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RAND EUROPE

Estimating the value of mobile telephony in mobile network not-spots

Technical appendices

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Prepared for DEFRA

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Preface

RAND Europe, in collaboration with Accent, was commissioned by Defra to examine the benefits of eliminating not-spot areas for residents and businesses in these areas and for tourists and other local visitors to these areas. At the core of the study is a survey conducted with people in these population groups. The survey questionnaire collected information on the characteristics of the respondents and their communication practices. It also included a stated preference discrete choice experiment in which respondents were asked to make choices between hypothetical mobile phone services, described by service characteristics and cost. From the data collected, discrete choice models were developed to quantify the importance of the mobile phone service characteristics and price. The outputs from these models were used to estimate the value respondents place on mobile phone services (their willingness to pay). Qualitative interviews were conducted with residents and local visitors to not-spot areas, providing further information on people's mobile phone needs.

RAND Europe led the study, designed the choice experiments and the surveys, and developed the models to analyse the survey results. Accent undertook the qualitative research and managed the data collection. The study was conducted between August 2013 and March 2014.

This report describes the key aspects of the study: survey methodology, design of the choice experiments, model analysis and findings, and the qualitative research findings. It may be of use to policymakers or researchers who are interested in consumers' willingness to pay for mobile phone services and the employment of stated preference discrete choice models and choice modelling methods.

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Abstract

In this study the social, economic and environmental impacts associated with eliminating mobile not-spots area are examined using a mix of qualitative and quantitative methods, including a survey incorporating a stated preference discrete choice experiment. A high-quality representative sample of responses is collected, which forms the basis for the choice modelling analysis. The resulting models quantify the value that residents and businesses in not-spot areas and local visitors and tourists to not-spot areas are willing to pay for mobile phone coverage. We find that individuals are willing to pay to reduce the distances that they have to travel to obtain mobile phone coverage, and that they are willing to pay for a high-quality and reliable signal. These benefits can then be compared to the costs of providing these services to provide an assessment of the social benefit of these investments. We did not find substantial evidence for willingness to pay for better services (3G/4G), although this may emerge as these services become more mainstream. Moreover, not-spots were found to have a negative impact on local businesses located in these areas and may impact the long-term sustainability of rural communities.

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Appendix A. Current communication device usage

Table A.1: Access to and usage of current communication devices by segment (residents, visitors and tourists)

	Access	Usage per day (% of Access)				
Residents (residents)	(Y/N)	<10 mins	10 – 30 mins	30 mins – 1 hr	1 – 2 hrs	> 2 hrs
Landline telephone	99%	32%	40%	19%	6%	3%
Mobile phone (personal use)	97%	80%	11%	5%	2%	3%
Mobile phone (business)	14%	50%	28%	16%	3%	3%
Computer broadband for VoIP service	52%	60%	7%	14%	8%	11%
Femtocell	6%	38%	46%	0%	0%	15%
VoIP phone	1%	50%	0%	50%	0%	0%
Satellite phone	0%					
Others	0.1%	100%	0%	0%	0%	0%
Residents (home-run business)						
Landline telephone	98%	18%	45%	20%	6%	11%
Mobile phone (personal use)	92%	69%	21%	8%	0%	2%
Mobile phone (business)	45%	53%	20%	17%	7%	3%
Computer broadband for VoIP service	52%	62%	15%	6%	6%	12%
Femtocell	5%	0%	0%	33%	0%	67%
VoIP phone	5%	33%	67%	0%	0%	0%
Satellite phone	0%					
Others	2%	100%	0%	0%	0%	0%
Local visitors (local visitors)						
Landline telephone	99%	33%	39%	22%	5%	1%
Mobile phone (personal use)	99%	63%	18%	11%	5%	3%
Mobile phone (business)	18%	43%	19%	24%	10%	5%
Computer broadband for VoIP service	50%	60%	20%	12%	0%	8%
Femtocell	7%	25%	25%	13%	0%	38%
VoIP phone	1%	0%	100%	0%	0%	0%
Satellite phone	0%					
Others	3%	50%	0%	0%	0%	50%
Local visitors (local visitor business)						
Landline telephone	100%	15%	33%	39%	9%	3%
Mobile phone (personal use)	85%	46%	29%	14%	11%	0%
Mobile phone (business)	58%	21%	37%	16%	21%	5%
Computer broadband for VoIP service	42%	79%	0%	14%	7%	0%
Femtocell	0%					
VoIP phone	0%					
Satellite phone	0%					
Others	12%	75%	25%	0%	0%	0%
Tourists						
Landline telephone	90%	62%	29%	5%	2%	1%

Mobile phone (personal use)	97%	48%	27%	10%	11%	5%
Mobile phone (business)	19%	24%	34%	10%	7%	24%
Computer broadband for VoIP service	57%	56%	16%	11%	4%	12%
Femtocell	0%	100%	0%	0%	0%	0%
VoIP phone	9%	43%	29%	21%	7%	0%
Satellite phone	0%					
Others	0%					

Table A.2: Current average monthly bills for resident and local visitor segments

	< £10	£10 – £20	£20 – £30	£30 – £50	> £50	Don't know
Residents	56%	22%	9%	3%	4%	6%
Residents – business	33%	28%	13%	14%	6%	6%
Local visitors	41%	29%	9%	15%	2%	3%
Local visitors – business	21%	30%	12%	24%	6%	6%
Tourists	35%	28%	19%	14%	3%	1%

Table A.3: Access to current communication devices and average monthly bills for business segments

	Access	Monthly bill (average)				
Small business	(Y/N)	<£10	£10 – £50	£50 – £100	£100 – £200	>£200
Landline telephone	96%	4%	57%	26%	11%	2%
Mobile phone (personal use)	54%	37%	50%	10%	3%	0%
Mobile phone (business)	34%	5%	79%	11%	5%	0%
Computer broadband for VoIP service	32%	33%	50%	11%	0%	6%
Femtocell	7%	100%	0%	0%	0%	0%
VoIP phone	2%	0%	100%	0%	0%	0%
Satellite phone	0%					
Others	0.1%	100%	0%	0%	0%	0%
Large business						
Landline telephone	100%	9%	35%	26%	17%	13%
Mobile phone (personal use)	54%	36%	56%	4%	4%	0%
Mobile phone (business)	41%	11%	32%	26%	32%	0%
Computer broadband for VoIP Service	28%	38%	31%	15%	8%	8%
Femtocell	0%	0%	100%	0%	0%	0%
VoIP phone	11%	80%	20%	0%	0%	0%
Satellite phone	0%					
Others	0%					

