,275	13.5%	20%	25%	0.67	0.54
DTT	3,468,100	14.1%	20%	25%	0.70	0.56
Analogue	10,676,371	43.3%	39%	25%	1.10	1.73
TV Households	24,656,746	100.0%	100%	100%	1.00	1.00

RP Modelling

- 3.23 A number of different models were investigated for the RP model. The model equation is exactly as shown in Equation 1, where t is always 1 since there is only one observation per individual, k , the number of alternatives is 4 and n , the number of observations is 2019. The alternatives are:
- analogue;
 - DTT;
 - cable; and
 - satellite.
- 3.24 Table 3.16 shows how each of the alternatives were coded for the model. The dummy variables for each of the platforms correspond to the TV platform description and are equal to 1 if they are present and 0 if not. The dummy variables are used in the RP

model and the cost and channel variables are used in the combined RP and SP model. The number of channels, the installation cost and the monthly cost were calculated from the RP data as shown in paragraph 3.3.

TABLE 3.16 RP CHOICE SET

TV Platform	DTT Dummy	Cable Dummy	Satellite Dummy	Analogue Dummy	Number of Channels	Installation Cost £	Monthly Cost £ per month
RP Digital Terrestrial	1	0	0	0	29	61	0
RP Cable	0	1	0	0	58	20	31
RP Satellite	0	0	1	0	141	44	33
RP Analogue	0	0	0	1	5	0	0

3.25 The RP model coefficients are presented in Table 3.17; these are the values of the β , and the x are the named variables that these coefficients apply to. In this model, *all* of the variables are dummy variables, meaning that they can take one of two values: 0 or 1. Those variables written as two names separated by an asterisk are interaction terms, literally being the product of the two named dummy variables, for instance "HH income >30K * satellite" is a dummy variable that is 1 when these two conditions apply (when the head of household's income is greater than £30,000, and when the alternative in question is satellite), and zero otherwise. Thus, the coefficient of 0.28 indicates that when the head of household earns more than £30,000, it is more probable that the household has satellite TV than would otherwise be the case.

TABLE 3.17 RP MODEL COEFFICIENTS

Variable	Coeff.	Std.Err.	Adjusted Z
DTT constant	-1.42	0.02	-8.52
satellite constant	-0.84	0.01	-5.87
cable available * cable	-0.35	0.02	-1.94
cable not available*cable	-40.04	2087600.0	0.0
HH income >30k * satellite	0.28	0.01	2.45
HoH over 60 * satellite	-0.84	0.01	-6.39
HoH over 60 * cable	-0.87	0.02	-5.15
HoH over 60 * dtt	-0.47	0.02	-3.13
HH TV >20 hours * dtt	0.55	0.02	3.24
HH TV >20 hours * satellite	0.80	0.01	5.75
HH TV >20 hours * cable	0.48	0.02	2.57
private rented * cable	-0.99	0.05	-1.95
children * multi-channel TV	0.44	0.01	3.43

3.26 The cable constant is split into two interaction terms, depending on whether or not cable is available in the area. The coefficient of -40.04 for cable not available interacted with the cable alternative is an arbitrary large negative number. This produces a large negative utility that ensures that no one would choose cable if it was

not available. As no one is able to choose cable when it is not available, the coefficient is not statistically significant.

3.27 The “cable available * cable” interaction term is not quite significant at the 95% level, but is the best estimate of the coefficient for this variable and has been retained in the model.

3.28 The remaining model coefficients have the following implications:

- if the household income is greater than £30,000, the respondent is more likely to have satellite TV;
- if the head of household is aged over 60, then the respondent is less likely to have satellite, cable or DTT;
- if the total number of hours of television watched by the household per week is more than 20 hours, they are more likely to have satellite, cable or DTT;
- people in private rented accommodation are less likely to have cable television; and
- when there are children in the household, the household is more likely to have multi-channel TV.

Within-Platform SP Modelling

- 3.29 Analysis of the proportions of choices for the new alternative was undertaken; this often provides a very clear picture of how people have responded to the different factors in the experimental design. The results are shown in Table 3.18.

TABLE 3.18 WITHIN-PLATFORM SP - CHOICE PROPORTIONS ANALYSIS

Attribute	Level	% Choosing new alternative	Difference (% points)
Interactivity	None	29%	
	Camera Angles	24%	-5%
	Camera Angles & Voting	25%	-4%
	Camera Angles & Voting & Gaming	25%	-4%
Mobility	Nowhere	23%	
	Urban Areas	26%	4%
	Anywhere in UK	27%	5%
Quality of Picture & Sound	Picture & sound as now	24%	
	Cinema Picture & sound as now	27%	3%
	Cinema Picture & surround sound	26%	2%
PC Features	Without	23%	
	Internet / E-mail through TV	29%	6%
Monthly Cost (£)	3	50%	
	7	27%	-23%
	15	17%	-33%
	30	8%	-42%

- 3.30 It can be seen that with the exception of camera angles and surround sound, all of the attributes have effects that act in the expected direction - although some of these are small. The price range used seems to have worked reasonably well, with as much as 50% of people choosing the new alternative if priced at £3 per month, a proportion that is reduced to only 8% if the price is £30 per month. Camera angles is the only facility that appears to be perceived by many as an unwanted extra.
- 3.31 The trading analysis showed that in total 62% of respondents traded, which was higher than the pilot results of 55% - showing that the changes that were made following the pilot study have had the desired effect of increasing trading. Table 3.19 shows the trading analysis of people by their current TV platform. People who currently have

multi-channel TV sets were more likely to trade compared to people having only analogue TV. The vast majority of non-traders tended to stick to the existing channels.

TABLE 3.19 WITHIN SP EXERCISE - TRADING ANALYSIS

Trading Behaviour	DTT	Current Platform			Total
		Cable	Satellite	Analogue	
Trader	60%	73%	65%	50%	62%
Non-trader: existing	38%	23%	33%	48%	36%
Non-trader: new alternative	2%	4%	2%	2%	2%
Total	100%	100%	100%	100%	100%
Number	816	792	800	824	3232

3.32 Table 3.20 shows the SP design data used for the within-platform SP model - this is essentially the same data shown earlier in Table 2.2, re-coded in preparation for the discrete choice analysis. The attributes ending in the suffix 1 relate to the existing TV system (what they actually have) and the attributes ending in suffix 2 relate to the new alternative. All of the variables, except for monthly cost are coded as dummy variables, i.e. 1 if they are present and 0 if they are not. The monthly cost is coded as it was shown on the SP card.

TABLE 3.20 WITHIN-PLATFORM SP DESIGN DATA

sppack	card_num	Camera_angles_1	Voting1	Gaming_1	Monthly_cost1	Mobility_urban_1	Mobility_any_where1	Cinema_quality_1	Surr'nd_sound_1	PC_features1	Camera_angles_2	Voting_2	Gaming_2	Monthly_cost2	Mobility_urban2	Mobility_any_where2	Cinema_quality_2	Surr'nd_sound_2	PC_features2
1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0
1	2	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	1	1	1
1	3	0	0	0	0	0	0	0	0	0	1	0	0	15	1	0	1	1	0
1	4	0	0	0	0	0	0	0	0	0	1	0	0	30	0	1	1	0	1
1	5	0	0	0	0	0	0	0	0	0	1	1	0	15	0	0	0	0	1
1	6	0	0	0	0	0	0	0	0	0	1	1	0	30	1	0	0	0	0
1	7	0	0	0	0	0	0	0	0	0	1	1	1	3	1	0	0	0	1
1	8	0	0	0	0	0	0	0	0	0	1	1	1	7	0	1	0	0	0
1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
2	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0
2	2	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	1	1	1
2	3	0	0	0	0	0	0	0	0	0	1	0	0	15	1	0	1	1	0
2	4	0	0	0	0	0	0	0	0	0	1	0	0	30	0	1	1	0	1
2	5	0	0	0	0	0	0	0	0	0	1	1	0	15	0	0	0	0	1
2	6	0	0	0	0	0	0	0	0	0	1	1	0	30	1	0	0	0	0
2	7	0	0	0	0	0	0	0	0	0	1	1	1	3	1	0	0	0	1
2	8	0	0	0	0	0	0	0	0	0	1	1	1	7	0	1	0	0	0
2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

3.33 The coefficients of the within-platform SP model are shown in Table 3.21. In this case there were two options:

- existing TV system; and
- add extra TV package to the respondents' current TV package.

The utility equations can be defined with the utility of the existing TV system set to zero, and this allows the logit equation shown in Equation 1 to be simplified, as shown in the following equations. For the within model there are two alternatives; $i = 1$ represents the existing TV system, and $i = 2$ the extra TV package.

EQUATION 2 WITHIN-PLATFORM SP MODEL EQUATION, STEP 1

$$P_{n2t} = \frac{\exp(\beta' x_{n2t})}{\exp(\beta' x_{n1t}) + \exp(\beta' x_{n2t})}$$

Dividing through by $\beta' x_{n2t}$ produces Equation 3.

EQUATION 3 WITHIN-PLATFORM SP MODEL EQUATION, STEP 2

$$P_{n2t} = \frac{1}{1 + \exp(\beta' x_{n1t} - \beta' x_{n2t})}$$

Knowing that the utility of the existing alternative, $\beta' x_{n1t}$, can be set to zero (by definition), the logit equation can be re-written as shown in Equation 4.

EQUATION 4 WITHIN-PLATFORM SP MODEL EQUATION, STEP 3

$$P_{n2t} = \frac{1}{1 + \exp(-\beta' x_{n2t})}$$

3.34 In this equation, option $i=2$ is adding the new TV package, $n = 398$, and $t = 8$ (8 SP cards per respondent, excluding the cards with dominated choices as these were not part of the orthogonal experimental design). The coefficients shown in Table 3.21 are the values of the β , where the x are the named variables that these coefficients apply to.

TABLE 3.21 WITHIN-PLATFORM SP MODEL

Variable	Coef.	Std. Err.	z	Value per month (£)
Monthly cost (£)	-0.099	0.009	-11.12	N/A
Camera angles	-0.032	0.121	-0.26	*
Voting	-0.220	0.111	-1.99	*
Gaming	-0.162	0.181	-0.90	*
Mobility (urban areas)	0.072	0.112	0.64	*
Mobility (anywhere in UK)	0.427	0.119	3.58	4.31
Cinema quality	0.245	0.127	1.92	2.47
Surround sound	-0.150	0.112	-1.33	*
PC features	0.434	0.105	4.14	4.39
Gaming * HoH aged 30-39	0.992	0.258	3.85	10.02
Gaming * satellite	0.592	0.202	2.93	5.98
Cinema quality * satellite	0.431	0.193	2.23	4.35
Constant (30 extra channels)	-0.501	0.158	-3.16	-5.06

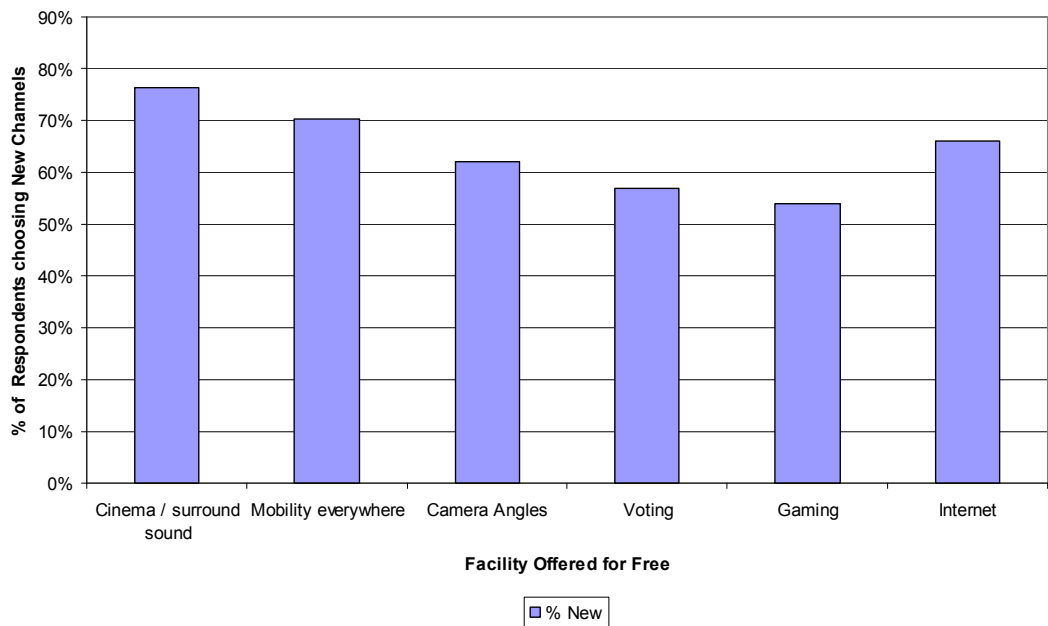
- 3.35 The model indicates that the most valued attributes are PC features (valued on average at £4.39 per month), mobility (anywhere in the UK - valued on average at £4.31 per month), and cinema quality (DVD-equivalent) picture quality. Gaming was very highly valued by respondents from households where the head of the household was aged 30-39 (they were on average willing to pay £10.02 per month extra for this feature), and it was also valued more highly than average by households with satellite (they were on average willing to pay £5.98 per month extra for this feature). Households with satellite also valued cinema quality significantly more than other households, with the difference equating to an average of £4.35 per month. Valuations have not been given for attributes whose coefficients were not significantly different from zero at the 95% level of confidence.
- 3.36 The constant is negative, which is counterintuitive. In theory, the constant is used to represent the benefit of the additional channels offered in the new package. However, there were a high proportion of people who refused to choose the new package. The characteristics of these people are described further in Table 3.22. The constant is representing these people, as their choices are not captured in another specific variable.
- 3.37 The interactive features appear to be regarded by the average respondent as being of negative value. Although not statistically significant at the 95% level of confidence, this is surprising because one would not expect them to be actively disagreeable; if they are not wanted they can just be ignored. There are two factors that we believe lie behind the negative values:
- The negative willingness to pay for these features can be interpreted as meaning that on average, people want either to pay less in compensation for the features that are not wanted, or they want to be able to choose not to have particular features. These are the two ways in which a package with negatively-valued

features could be made equal in terms of utility to an otherwise equivalent package without them. In the SP exercise, people are told that each attribute is included in the cost shown, so attributes that are not wanted may be considered as representing costs without associated benefits - giving people the feeling that the package as a whole is over-priced.

- Another reason for the interactive features being perceived negatively could be that they represent a change to the nature of the TV medium, with implied changes to how programming will work in future and the demands that will be placed on the viewer in terms of being able to understand and interact with new technology. It is quite possible that some people do not want to interact; they might just want to be passive viewers. These people will actively dislike the new features and regard them as being of negative utility.

3.38 The within-platform SP model was originally developed making use of the responses to the dominated choice as a way of picking out people with a negative attitude towards the new alternative. This showed that the people who refused an additional feature even when it was offered to them for free were significantly less disposed to choose the new alternative in general. The number of people who refused an additional feature for free varied depending on the type of feature that was being offered. Figure 3.8 shows the percentage of respondents choosing the new channels for each of the additional free options.

FIGURE 3.8 PERCENTAGE OF RESPONDENTS CHOOSING THE NEW CHANNELS WHEN DIFFERENT FACILITIES WERE OFFERED FOR FREE.



- 3.39 A simple logit model was developed to investigate the characteristics of these "refuseniks". The equation is shown in Equation 5 below. This equation is developed in the same way as Equation 4; where the two alternatives are whether a person is a refusenik or not, the "utility" of being a refusenik is modelled as $\beta' x_{n2}$, and the utility of not being a refusenik is set to zero. The results are shown in Table 3.22 below.