Table A.4: Mobile phone usage by age

Mobile phone usage	Mobile phone for personal usage						Mobile phone for business usage					
	No. of respondents			% by column			No. of respondents			% by column		
Age	<45	45 – 64	65+	<45	45 – 64	65+	<45	45 – 64	65+	<45	45 – 64	65+
Residents												
<10 mins	20	105	100	71%	70%	89%	8	22	2	62%	51%	33%
10 – 30 mins	3	26	9	11%	17%	8%	2	11	2	15%	26%	33%
30 mins – 1 hr	2	12	2	7%	8%	2%	3	6	1	23%	14%	17%
1 – 2 hrs	1	2	1	4%	1%	1%	0	2	1	0%	5%	17%
>2 hrs	2	5	0	7%	3%	0%	0	2	0	0%	5%	0%
Total	28	150	112	100%	100%	100%	13	43	6	100%	100%	100%
Local visitors												
<10 mins	12	43	33	39%	60%	75%	5	8	0	42%	31%	0%
10 – 30 mins	9	16	5	29%	22%	11%	2	8	1	17%	31%	50%
30 mins – 1 hr	6	6	5	19%	8%	11%	3	5	0	25%	19%	0%
1 – 2 hrs	3	5	1	10%	7%	2%	2	4	0	17%	15%	0%
>2 hrs	1	2	0	3%	3%	0%	0	1	1	0%	4%	50%
Total	31	72	44	100%	100%	100%	12	26	2	100%	100%	100%
Tourists												
<10 mins	21	28	22	40%	41%	76%	2	5	0	20%	29%	0%
10 – 30 mins	10	28	3	19%	41%	10%	4	5	1	40%	29%	50%
30 mins – 1 hr	8	6	1	15%	9%	3%	1	1	1	10%	6%	50%
1 – 2 hrs	9	4	3	17%	6%	10%	0	2	0	0%	12%	0%
>2 hrs	4	3	0	8%	4%	0%	3	4	0	30%	24%	0%
Total	52	69	29	100%	100%	100%	10	17	2	100%	100%	100%