EQUATION 5 REFUSENIK MODEL EQUATION

$$P_{n2} = \frac{1}{1 + \exp(-\beta' x_{n2})}$$

TABLE 3.22 LOGIT MODEL FOR CHARACTERISTICS OF "REFUSENIKS"

Variable	Coef.	Std. Err.	z	P> z	95% Confidence Interval	
HH with children	-0.891	0.308	-2.89	0.004	-1.494	-0.287
Female respondent	0.573	0.225	2.55	0.011	0.132	1.014
HoH aged 60 - 69	0.573	0.273	2.1	0.036	0.039	1.108
HoH aged 70+	0.887	0.341	2.6	0.009	0.219	1.555
Constant	-0.968	0.198	-4.89	0	-1.355	-0.580

- 3.40 The key characteristics of the refuseniks are that they tend to be female, they tend to be elderly, and they tend not to have children in the household. This suggests that their refusal to opt for a package of high technology TV features and equipment may well represent how they would actually behave in real life. Therefore, in order to estimate realistic economic valuations of the attributes in question, it was decided to estimate the model with the refuseniks included in the sample.

Between-Platform SP Modelling

- 3.41 The between-platform SP model has been developed for the following choice set: DTT; cable; satellite; analogue and no TV. The following table shows the raw choice proportions, firstly when analogue was available and secondly when the respondents who initially chose analogue were asked to choose again, this time assuming analogue was not available.

TABLE 3.23 BETWEEN-PLATFORM SP - RAW CHOICE PROPORTIONS

Platform	Choice 1 – Analogue Available	Choice 2 – Analogue not Available	Difference (% points)
DTT	42%	52%	10%
Satellite	20%	22%	2%
Cable	19%	21%	2%
Analogue	18%	0%	-18%
No TV	1%	5%	4%
Total	100%	100%	0%

- 3.42 It is immediately striking that the proportion of people choosing DTT is much higher than the proportion of households that currently have it. In particular in Choice 2, where the respondents who initially chose analogue were asked to re-select, the majority of these people chose DTT.
- 3.43 It is also worth noting that the proportion of choices for no TV is tiny, particular for Choice 1, and remains small for Choice 2. This is good because it suggests that the number of "protest votes" is insignificant. In this respect, the SP design has succeeded in giving nearly everyone a viable TV alternative.
- 3.44 Further analysis of the raw choice data (Table 3.24) shows that DTT captured at least a third of all choices across all types of present TV platform, with the highest proportion of choices for DTT coming from DTT households (57%), and the lowest from satellite households (33%). Interestingly, there is a much higher degree of switching between satellite & DTT and cable & DTT than between satellite & cable - suggesting that people with satellite or cable have made up their minds and are unlikely to switch to the competing platform. It is also interesting to note that as many analogue respondents opted for DTT as opted for analogue - this suggests that to many analogue households DTT is already an attractive proposition. Existing DTT households were more likely to switch back to analogue than to one of the other multi-channel platforms.

TABLE 3.24 BETWEEN-PLATFORM SP TRANSITION MATRIX (1)

Present TV Platform	SP Alternatives					
	DTT	Satellite	Cable	Analogue	No TV	All
Digital Terrestrial	57%	13%	13%	17%	0%	100%
Satellite	33%	47%	14%	5%	1%	100%
Cable	35%	11%	46%	8%	1%	100%
Analogue	42%	11%	5%	41%	1%	100%
All	42%	20%	19%	18%	1%	100%

3.45 The between-platform SP transition matrix (2) shows the same data as above, but this time showing the percentage of respondents choosing free to air and subscription channels for DTT and satellite for the between-platform SP. For example, Table 3.24 shows that 47% of current satellite households chose satellite in the between-platform SP. Table 3.25 shows that of these 47%, 12% chose free to air channels and 36% chose subscription channels³. For DTT there are three alternatives;

- DTT (No Choice) – choices on SP cards where there DTT subscription was not available;
- DTT (Free to Air) – on the SP cards where DTT subscription was available, the percentage who chose free to air; and
- DTT (Subscription) - on the SP cards where DTT subscription was available, the percentage who chose the DTT subscription channels

TABLE 3.25 BETWEEN- PLATFORM SP TRANSITION MATRIX (2)

Present TV Platform	SP Alternatives						Cable	Analogue	No TV	All
	DTT (Total)	DTT (No Choice)	DTT (Free to Air)	DTT (Subscription)	Satellite (Free to Air)	Satellite (Subs'n)				
Digital Terrestrial	57%	20%	25%	13%	5%	7%	13%	17%	0%	100%
Satellite	33%	10%	11%	13%	12%	36%	14%	5%	1%	100%
Cable	35%	10%	11%	14%	2%	9%	46%	8%	1%	100%
Analogue	42%	14%	21%	6%	4%	6%	5%	41%	1%	100%
All	42%	13%	17%	11%	6%	14%	19%	18%	1%	100%

3.46 Analysis of the proportions of choices for the new alternative was undertaken; this often provides a very clear picture of how people have responded to the different factors in the experimental design. The results are shown in Table 3.26.

³ The figures do not sum due to rounding

TABLE 3.26 BETWEEN-PLATFORM SP CHOICE PROPORTIONS ANALYSIS

Attribute	Level	Proportion choosing the relevant platform	Change (% points)
DTT: monthly cost of basic subscription (£)	Not Available	40%	
	10	42%	1%
	15	43%	2%
DTT: installation cost	50	48%	
	75	42%	-5%
	100	35%	-12%
DTT: premium channels	Not Available	38%	
	£5 / £10 / £15	45%	7%
	£15 / £20 / £25	42%	-3%
Cable: monthly cost of basic subscription (£)	15	21%	
	20	20%	-1%
	25	17%	-4%
Cable: number of channels	60	21%	
	80	17%	-3%
	100	20%	-1%
Cable installation cost (£)	50	22%	
	75	22%	-1%
	100	14%	-9%
Satellite: monthly cost of basic subscription	20	22%	
	25	20%	-2%
	30	19%	-3%
Satellite: number of channels	100	17%	
	150	22%	5%
	200	22%	5%
Satellite: installation cost (£)	75	26%	
	100	20%	-7%
	125	16%	-10%

3.47 The trading analysis showed that the number of respondents trading on the between SP exercise was slightly lower than the pilot results. In the main survey 56% of

respondents traded between different platforms, compared to 63% in the pilot survey. The lower level of trading may have been due to the main survey having been conducted by telephone, where the pilot survey was done face-to-face. The table below shows the trading analysis and the respondents' current TV platform.

TABLE 3.27 BETWEEN-PLATFORM SP EXERCISE - TRADING ANALYSIS

Trading behaviour	Current Platform				Total
	DTT	Cable	Satellite	Analogue	
Trader	54%	57%	66%	46%	56%
Non-trader: Analogue	11%	5%	2%	30%	12%
Non-trader: Cable	4%	26%	2%	0%	8%
Non-trader: DTT	27%	11%	8%	19%	16%
Non-trader: Satellite	4%	1%	22%	5%	8%
Total	100%	100%	100%	100%	100%

- 3.48 As Table 3.27 shows, people who currently had multi-channel TVs were more likely to trade, particularly satellite subscribers, than the respondents who currently had analogue. Between 25%-30% of each platform continually chose their current platform in the between exercise rather than trading.
- 3.49 Table 3.28 shows an extract of the SP design data used for the between-platform SP discrete choice analysis. This data is derived directly from the experimental design shown in Table 2.3, the difference is that the experimental design has translated into variables for use in the discrete choice analysis. The data shown in the table is for cards 1 and 2 of the 27 cards in the full experimental design. All of the variables except for the costs and the number of channels are coded as dummy variables, i.e. 1 if they were present on the card and 0 if they were not. The number of channels is the number of free to air channels offered for digital terrestrial, the number of subscription channels for cable and the number of free to air channels and subscription channels for satellite. The monthly subscription cost is coded as zero for DTT, because the cost for the DTT subscription channels is part of a composite variable, together with the presence / absence of the option to pay for extra subscription channels. The way in which the utility of these channels is separated from their cost is described in 3.55 below.

TABLE 3.28 BETWEEN-PLATFORM SP DESIGN DATA

Card Number	Choice Index	TV Platform	Analogue Dummy	Cable Dummy	DTT Dummy	Satellite Dummy	DTT Subs'n Available	DTT Subs'n Available at £15	DTT Premium Available	DTT Premium at Higher Cost	Natural Log of Channels	Install'n Cost (£)	Monthly Subs'n Cost (£)
1	1	BSP No TV	0	0	0	0	0	0	0	0	0	0	0
1	2	BSP Analogue	1	0	0	0	0	0	0	0	1.6	0	0
1	3	BSP Cable	0	1	0	0	0	0	0	0	4.1	50	15
1	4	BSP Digital Terrestrial	0	0	1	0	0	0	0	0	3.4	50	0
1	5	BSP Satellite	0	0	0	1	0	0	0	0	4.6	75	20
2	1	BSP No TV	0	0	0	0	0	0	0	0	0	0	0
2	2	BSP Analogue	1	0	0	0	0	0	0	0	1.6	0	0
2	3	BSP Cable	0	1	0	0	0	0	0	0	4.1	75	25
2	4	BSP Digital Terrestrial	0	0	1	0	1	0	1	0	3.4	50	0
2	5	BSP Satellite	0	0	0	1	0	0	0	0	5.3	125	20

- 3.50 The natural log of channels was used rather than the actual number of channels, in order to represent the diminishing effect of adding more channels. For example, if the respondent only has five channels, an additional thirty channels would be of a higher utility value than adding thirty channels when the respondent currently has two hundred channels.
- 3.51 The between-platform SP exercise was modelled using a logit model of the type described in Equation 1. In this case $n = 403$, $t = 9$ (9 SP cards per respondent) and $k=5$, as there were 5 alternatives: DTT; satellite; cable; analogue and no TV.
- 3.52 Table 3.29 below shows the results. This model has 29 coefficients, which have been presented in 4 groups to aid understanding; those coefficients that relate directly to the characteristics of each TV platform; the platform-specific constants; the coefficients relating to each household's existing platform; and the coefficients relating to other household characteristics. All the constants and interaction terms relating to constants are defined in relation to analogue, which as the base category has a constant of 0.

TABLE 3.29 BETWEEN-PLATFORM SP MODEL COEFFICIENTS

Description	Coef	Std. Err	Z
TV Platform Characteristics			
installation cost (£)	-0.013	0.000	-10.532
monthly cost (£ per month)	-0.024	0.001	-2.829
natural log of number of channels	0.272	0.013	2.029
subscription available for DTT	0.058	0.007	0.779
premium channels available for DTT	0.317	0.009	3.682
DTT premium monthly cost £10 more	-0.132	0.009	-1.543
TV Platform Specific Constants			
constant: no TV	-4.571	0.053	-8.626
constant: satellite	-0.683	0.052	-1.308
constant: cable	-1.455	0.043	-3.391
constant: DTT	-0.038	0.028	-0.133
Interactions with Household's existing Platform			
currently satellite * no TV	2.370	0.041	5.828
currently satellite * DTT	1.884	0.016	11.536
currently satellite * cable	3.281	0.021	15.837
currently satellite * satellite	3.661	0.018	20.874
currently cable * satellite	1.644	0.023	7.152
currently cable * DTT	1.422	0.019	7.588
currently cable * cable	3.967	0.021	18.485
currently DTT * DTT	1.221	0.014	8.958
currently DTT * cable	1.997	0.020	9.789
currently DTT * satellite	1.094	0.019	5.816
Household Characteristics			
HoH over 60 * no TV	2.087	0.049	4.265
rented property * DTT	-0.813	0.012	-6.990
rented property * cable	-0.950	0.017	-5.456
rented property * satellite	-0.903	0.015	-5.828
HH TV hours >20 * DTT	0.627	0.010	6.578
HH TV hours >20 * satellite	0.300	0.013	2.354
HH income >30K * cable	0.537	0.012	4.386
HH income >30K * satellite	0.739	0.010	7.187
children in HH * cable	-0.161	0.013	-1.273

- 3.53 The cost coefficients are all correctly signed and the majority are statistically significant. The relative sizes of the installation cost and monthly cost coefficients suggest a high sensitivity to installation cost. The monthly cost coefficient produces sensible valuations of the different types of channels, as will be seen in the following section.

- 3.54 The natural log of the number of channels is also statistically significant, indicating that more channels increases the probability of a TV platform being chosen, but with declining marginal effect - the more channels there are, the less benefit additional channels will bring.
- 3.55 One of the key outputs from the between-platform model was to determine the willingness to pay for subscription and premium channels. Due to the design requirement to vary both the presence / absence and the cost of subscription and premium channels for DTT, the coefficients relating to DTT subscription and premium channels need some additional work to interpret them correctly. This is because the number of channels and cost increased simultaneously (relative to the subscription / premium service not being available); therefore it is necessary to separate the elements of cost and benefit to estimate the actual value of these services. This is done by making use of the secondary choice data; this describes what proportion of people choosing DTT actually opted to pay for the subscription and premium services when they were given the choice, and also allows the derivation of the demand-weighted average number of premium channels and average premium cost. The stages in the calculation are shown in Table 3.30.

TABLE 3.30 DERIVING WTP VALUES FOR DTT SUBSCRIPTION AND PREMIUM SERVICES

Step	Description	Subscription channels	Premium channels
1	monthly cost coefficient ⁴	-0.024	-0.024
2	coefficients on subscription or premium channels	0.058	0.317
3	average cost (£ per month)	12.5	13.7
4	proportion of people choosing DTT willing to pay for subscription or premium channels ⁵	40%	35%
5	adjusted monthly cost coefficient = (1) * (4)	-0.0096	-0.0084
6	cost component of utility = (3) * (5)	-0.120	-0.115
7	adjusted coefficient = (2) - (6)	0.178	0.432
8	WTP (£ per month for pack) = -(7)/(1)	7.43	18.03
9	Number of channels in pack	30	11
10	WTP (£ per month per channel) = (8)/(9)	0.25	1.64

- 3.56 The result of the above calculations is that the estimated average willingness to pay per channel is 25p for DTT subscription channels and £1.64 for DTT premium channels. The subscription channels and premium channels were presented in terms of content as being similar to the corresponding satellite and cable offerings.

⁴ The monthly cost coefficient and the coefficients on subscription and premium channels are taken from Table 3.29.

⁵ This is calculated using the secondary choice data and is the proportion of people who choose DTT and then opted for subscription or premium channels when they were given the option.

- 3.57 The constants are the mean values of the logit random error terms for the four utility equations. They are only meaningful in the context of the other parameters in these utility equations. Perhaps the only simple observation that can be made is that the no TV option is seen as conveying significant disutility compared to having ordinary analogue TV (the constant on analogue is not shown in Table 3.29 but is equal to 0). The platform constants are adjusted by the socio-demographic coefficients, and also with respect to the present TV platform.
- 3.58 The third block of coefficients in Table 3.29 adjusts the platform constants according to the households' present TV platforms. The adjustments are very strong for satellite and cable households with respect to their present TV platforms, suggesting that they have a strong pre-disposition to stick with it. These adjustments are all significant and positive, underlining the message that existing multi-channel households are in general more likely to stay with a multi-channel platform than switch back to analogue (this can also be seen in Table 3.24).
- 3.59 The fourth block of coefficients in Table 3.29 adjusts the platform constants with respect to socio-demographic characteristics. In general these coefficients are consistent with the findings of the RP discrete choice analysis:
- elderly households (where the head of the household is aged over 60) are more likely to opt for no TV;
 - households in rented property are less likely to opt for any of the multi-channel platforms;
 - households with combined viewing time of more than 20 hours per week are more likely to choose DTT or satellite; and
 - households with income greater than £30k per annum are more likely to choose cable or satellite.
 - people with children are more likely to opt for cable.
- 3.60 The following equation gives an example of how the logit model parameters are applied to construct one of the utility equations (the βx in Equation 1). The relevant variables from Table 3.29 are included in the equation. For this example they are the variables relevant to the satellite option and are used to calculate the utility of satellite. The variables, apart from the installation cost, monthly cost and channels, are all binary, either 1 or 0: 1 if the attribute is present and 0 if it is not.