Figure A.1: Current residents' mobile phone usage by function

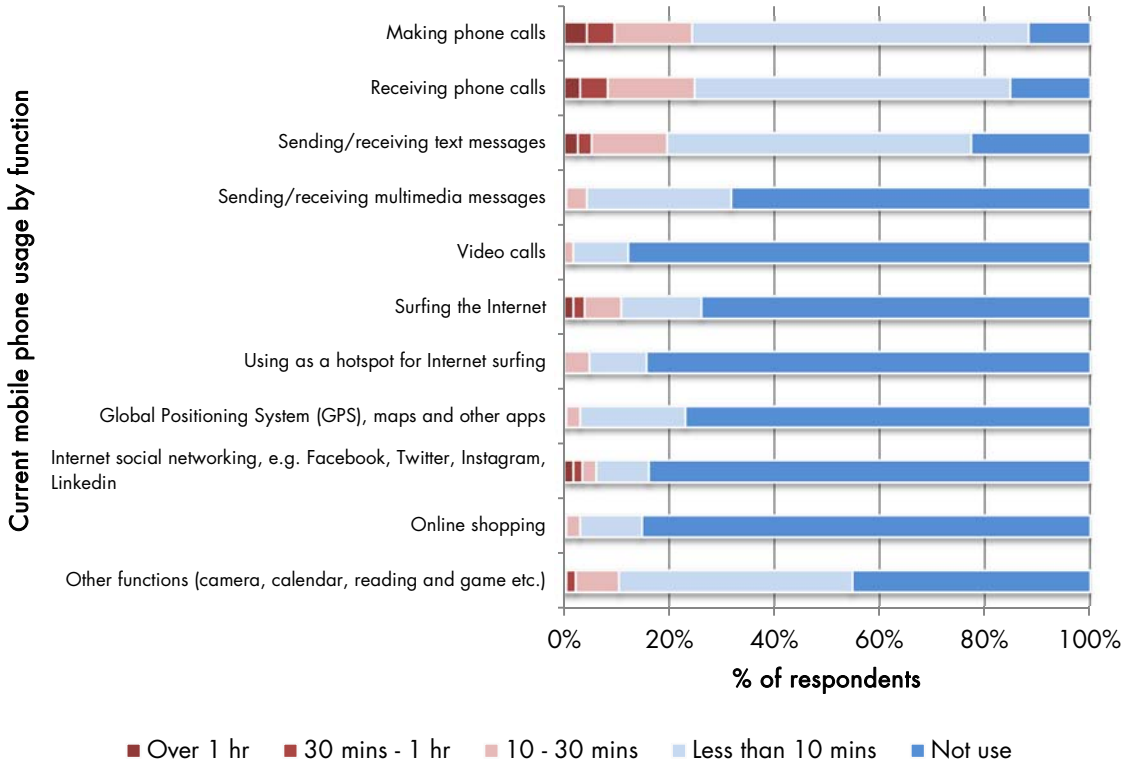


Figure A.2: Current local visitors' mobile phone usage by function

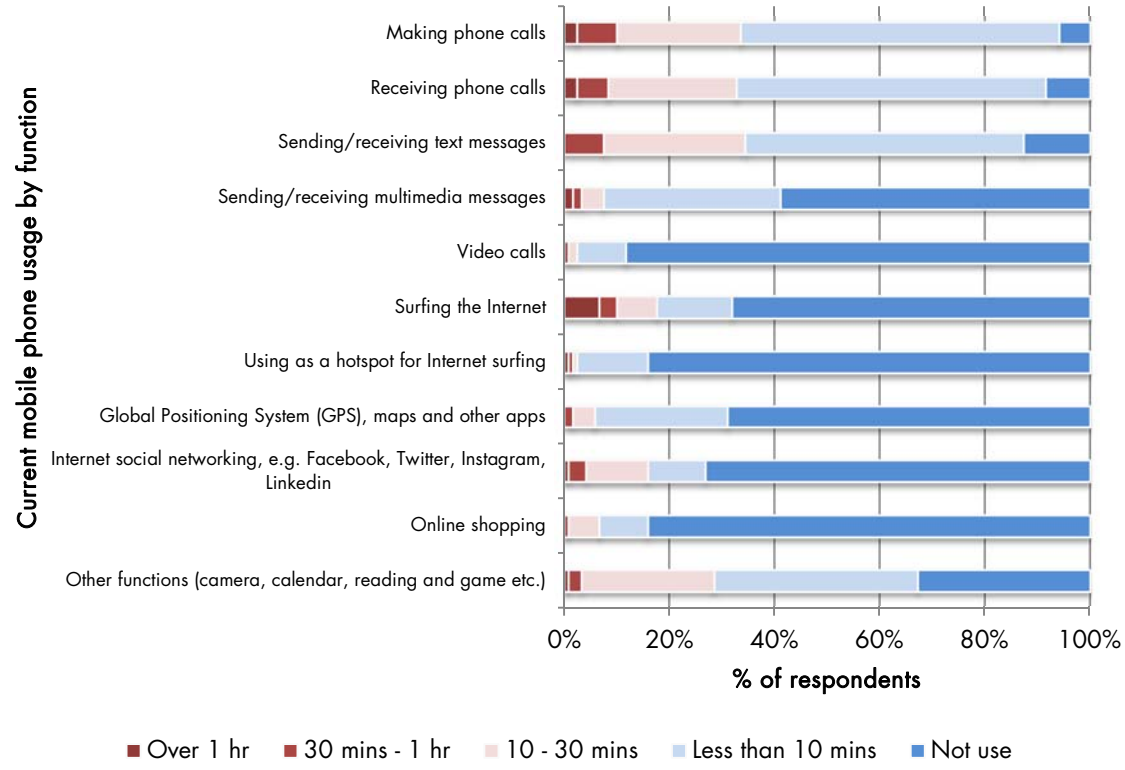
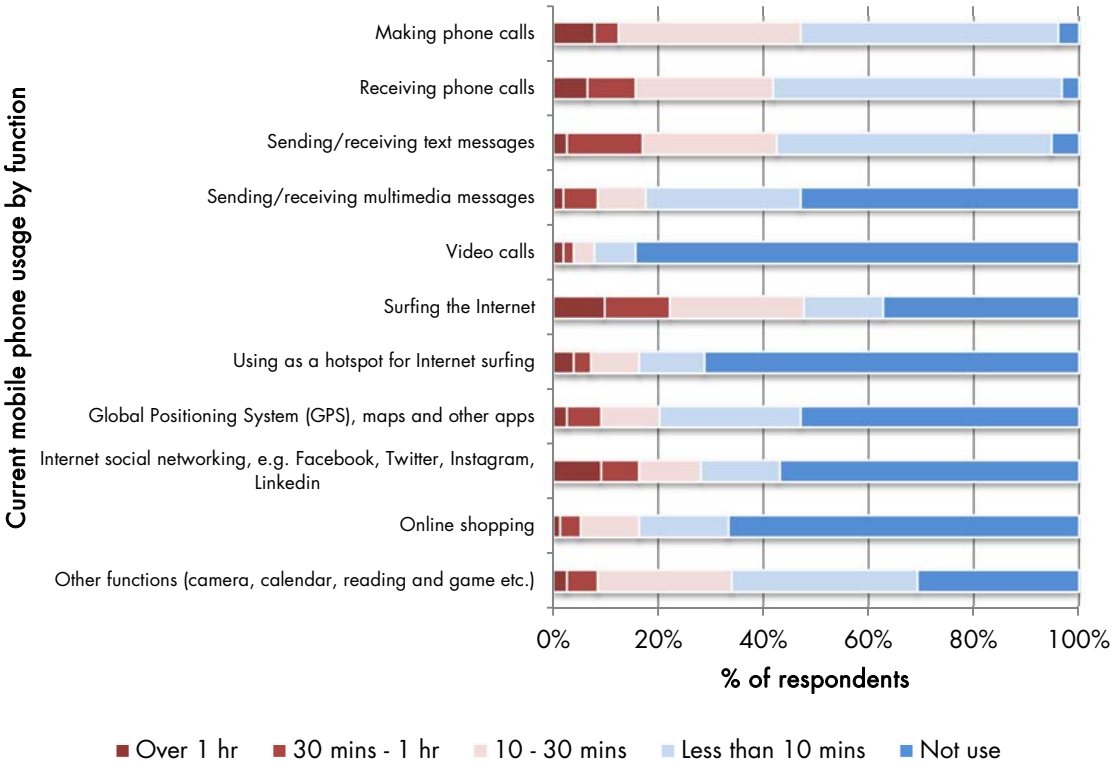


Figure A.3: Current tourists' mobile phone usage by function



Appendix B. Survey sample description

Respondents' socio-economic characteristics were collected and analysed in the survey in order to understand the representativeness of the sample in the not-spot regions. Below we present the socio-economic profile of the non-business segments in terms of age, gender and household income.