EQUATION 6 - UTILITY EQUATION FOR SATELLITE

$$\beta x(\text{satellite}) = -0.013 * \text{installation_cost} - 0.024 * \text{monthly_cost} + 0.272 * \log_channels - 0.683 + 3.661 * \text{currently_satellite} + 1.644 * \text{currently_cable} + 1.094 * \text{currently_DTT} - 0.903 * \text{rented_property} + 0.300 * \text{HH_TV_hours} > 20 + 0.739 * \text{HH_income} > 30k$$

- 3.61 If, for instance, the respondent is currently a satellite subscriber whose household watches more than 20 hours of TV a week, earns more than £30k a year, owns their own home and has no children then the equation simplifies to:

EQUATION 7 – UTILITY EQUATION FOR SATELLITE FOR A PARTICULAR EXAMPLE

$$\beta x(\text{satellite}) = -0.013 * \text{installation_cost} - 0.024 * \text{monthly_cost} + 0.272 * \text{log_channels} \\ - 0.683 + 3.661 * \text{currently_satellite} + 0.300 * \text{HH_TV_hours} > 20 \\ + 0.739 * \text{HH_income} > 30k$$

- 3.62 If we assume that the installation cost is £100, the monthly cost is £18 and the number of channels is 100, then the equation becomes:

EQUATION 8

$$\beta x(\text{satellite}) = -0.013 * 100 - 0.024 * 18 + 0.272 * 4.605 - 0.683 + 3.661 * 1 + 0.300 * 1 \\ + 0.739 * 1 = 3.63$$

- 3.63 Table 3.31 shows the utility equations for all of the alternatives. The first half of the table shows the variables that should be included in the equation for each of the alternatives. A 1 indicates that the variable should be included and 0 means that the variable is not included. The installation cost, monthly cost and log of channels are examples of values used in the SP exercise. The second half of the table shows the variables to be included for a particular example as described in paragraph 3.61.

TABLE 3.31 EXAMPLE OF ALL UTILITY EQUATIONS FOR THE BETWEEN-PLATFORM SP MODEL

		All Model Variables																																	
Alternative		installation cost (£)	monthly cost (£ per month)	natural log of number of channels	subscription available for DTT	premium channels available for DTT	DTT premium monthly cost £.10 more	constant: no TV	constant: satellite	constant: cable	constant: DTT	currently satellite * no TV	currently satellite * DTT	currently satellite * cable	currently satellite * satellite	currently cable * satellite	currently cable * DTT	currently cable * cable	currently DTT * DTT	currently DTT * cable	currently DTT * satellite	HoH over 60 * no TV	rented property * DTT	rented property * cable	rented property * satellite	HH TV hours >20 * DTT	HH TV hours >20 * satellite	HH income >30K * cable	HH income >30K * satellite	Children in HH * cable	Total Utility	Probability of Choosing this option			
Coef		-0.01	-0.02	0.27	0.06	0.32	-0.13	-4.56	-0.69	-1.47	-0.05	2.36	1.88	3.26	3.66	1.65	1.42	3.95	1.22	1.98	1.09	2.08	-0.81	-0.97	-0.90	0.64	0.31	0.51	0.74	-0.16					
All Variables to be included in the equation	BSP No TV	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
	BSP Analogue	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	BSP Cable	50	15	4.1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1		
	BSP Digital Terrestrial	50	0	3.4	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0		
	BSP Satellite	100	18	4.6	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0		
Example Equation	BSP No TV	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2.2	0%	
	BSP Analogue	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	2%	
	BSP Cable	50	15	4.1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2.4	14%		
	BSP Digital Terrestrial	50	0	3.4	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2.9	22%		
	BSP Satellite	100	18	4.6	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	3.9	61%			

Combination of Coefficients from Within-Platform and Between-Platform SP

- 3.64 It is recommended that the within-platform SP coefficients should be re-scaled to the scale of the between-platform SP set of coefficients, because the between-platform SP has been designed especially to simulate as closely as possible the type of choice that people face in the actual market.
- 3.65 The coefficients from the within-platform SP exercise can be combined with the between-platform parameter set by re-scaling them using the ratio of the monthly cost coefficients. The way in which this is done is shown in Equation 9 and Table 3.32 below.

EQUATION 9 RE-SCALING OF WITHIN-PLATFORM SP (WSP) COEFFICIENTS FOR INCLUSION IN BETWEEN-PLATFORM SP (BSP) MODEL

$$\beta_{x,BSP} = \beta_{x,WSP} * \frac{\beta_{MCOST,BSP}}{\beta_{MCOST,WSP}}$$

- 3.66 The equation shows how each individual coefficient is re-scaled by the ratio of the monthly cost coefficients.
- 3.67 Table 3.32 shows the results of doing this on all the coefficients that might be of use (those not statistically significant have been left out and indicated with * in the BSP coefficient column). It should be noted that the re-scaling does not affect the implied monetary value of each attribute. Only those attributes that were statistically significant from zero at the 95% level (as indicated in Table 3.21) are included in this table.

TABLE 3.32 RE-SCALING OF WITHIN-PLATFORM SP (WSP) COEFFICIENTS FOR INCLUSION IN BETWEEN-PLATFORM SP (BSP) MODEL

Variable	Coef. (WSP)	Value per month (£)	Coef. (BSP)
Monthly cost BSP ($\beta_{MCOST,BSP}$)	N/A	N/A	-0.024
Monthly cost WSP ($\beta_{MCOST,WSP}$)	-0.099	N/A	N/A
Mobility (anywhere in UK)	0.427	4.31	0.103
Cinema quality	0.245	2.47	0.059
PC features	0.434	4.39	0.105
Gaming * HoH aged 30-39	0.992	10.02	0.240
Gaming * satellite	0.592	5.98	0.143
Cinema quality * satellite	0.431	4.35	0.104

Technical Explanation of Re-Scaling Coefficients

- 3.68 The following is a more detailed explanation of how Equation 9 is derived. This involves making explicit the assumptions that are made about the scales of the coefficients in the between-platform SP (BSP) and within-platform SP (WSP) models.

$\beta_{x,BSP} = \lambda_{BSP} * \beta'_x$ where λ_{BSP} is the BSP scale factor and β'_x is the underlying behavioural coefficient for attribute x.

$\beta_{x,WSP} = \lambda_{WSP} * \beta'_x$ where λ_{WSP} is the WSP scale factor and β'_x is, again, the underlying behavioural coefficient for attribute x.

$\beta_{MCOST,BSP} = \lambda_{BSP} * \beta'_{MCOST}$ where λ_{BSP} is the BSP scale factor and β'_{MCOST} is the underlying behavioural coefficient for attribute x.

$\beta_{MCOST,WSP} = \lambda_{WSP} * \beta'_{MCOST}$ where λ_{WSP} is the WSP scale factor and β'_{MCOST} is, again, the underlying behavioural coefficient for attribute x.

Now, we can transform a coefficient from being at WSP scale to being at BSP scale as follows:

$$\beta_{x,BSP} = \lambda_{WSP} * \beta'_x * \frac{\lambda_{BSP} * \beta'_{MCOST}}{\lambda_{WSP} * \beta'_{MCOST}} = \beta'_x * \lambda_{BSP}$$

This is the same as Equation 9, but with the scaling of the coefficients made explicit:

$$\beta_{x,BSP} = \beta_{x,WSP} * \frac{\beta_{MCOST,BSP}}{\beta_{MCOST,WSP}} = \lambda_{WSP} * \beta'_x * \frac{\lambda_{BSP} * \beta'_{MCOST}}{\lambda_{WSP} * \beta'_{MCOST}} = \beta'_x * \lambda_{BSP}$$

The key assumption is that the underlying behavioural coefficients are independent of scale, and that the only difference between their estimated values in different SP exercises is related to the difference in scale.