Figure B.1: Age and gender profile for non-business segments

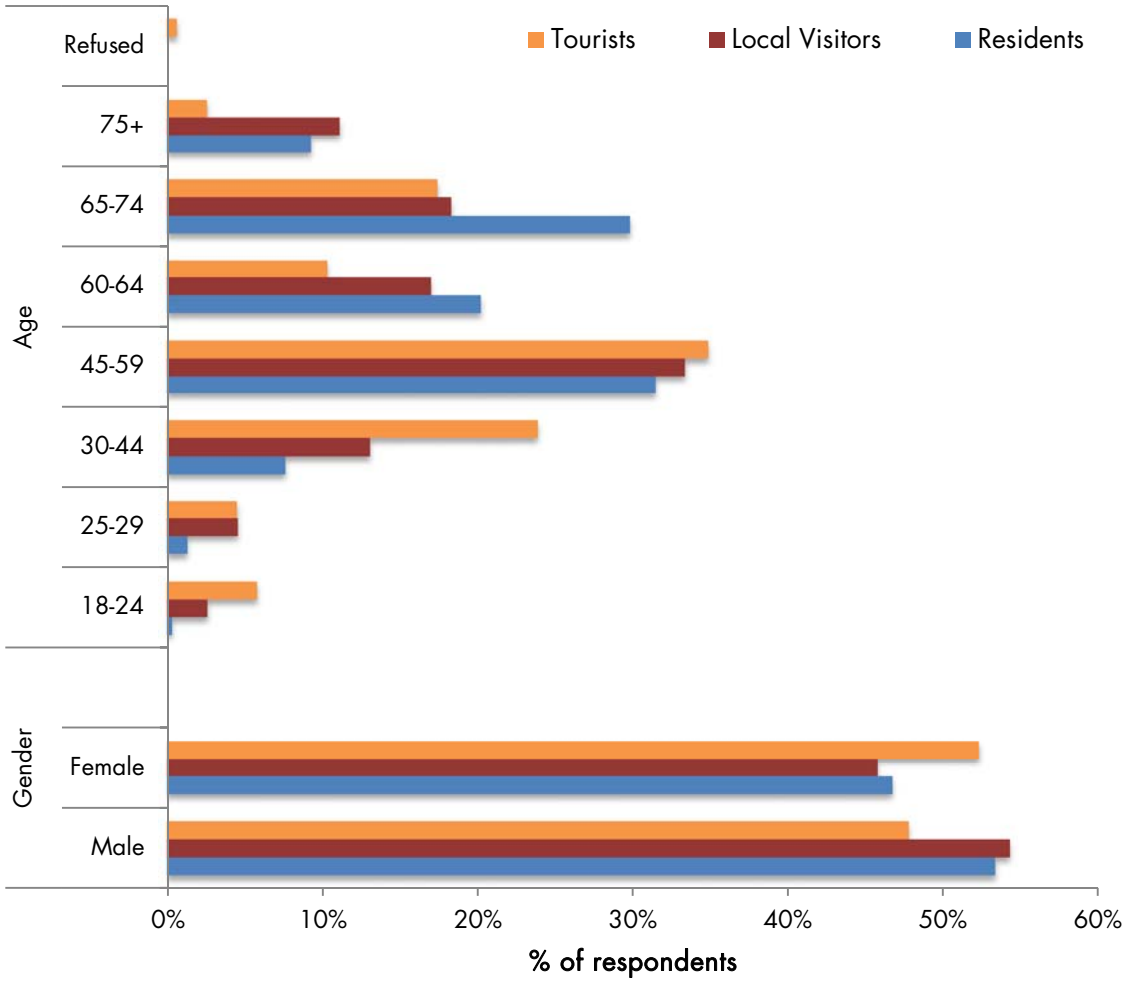
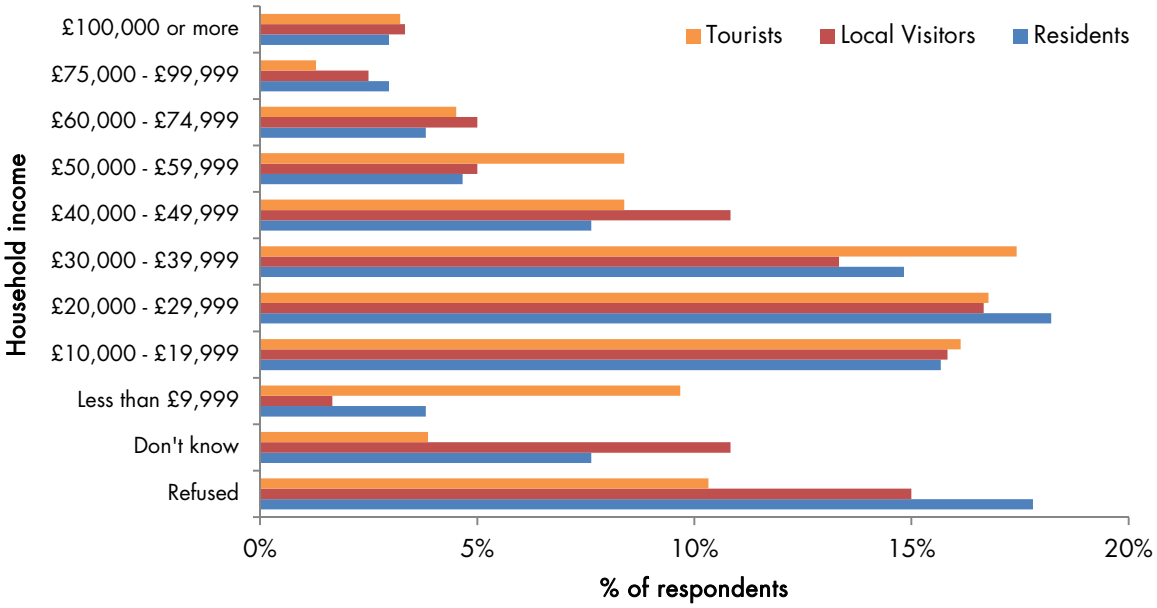


Figure B.2: Income profile for non-business segments



The tables below show the family structure of surveyed residents and local visitors. Some 83 per cent of residents and 88 per cent of local visitors have two or more adults in the household, and 19 per cent of local visitors and 24 per cent of the residents have one or more children aged 17 or younger.

Table B.1: Number of adults per household

	one adult	two or more adults	one adult	two or more adults
	No. of respondents		%	
Residents	50	252	17%	83%
Local visitors	18	135	12%	88%

Table B.2: Number of children aged 17 or below per household

	no children (aged 17 or younger)	with children (aged 17 or younger)	no children (aged 17 or younger)	with children (aged 17 or younger)
	No. of respondents		%	
Residents	245	57	81%	19%
Local visitors	116	37	76%	24%

Figures B.3 and B.4, below, show the annual turnover and type of industry for business segments and home-run businesses.

Figure B.3. Business segment profile

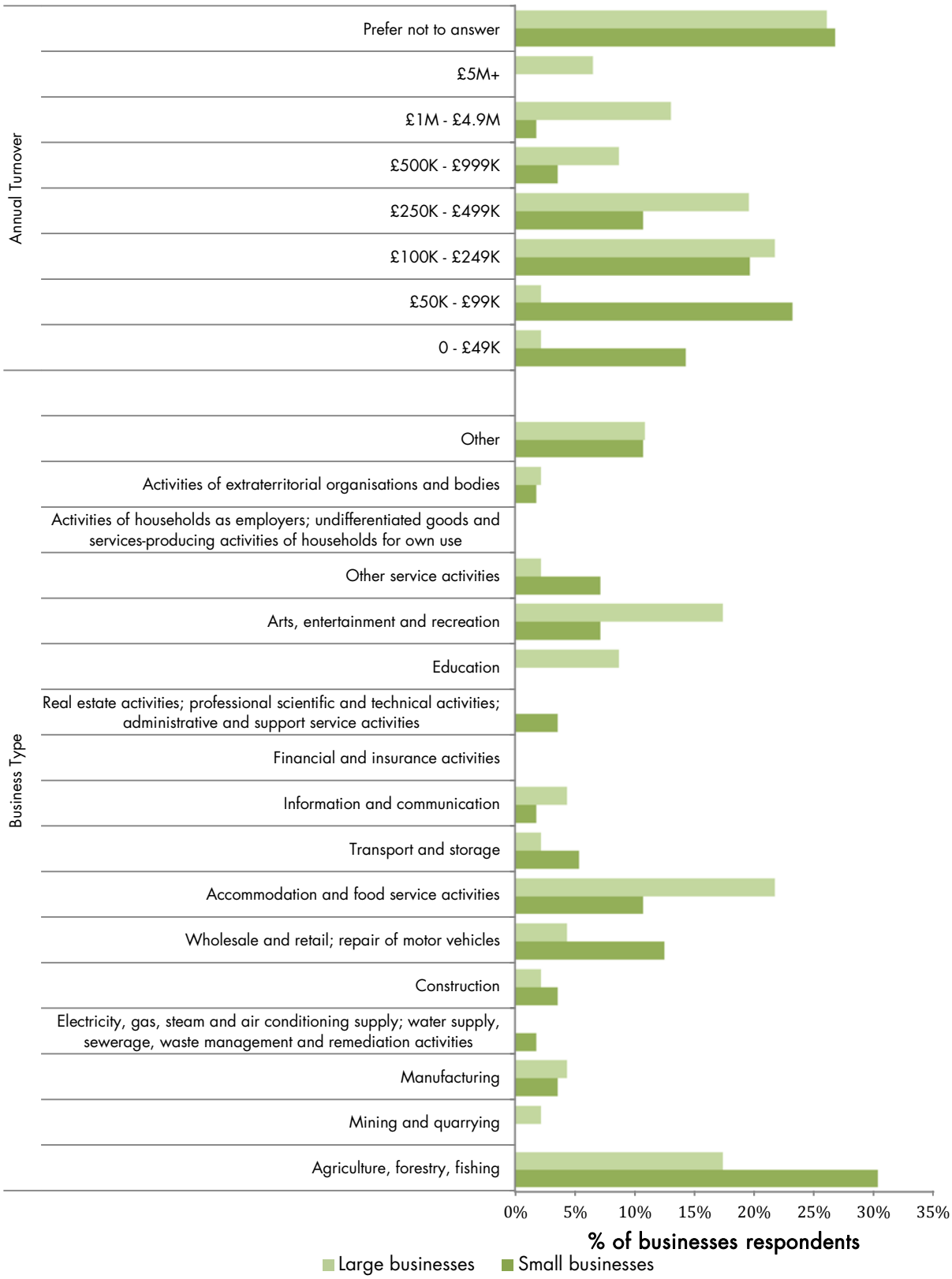
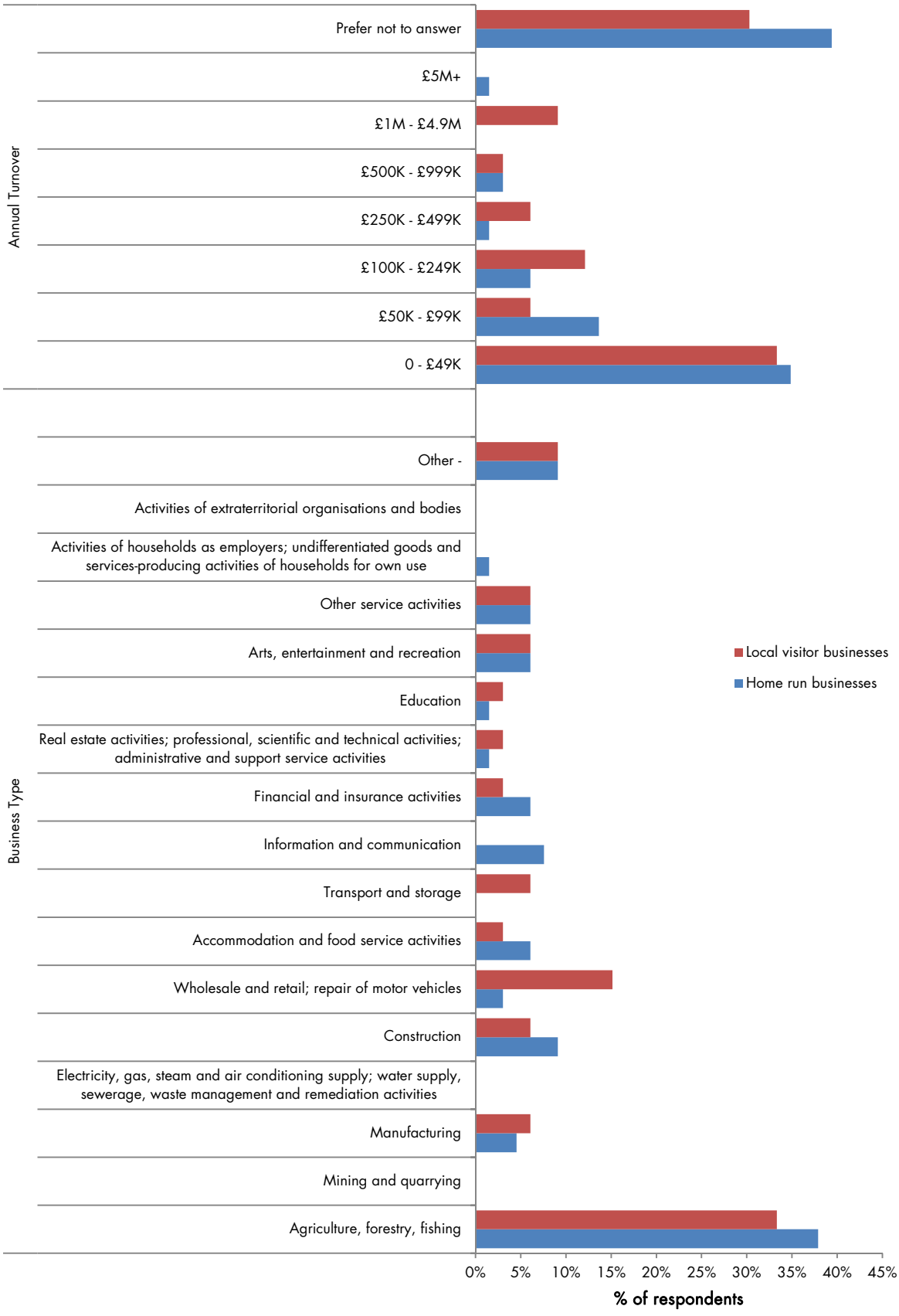


Figure B.4. Home-run business segment profile



We observed that businesses' mobile phone access (for both personal and business purposes) was relatively low and investigated the relation between business mobile access and type of industry. The figures below show mobile phone access and industry type. There are no clear trends, probably because of the small sample sizes for the businesses segment. However, some industries do show a high percentage of mobile phone access, such as manufacturing, electricity, construction, real estate activities and activities of extraterritorial organisations.

Figure B.5. Businesses segment mobile phone access (for personal/business purposes) by type of industry