RP-SP Modelling

- 3.69 The RP and SP data was combined and a model was estimated on the combined set of data. This operation consisted of simply stacking the RP and SP data vertically, and combining the utility expressions from the RP and SP models, with terms specific to each data set only applying to choices from the same data set. The cost coefficients have been specified as being generic; applying to both the RP choices and the SP choices. However, as only the SP costs varied across the data, the cost coefficients are derived entirely from the SP data. The resulting set of coefficients is shown in Table 3.33 over the page.
- 3.70 It can be seen by comparison of Table 3.17 and Table 3.29 that the only difference between the sets of coefficient values shown here and those shown for the RP and Between SP models is the RP constants. As a result of the model estimation process, the RP constants have been adjusted to account for the effect of monthly cost and

installation cost having been included in the utility expression for the RP choices. The model predicts the aggregate market shares in the estimation data perfectly, for both RP and SP data sets - this is a feature of what the logit model estimation process does. In particular for the RP data, as the input data was weighted to reflect the market shares, the RP constants are adjusted in order to ensure that the model predicts the aggregate market shares perfectly.

- 3.71 This model can be used to predict the effects of changes to the range and characteristics of TV platforms on the market, both on estimates of demand and on aggregate consumer surplus.

TABLE 3.33 RP-SP MODEL COEFFICIENTS

Description	Coeff.	StDev	Adj Z
installation cost	-0.013	0.000	-10.545
monthly cost	-0.024	0.001	-2.832
log of channels	0.272	0.013	2.031
subscription available for DTT	0.058	0.007	0.780
premium channels available for DTT	0.317	0.009	3.687
DTT premium monthly cost £10 more	-0.132	0.009	-1.545
SP no TV constant	-4.571	0.053	-8.637
SP satellite constant	-0.683	0.052	-1.310
SP cable constant	-1.455	0.043	-3.395
SP DTT constant	-0.038	0.028	-0.133
SP currently satellite * notv	2.370	0.041	5.835
SP currently satellite * DTT	1.884	0.016	11.550
SP currently satellite * cable	3.281	0.021	15.856
SP currently satellite * satellite	3.661	0.018	20.901
SP currently cable * satellite	1.644	0.023	7.161
SP currently cable * DTT	1.422	0.019	7.597
SP currently cable * cable	3.967	0.021	18.508
SP currently DTT * DTT	1.221	0.014	8.969
SP currently DTT * cable	1.997	0.020	9.801
SP currently DTT * sat	1.094	0.019	5.823
SP HoH over 60 * no tv	2.087	0.049	4.270
SP rented property * DTT	-0.813	0.012	-6.999
SP rented property * cable	-0.950	0.017	-5.463
SP rented property * satellite	-0.903	0.015	-5.835
SP HH tv hours >20 * DTT	0.627	0.010	6.586
SP HH tv hours >20 * sat	0.300	0.013	2.357
SP HH income >30K * cable	0.537	0.012	4.391
SP HH income >30K * satellite	0.739	0.010	7.196
SP HH children * cable	-0.161	0.013	-1.275
RP DTT constant	-1.125	0.030	-3.753
RP cable available * cable	-0.026	0.045	-0.058
RP cable not available * cable	-31.880	41553.000	0.000
RP satellite constant	-0.401	0.054	-0.745
RP HH income >30k * satellite	0.282	0.012	2.447
RP HoH 60+ * satellite	-0.840	0.013	-6.374
RP HoH 60+ * cable	-0.867	0.017	-5.139
RP HoH 60+ * DTT	-0.472	0.015	-3.126
RP HH tv hours >20 * DTT	0.545	0.017	3.227
RP HH tv hours >20 * satellite	0.798	0.014	5.730
RP HH tv hours >20 * cable	0.478	0.019	2.559
RP private rented * cable	-0.990	0.051	-1.944
RP HH children * multi channel	0.439	0.013	3.419

- 3.72 Table 3.34 shows an example of the utility equations for each of the alternatives for the combined RP and between-platform SP model. Due to the limiting amount of space, not all of the parameters are shown, only those that are used in the utility calculation of the example. The set of alternatives includes the RP set which are all prefixed with RP and the between-platform SP alternatives, which are prefixed with BSP. As in the previous example, it is assumed that the respondent is currently a satellite subscriber, whose household watches more than 20 hours of TV a week, earns more than £30k a year and owns their own home. In addition it is assumed that the respondent is younger than 60, has children and cable is available where they live.

TABLE 3.34 EXAMPLE OF LOGIT CALCULATION FOR COMBINED RP AND BETWEEN-PLATFORM SP

Model Variables relevant in specific example																														
Description	installation cost	monthly cost	log of channels	subscription available for DTT	premium channels available for DTT	DTT premium monthly cost £10 more	SP no TV constant	SP satellite constant	SP cable constant	SP DTT constant	SP currently satellite * notv	SP currently satellite * DTT	SP currently satellite * cable	SP currently satellite * satellite	SP HH tv hours >20 * DTT	SP HH tv hours >20 * sat	SP HH income >30K * cable	SP HH income >30K * satellite	SP HH children * cable	RP DTT constant	RP cable available * cable	RP satellite constant	RP HH income >30k * satellite	RP HH tv hours >20 * DTT	RP HH tv hours >20 * satellite	RP HH tv hours >20 * cable	RP HH children * multi channel	Total Utility	Probability of Choosing this option	
Coeff.	-0.01	-0.02	0.27	0.06	0.32	-0.13	-4.56	-0.69	-1.47	-0.05	2.36	1.88	3.26	3.66	0.64	0.31	0.51	0.74	-0.16	-1.13	-0.03	-0.40	0.28	0.55	0.80	0.48	0.44			
RP Analogue	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	16%
RP Cable	20	31	4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1.2	33%	
RP Digital Terrestrial	61	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0.2	12%	
RP Satellite	44	33	4.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	1.3	39%	
BSP No TV	0	0	0.0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2.2	0%
BSP Analogue	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	2%
BSP Cable	50	15	4.1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2.4	14%
BSP Digital Terrestrial	50	0	3.4	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2.9	22%
BSP Satellite	100	18	4.6	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3.9	61%

- 3.73 As the combination of the RP and between-platform SP sets of coefficients does not change the scale of the SP coefficients, the within-platform SP coefficients can be combined with the above set of coefficients using the re-scaling procedure that is outlined in 3.64 above. The recommended combined set of RP, between-platform SP and within-platform SP coefficients, for the purpose of consumer surplus calculations, is shown in Table 3.37.

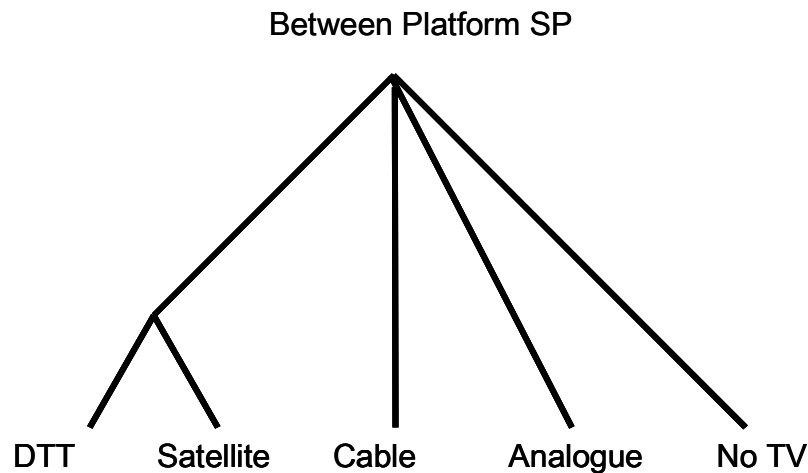
Testing the IIA Assumption

- 3.74 The IIA assumption was tested using a Hausman test implemented using a statistical technique called seemingly-unrelated estimation⁶. The basic between-SP model was estimated, together with 5 other models with a different alternative missing from the choice set of each. Having done this, the null hypothesis of equality of the common parameters was tested for pair-wise combinations of the full model and each of the models with alternatives missing. The results varied depending on which alternative was dropped from the choice set; the null hypothesis of parameter homogeneity was rejected in 3 out of the 5 tests. This suggested that a nested logit model would be worth developing.