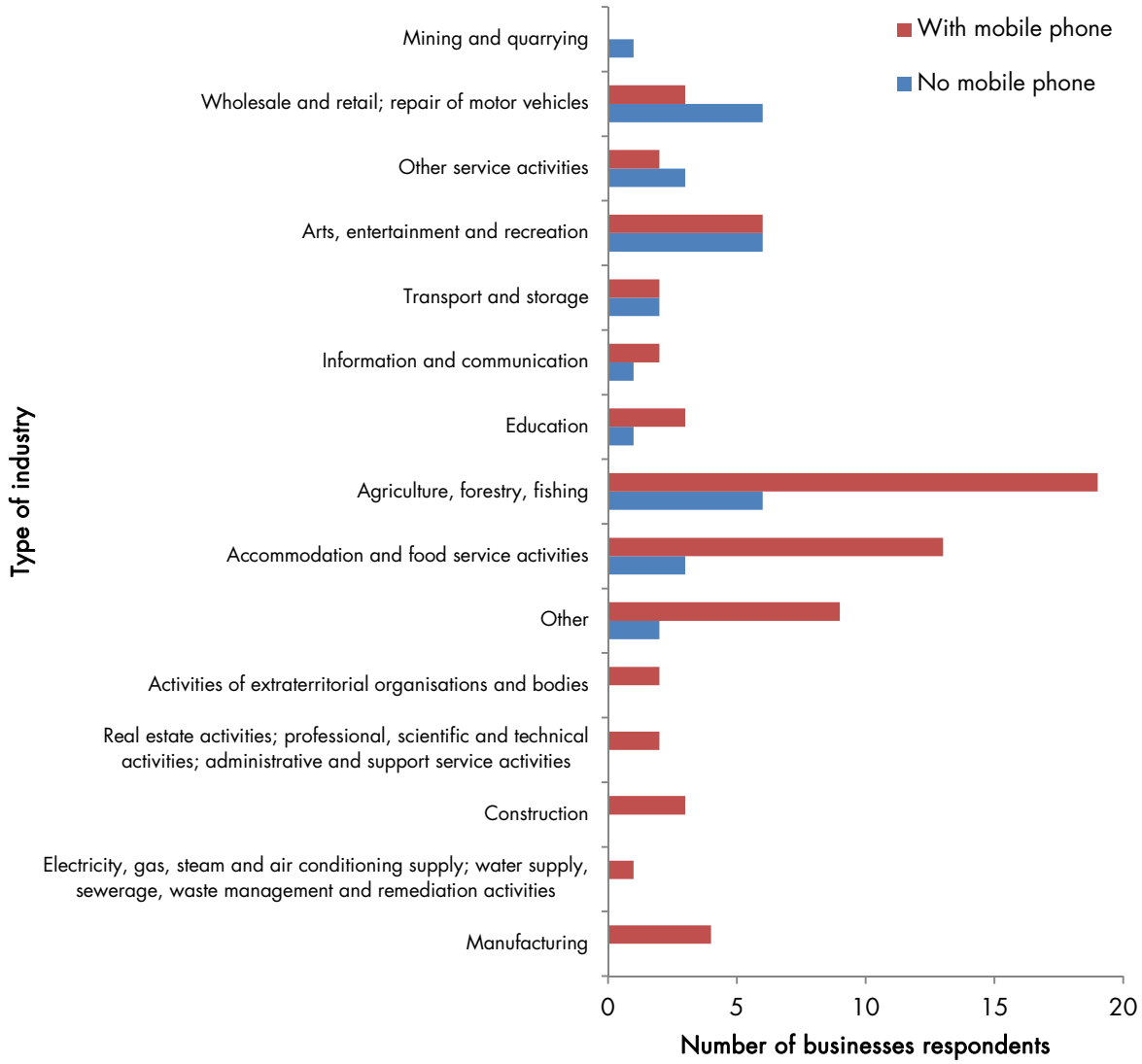
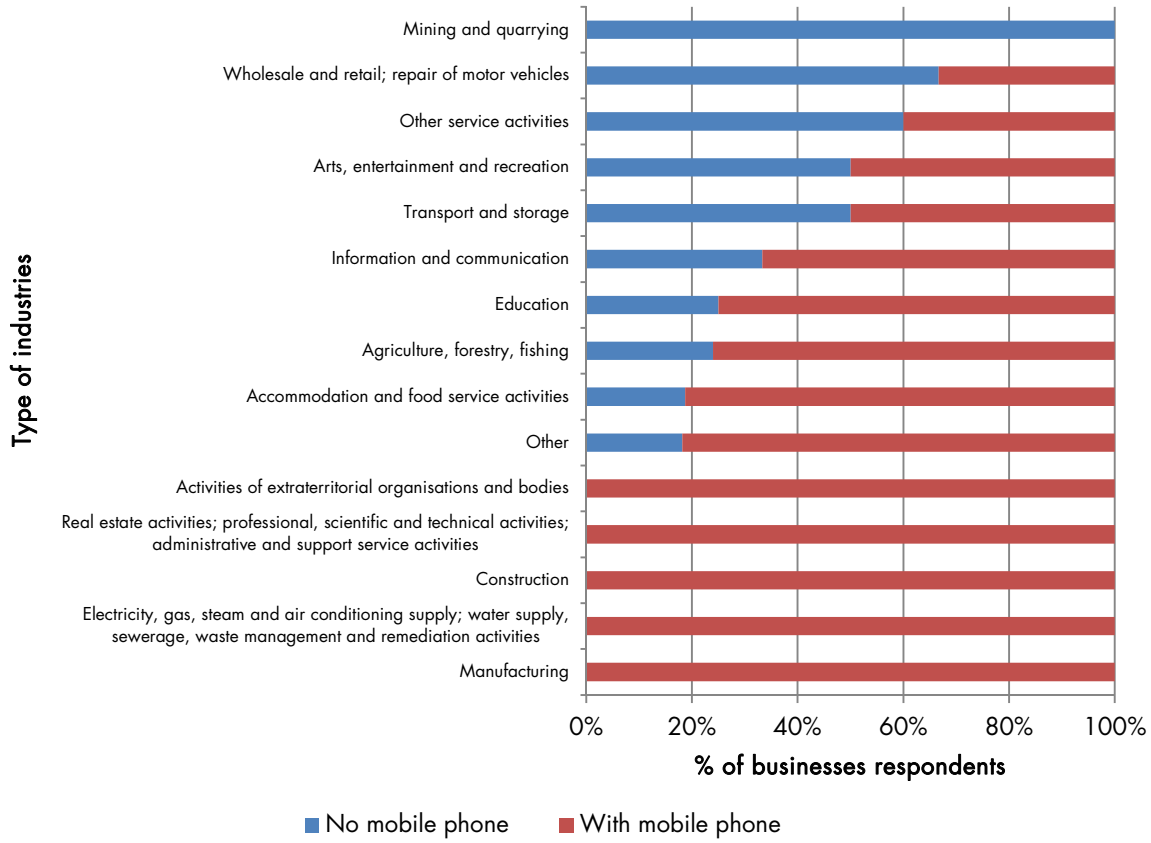


Figure B.6. Percentage of businesses segment mobile phone access (for personal/business purposes) by type of industry



The tables below present length of stay information for tourists in not-spot regions and their awareness and perception of the mobile phone not-spots prior to their travel.

Table B.3: Length of stay in not-spots by tourist segment

Length of stay at tourist destination	Tourists	%
Less than 1 day	54	35%
1–3 days	53	35%
3–7 days	31	20%
7–15 days	10	7%
More than 15 days	5	3%
Total	153	100%

Table B.4: Tourists' responses to the mobile phone not-spots in travel location

Response	Tourists	%
I was unaware whether or not there would be mobile signal at my destination and did not consider this as a factor	48	31%
I assumed there would be mobile signal at the destination	50	33%
I knew or assumed there was no mobile signal, but this was a minor consideration	22	14%
The lack of mobile signal was a disadvantage but this was outweighed by other factors	20	13%
I had no choice in the destination – someone else booked it or there was no alternative	12	8%
I actively sought a destination where there was no mobile phone coverage for my trip	1	1%
Total	153	100%

Appendix C. Understanding the stated preference choice experiments

In the main body of this report we have explored respondents' understanding and level of engagement in the stated preference choice exercises. The tables below summarise the average time spent on the survey questionnaire and provides further detail on respondents' understanding of the choice experiments

Table C.1. Time spent on completing the SP survey

Time spent (minutes)	Residents	Local visitors	Business	Tourists
8 – 10	0%	0%	0%	21%
10 – 20	21%	22%	36%	66%
20 – 30	52%	45%	50%	5%
30 – 40	21%	27%	13%	3%
40 – 50	5%	3%	1%	2%
50 – 60	1%	3%	0%	0%
60 – 70	0%	0%	0%	3%
Average time	26	27	23	16
Sample size	302	153	102	155

Table C.2. Understanding of the choices by population segment

	Understand the choice		The choices are realistic	
	Yes	No	Yes	No
Residents	94%	6%	71%	29%
Local visitors	95%	5%	65%	35%
Businesses	86%	14%	62%	38%
Tourists	98%	2%	70%	30%

	Very easy	Moderately easy	Moderately difficult	Very difficult
Residents	31%	48%	17%	4%
Local visitors	33%	43%	18%	6%
Businesses	34%	37%	26%	4%
Tourists	44%	50%	5%	1%

Appendix D. Choice model results

Discrete choice models are used to gain insight into what drives the decisions that individuals make when faced with a number of (discrete) alternatives. These models are constructed by specifying the range of alternatives available to the decisionmaker, and describing each of these alternatives with a utility equation that reflects the levels of each of the attributes present in the choice faced. Each term in the model is multiplied by a coefficient that reflects the size of its impact on the decisionmaking process (Ben-Akiva & Lerman 1985; Train 2003).

It is the model coefficients that are estimated in the model estimation procedure. The model is based on the assumption that each respondent chooses the alternative that provides him or her with the highest utility. An error term is included in each utility function to reflect unobservable factors in the individual's utility. The estimation can therefore be conducted within the framework of random utility theory, thus accounting for the fact that the analyst has only imperfect insight into the utility functions of the respondents.

The most popular and widely available estimation procedure is logit analysis. This produces estimates of the model coefficients, such that the choices made by the respondents are best represented. The standard statistical criterion of Maximum Likelihood is used to define best fit. The model estimation provides both the values of the coefficients (in utility terms) and information on the statistical significance of the coefficients.

Additional terms and non-linear variations can be tested, with the testing of the appropriate forms for the utility functions being an important part of the model estimation process. By examining different segmentation within the models we can investigate whether different groups of respondents place different values on the attributes in the choices, and can also test whether there are certain groups of respondents that are more likely to systematically choose one alternative over another.

Multinomial Logit (MNL) models (Louviere et. al. 2000) have been developed to interpret respondents' choice observations in each segment. To ensure that the differences in responses are appropriately accounted across sub-segments (for instance, residents and home-run businesses in the residents segment), scale parameters are introduced (Daly & Bradley 1991). This approach best utilises all the choice data available.

Figure D.1: Model structure for residents segment

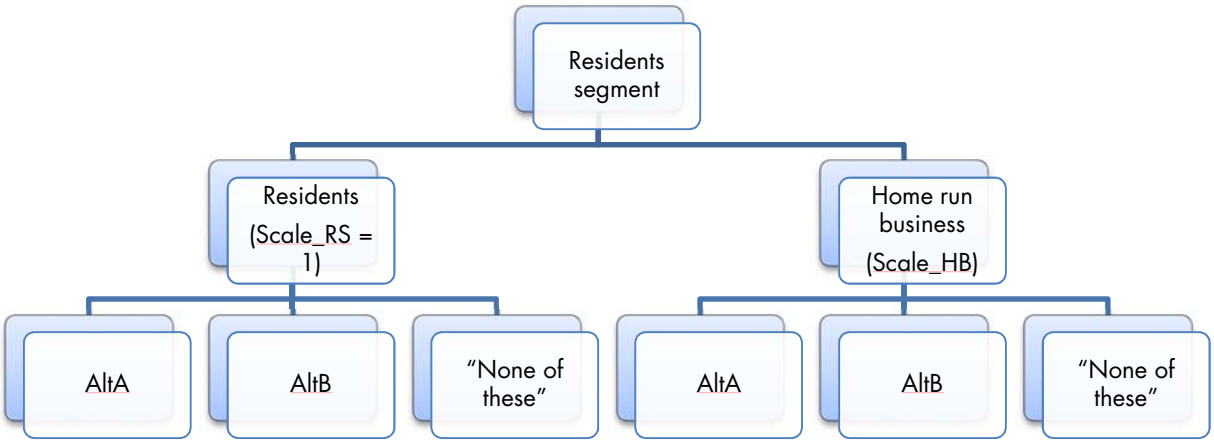


Figure D.1 shows the model structure adopted for the residents segment. Scales are incorporated to take account of the potential differences in error between the different datasets (in this case residents more generally and those who run businesses from their home). The scale captures the relative error (variance) in the responses of those who run businesses from their home relative to the reference dataset (general residents). As the scale parameters are inversely related to the error variance of each dataset, for a given set of scales, a scale parameter smaller than one indicates that the dataset has a greater level of error variance compared to the reference dataset.

Table D.1 describes the list of terms in the overall model fit statistics and the characteristics of the coefficients.