Nested Logit Model Development

- 3.75 Alternative nested logit structures were tested with the most basic utility equations (the coefficients in only the first two blocks of Table 3.29). The only one that was found to result in a useable set of coefficients had DTT and satellite in a nest, with the other alternatives on isolated branches. Figure 3.9 shows the structure of the nested logit model.

FIGURE 3.9 NESTED LOGIT STRUCTURE



- 3.76 The sets of coefficients obtained for the nested logit and the equivalent ordinary logit are compared in Table 3.35 below. The nested logit mu parameter⁷ is significantly different from both zero (with a t-ratio of 16.7 as shown) and from 1 (with a t-ratio of 2.8). If the mu parameter were equal to 1, the nested logit model would be equivalent to the ordinary logit model. Despite the statistical significance of the mu parameter, it

⁶ This analysis was undertaken in Stata using the commands *hausman* and *suest*. The Stata manuals and on-line help give further details and references to related academic papers.

⁷ The nested logit model that has been implemented is that referred to by Heiss as the "random utility maximisation nested logit (RUMNL)", and was estimated using Limdep-Nlogit as it was found that the rumnl command in Stata would not produce useful results for this application. The mu parameter referred to here multiplies the utility at the twig level, while $1/\mu$ multiplies the log sum at the branch level. Therefore, the condition for consistency with RUM is that $1/\mu$ should be between 0 and 1.

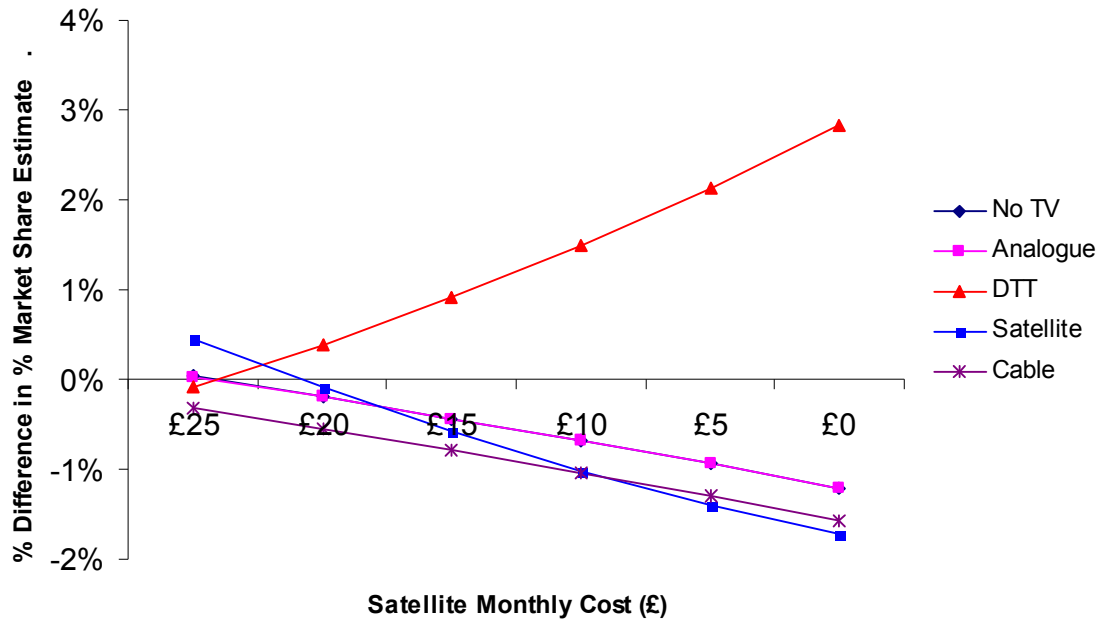
can be seen that there is a very strong resemblance between the two sets of coefficients, leading one to question how much a difference would result from implementing the nested logit model instead of the ordinary logit model.

TABLE 3.35 NESTED LOGIT AND MULTINOMIAL LOGIT COEFFICIENTS COMPARED

Variable	Coefficient		t-ratio	
	Nested logit	Ordinary logit	Nested logit	Ordinary logit
constant dtt	1.4391	1.42934	10.3073	11.8092
constant satellite	1.51737	1.44408	4.66212	5.60935
constant cable	1.07455	1.16976	4.77502	6.24214
constant no tv	-3.16078	-3.15915	-14.848	-16.0771
installation cost	-0.01021	-0.01127	-9.30945	-10.3182
monthly cost	-0.02058	-0.02274	-2.67494	-3.08432
number of channels	0.002217	0.002542	2.50771	2.66823
subscription available for dtt	0.075797	0.081787	1.1711	1.13064
premium channels available for dtt	0.259176	0.27963	3.47224	3.35205
DTT premium monthly cost £10 more	-0.10039	-0.10938	-1.34283	-1.31863
DTT-satellite mu	1.2034		16.7119	

- 3.77 The effect of the nested logit model on the estimated market shares was put to the test by applying both models and varying the monthly cost of satellite from £25 to 0. The results are shown in Figure 3.10. As the satellite monthly cost is reduced from £25 to 0, the ordinary logit model progressively over-estimates the market share of DTT and under-estimates the market shares of the other platforms, relative to the nested logit model's estimates of these market shares. This is because the nested logit model treats satellite as competing more closely with DTT than with the other platforms, and therefore tending to capture more market share from DTT than the other platforms. However, even when the monthly cost of satellite is halved, the difference between the two models is only 1% of the estimated market share (note that this is in % and not percentage points).

FIGURE 3.10 SENSITIVITY TEST ON ORDINARY LOGIT VS NESTED LOGIT ESTIMATES OF MARKET SHARES⁸



3.78 The market share data underlying the graph is shown in Table 3.36.

TABLE 3.36 COMPARISON OF RESULTS FROM NESTED AND MULTINOMIAL LOGIT MODELS

Model	Platform	Satellite monthly subscription cost (£)					
		£25	£20	£15	£10	£5	£0
Nested	No TV	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%
Nested	Analogue	17.9%	17.6%	17.1%	16.7%	16.2%	15.7%
Nested	DTT	42.1%	40.9%	39.6%	38.3%	36.9%	35.4%
Nested	Satellite	20.1%	22.1%	24.2%	26.5%	28.9%	31.4%
Nested	Cable	19.1%	18.7%	18.3%	17.8%	17.3%	16.8%
Multinomial	No TV	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%
Multinomial	Analogue	17.9%	17.5%	17.1%	16.6%	16.1%	15.5%
Multinomial	DTT	42.1%	41.1%	40.0%	38.9%	37.7%	36.4%
Multinomial	Satellite	20.2%	22.1%	24.1%	26.2%	28.5%	30.8%
Multinomial	Cable	19.1%	18.6%	18.1%	17.6%	17.1%	16.5%

3.79 The experience obtained trying to estimate nested logit models on the between SP data suggests that the structure with DTT and satellite in a nest, while it is the only one that could be successfully estimated, need not be significantly better than the ordinary logit

⁸ Note that the lines for Analogue and No TV are overlapping on the graph.

at modelling the choice behaviour exhibited in the data. Alternative structures resulted in the estimation package failing to estimate a model. On top of this, it is not straight-forward to combine the SP and RP data using a nested logit model; it has been found that the nest structure developed for the SP data is not appropriate when the RP data is included, and such a model could not be estimated.

- 3.80 Given the difficulties experienced in fitting nested logit models and the small differences that would result from such a model structure being used instead of an ordinary logit model, it is recommended that the ordinary logit model should be maintained. Already it appears that the amount of time spent trying to get such a model structure to produce useful results has been somewhat disproportionate, considering the small difference between the results of the nested logit model and the ordinary logit model.
- 3.81 Considering the information in Table 3.24, it is perhaps not surprising that nested models have proved difficult to estimate. DTT appears to be an attractive option from the perspective of households with any of the other TV platforms, while there is no such willingness to switch between these other platforms, and neither is there much evidence that people with DTT are anxious to leave. This suggests that a more sophisticated model form such as cross-nested logit (where an alternative can be in more than one nest at a time) might be worth considering in future for this type of problem.

Calculation of Consumer Surplus

- 3.82 It is recommended that in order to calculate consumer surplus, the RP-SP set of coefficients described in **Error! Reference source not found.** should be applied to the full RP data set, in combination with relevant coefficients from the within-platform SP model (re-scaled as shown in Table 3.32). This combined set of parameters is shown in Table 3.37 below.

TABLE 3.37 COEFFICIENTS FOR CONSUMER SURPLUS CALCULATIONS

Description	Coeff.
installation cost (£)	-0.013
monthly cost (£ per month)	-0.024
natural log of channels	0.273
subscription available for DTT	0.058
premium channels available for DTT	0.316
DTT premium monthly cost £10 more	-0.132
RP DTT constant	-1.126
RP cable available * cable	-0.028
RP cable not available * cable	-32.883
RP satellite constant	-0.403
RP HH income >30k * satellite	0.282
RP HoH 60+ * satellite	-0.840
RP HoH 60+ * cable	-0.867
RP HoH 60+ * DTT	-0.472
RP HH tv hours >20 * DTT	0.545
RP HH tv hours >20 * satellite	0.798
RP HH tv hours >20 *cable	0.478
RP private rented * cable	-0.990
RP HH children * multi channel	0.439
Mobility (anywhere in UK)	0.103
Cinema quality	0.059
PC features	0.105
Gaming * HoH aged 30-39	0.240
Gaming * satellite	0.143
Cinema quality * satellite	0.104

- 3.83 Calculating the changes in consumer surplus were not part of the remit of the project, but the understanding is that the above coefficients will be used in the following equation for calculating the difference in consumer surplus of different options.

EQUATION 10 CHANGE IN CONSUMER SURPLUS CALCULATION

$$\Delta E(CS_n) = \frac{1}{\alpha_n} \left[\ln \left(\sum_{j=1}^{J^1} \exp(V_{1nj}) \right) - \ln \left(\sum_{j=1}^{J^0} \exp(V_{0nj}) \right) \right]$$

Where α_n is the cost coefficient, the suffixes 0 and 1 relate to the situations before and after change, j is the number of alternatives and n is the number of people.

Data Files and Command Files

- 3.84 A comprehensive set of data files and command files (in Stata 8 format) accompany this report. A more detailed description of these files is provided in Appendix D.

4. CONCLUSIONS

- 4.1 This report has presented the results of a major survey about digital television and competing television platforms, undertaken for the DTI to feed into an update of the cost-benefit appraisal of the switchover to digital television in the UK. The survey was designed to collect both revealed preference (RP) and stated preference (SP) data about people's choices of TV platform, and to provide the data required to calculate changes to aggregate consumer surplus under a variety of scenarios. A total of 2019 RP interviews were undertaken, and SP data was also collected from a sub-set of 403 of these respondents. The results provide a wealth of information about the key factors that motivate people's choice of TV platform.
- 4.2 The RP data shows that key factors influencing the present market shares of the different TV platforms are household income, age of the head of the household, household TV viewing hours per week, housing tenure, and whether or not there are children in the household (see 3.28 above for further details). Several of these relationships can also be seen in the between-platform stated preference data: housing tenure; household TV viewing hours per week and household income. This gives reassurance that the stated preference data is describing behaviour that is consistent with the actual choices described in the RP data.
- 4.3 It has not been possible to obtain an RP model with coefficients describing the sensitivity to the key characteristics of TV platforms, such as number of channels, monthly cost and installation cost. This is because there is at present no data where these characteristics are observed to vary for each TV platform⁹. However, the SP between-platform exercise had been designed specifically to collect data with this type of variation of key TV platform attributes. This has permitted the estimation of a discrete choice model with both key platform characteristics and socio-economic characteristics incorporated.
- 4.4 Two stated preference exercises were included in the survey, one about within-platform choices and the other about between-platform choices. The within-platform exercise was used to estimate the willingness to pay (WTP) for a range of added-value services: interactive features (camera angles, voting, and gaming); mobile TV (in urban areas only or anywhere in the UK); enhanced picture & sound quality (HDTV-equivalent) and PC features (TV internet). The results show that there is significant willingness to pay for: mobile TV anywhere in UK (average WTP of £4.31 per month); HDTV (cinema / DVD quality) picture quality (average WTP of £2.47 per month) and PC features (average WTP of £4.39 per month). The willingness to pay for gaming was found to be segment-specific, with significantly higher than average willingness to pay in households with the head aged 30-39 and satellite TV households. The willingness to pay for HDTV picture quality was also found to be

⁹ The variation across different satellite and cable packages is not sufficient to permit the estimation of a useful model, because (a) the variations in costs and features such as the number of channels are strongly correlated, and (b) even if this were not the case, it would not be possible to estimate a useful model without additional variation in attributes between the different observations. This variation could in theory be provided by using data collected at different points in time, or alternatively through the use of SP data (which is the route that has been taken in the present project).

significantly higher in satellite TV households compared to other households. Other features were found to have insignificant willingness to pay: camera angles; voting; mobile TV (urban areas only); and surround sound. In most of these cases the results, although statistically insignificant, suggested that the majority of people positively did not want these features. See 3.35 above for further discussion on the results of this analysis.

- 4.5 The between-platform exercise was used to emulate the choice between alternative TV platforms that people face in the real market, and to enable the estimation of a discrete choice model including the number of channels, monthly cost, installation cost, and for DTT, willingness to pay for the availability of subscription and premium services.
- 4.6 The between-platform SP exercise was found to have been successful in offering people a realistic and acceptable range of choices; the option "no TV" was available but got less than 1% of the total choices made. The proportion of choices for no TV rose to 5% in the case where analogue was not available, indicating that there are some people who at least say they would opt out rather than switch over, but these people are clearly a small minority. The discrete choice modelling produced plausible coefficients for all the key model variables: installation cost; monthly cost; number of channels; and the willingness to pay for subscription and premium channels on DTT. The willingness to pay for subscription channels on DTT has been estimated at 25p per month per channel, compared to £1.64 per month per channel for premium channels. The socio-economic variables included in the model produce a picture that is broadly consistent with what was found with the RP data (see 3.59 above for further details).
- 4.7 Procedures have been established for combining the results of the within-platform and between-platform models, and for applying the SP models using the RP data so that the results are consistent with actual market shares. The limitations of the RP data prevented this being done in the way that was originally envisaged, the recommended approach is the best that can be achieved with the available data. The possibility of adopting a nested model structure for the between-platform discrete choice model was investigated, but it was found that the differences between the results produced using the nested model and the non-nested logit were very small, and the nested model could not be implemented satisfactorily to combine the SP and RP data. Therefore it is recommended that the simpler, non-nested model should be used. This has the added advantage that it allows all the analysis and modelling work to be kept within the Stata software package that is in use at the DTI.
- 4.8 All of the Stata data files and command files have been fully tested and handed over to the DTI team. It is understood that these will be used in building a spreadsheet model for calculating consumer surplus under various scenarios, and in benchmarking the present data against data collected for a previous study. This report and the related computer files have been written to be auditable, but should any further questions arise, the team at Steer Davies Gleave will be happy to help.

APPENDIX A

Survey Data Tables

APPENDIX B

The SP Pack

APPENDIX C

Technical Note

APPENDIX D

Data Files