Table D.1: Interpretation of the model fit statistics and coefficient estimations

Statistic	Definition
Observations	The number of choice observations included in the model estimation (reflecting the number of respondents and number of choice scenarios).
Final log (L)	This indicates the value of the log-likelihood at convergence. The log-likelihood is defined as the sum of the log of the probabilities of the chosen alternatives, and is the function that is maximised in model estimation. The value of log-likelihood for a single model has no obvious meaning; however, comparing the log-likelihood of two models estimated on the same data allows the statistical significance of new model coefficients to be assessed properly through the Likelihood Ratio test.
D.O.F.	Degrees of freedom, i.e. the number of coefficients estimated in this model. Note that if a coefficient is fixed to zero then it is not a degree of freedom.
Rho2(c)	If we compare the log-likelihood (LL(final)) value obtained with the log-likelihood of a model with only constants (LL(c)) we get: Rho2(c): 1 – LL(final)/LL(c) A higher value indicates a better-fitting model.
	Interpreting the coefficient estimation
Sign	The sign of the coefficient indicates the preference for that attribute. A positive sign indicates that the attribute has a positive impact on respondents' choices, and therefore the attribute is preferred by respondents and vice versa. In the case of attributes with different levels that have been coded as categorical variables in the choice models it indicates the preference for an attribute level relative to its reference level. The base level is a fixed attribute level relative to which the effects of other attribute levels are measured. A positive sign indicates that the attribute level is preferred relative to the base level by respondents and vice versa.
Magnitude	The magnitude of the coefficient indicates the degree of preference. The larger the coefficient the stronger the preference for the attribute.
Reference level	In the case of categorical variables it is necessary to fix a coefficient related to one of the levels to zero in order to estimate the model. The coefficients estimated for all other levels in that variable are then estimated with reference to the base level.
t-ratio	This indicates the significance of the coefficient. A 't-ratio' equal to (+/-) 1.96 indicates that the corresponding coefficient is significant at a 95 per cent level and in practice is the minimum acceptable level at which the effect implied by the coefficient is called significant. A 95 per cent significance level indicates that the corresponding effect identified has only 5 per cent chance of being purely random.

The results for the best models developed during the study are presented in Tables D.2 to D.5. The model coefficients reflect the results after bootstrapping to take account of repeated observations being collected from a single individual. Separate models are presented for all the four segments.

Table D.2: Discrete choice model results for residents

Mobile signal searching distance	Coefficient	Estimate	t-ratio
With signal at home (reference)	sig_notra	0.0000	n/a
Go out of building (under 65s)	sig_olt65	-0.2601	-1.9
Go out of building (over 65s)	sig_ogt65	0.0000	n/a
Penalty for have to travel for searching signal (constant)	TASC	-0.4439	-4.1
- Searching distance coded as continuous variable (/mile)			
Searching distance (/mile)	signal	-0.0871	-4.1
Quality of service			
Strong signal	qua_strg	0.4955	5.5
Weak signal	qua_weak	0.0000	n/a
Level of service provided			
2G (reference)	ser_2g	0.0000	n/a
2G + 3G / 2G +4G	ser_3g	0.0598	1.0
Cost (on top of monthly mobile phone cast – £)			
Monthly cost	cost	-0.0437	-8.1
Model parameters			
None constant	None	-0.6965	-4.0
None constant	None65	-0.5315	-3.1
Scale – Home-run businesses	Scale_HB	0.7332	4.7
Scale – Residents	Scale_RS	1.0000	n/a

Table D.3: Discrete choice model results for local visitors

Mobile signal searching distance	Coefficient	Estimate	t-ratio
With signal at home / go outside (reference)	sig_notra	0.0000	n/a
With signal at home / go outside (reference)	sig_out	0.0000	n/a
Penalty for have to travel for searching signal (constant)	TASC	-0.2724	-2.1
Searching distance (/mile)	signal	-0.1008	-2.4
Quality of service			
Strong signal	qua_strg	0.5375	4.7
Weak signal	qua_weak	0.0000	n/a
Level of service provided			
2G (reference)	ser_2g	0.0000	n/a
2G + 3G (under 45s)	ser_3g	0.4241	2.2
2G + 3G (over 45s)	ser_3ggt45	0.0000	n/a
2G + 4G	ser_4g	0.0000	n/a
Cost (on top of monthly mobile phone cast – £)			
Monthly cost	cost	-0.0614	-8.3
Model parameters			
None constant (under 45s)	None	-1.8845	-3.2
None constant (over 45s)	None45	-0.6703	-3.5
Scale – Local visitors business	Scale_HB	0.5989	3.1
Scale – Local visitors	Scale_RS	1.0000	n/a

Table D.4: Discrete choice model results for businesses

Mobile signal searching distance	Coefficients	Estimate	t-ratio
With signal at home / go outside (reference)	sig_notra	0.0000	n/a
Penalty for have to travel for searching signal (constant)	TASC	-0.3438	-2.2
- Searching distance coded as continuous variable (/mile)			
Searching distance (/mile)	signal	-0.1142	-2.1
Quality of service			
Strong signal	qua_strg	0.0778	0.4
Weak signal	qua_weak	0.0000	n/a
Level of service provided			
2G (reference)	ser_2g	0.0000	n/a
2G + 3G / 2G + 4G	ser_3g	0.1875	1.4
Cost (on top of monthly mobile phone cast – £)			
Monthly cost	cost	-0.0216	-5.9
Model parameters			
None constant (pilot)	None_P	-0.2235	-0.3
None constant (main)	None	-1.0896	-3.2
Scale parameters – large business + pilot survey	Scale_L	0.4640	2.6
Scale parameters – small business	Scale_S	1.0000	n/a

Table D.5: Discrete choice model results tourists

Mobile signal searching distance	Coefficient	Estimate	t-ratio
With signal at home / go outside (reference)	sig_notra	0.0000	n/a
Coded as a continuous distance (/mile)			
– Under 65s	signal	-0.0580	-1.7
– Over 65s	siggt65	-0.1558	-1.8
Quality of service			
Strong signal	qua_strg	0.7901	6.1
Weak signal	qua_weak	0.0000	n/a
Level of service provided			
2G (reference)	ser_2g	0.0000	n/a
2G + 3G (under 45)	ser_3g	0.5307	2.5
2G + 3G (over 45)	ser_3ggt45	0.0000	n/a
2G + 4G (under 45)	ser_4g	0.6734	2.7
2G + 4G (over 45)	ser_4ggt45	0.0000	n/a
Cost (on top of monthly mobile phone cast – £)			
Daily cost	cost	-0.3111	-7.2
Model parameters			
None constant	None	0.2459	1.8

Computing Willingness-to-Pay (WTP) Valuations and their Confidence Intervals

The ratio of an attribute parameter to the cost parameter provides a measure of willingness to pay (WTP). In the formula, β_x denotes the coefficient estimate for attribute X, β_{cost} is the coefficient for the cost.

In addition, when estimating the models, as well as obtaining the coefficient estimates we obtain the variance-covariance matrix of the parameter estimates. From this we are able to compute the variance of the ratios of model parameters, and hence the confidence intervals for the WTP estimates. Below are the formula[1] we used to calculate the WTP and the variance of the WTP.

$$WTP_X = \left(\frac{\beta_x}{\beta_{cost}}\right)$$

$$var\left(\frac{\beta_x}{\beta_{cost}}\right) = \left(\frac{\beta_x}{\beta_{cost}}\right)^2 * \left(\frac{var(\beta_x)}{{\beta_x}^2} + \frac{var(\beta_{cost})}{{\beta_{cost}}^2} - \frac{2cov(\beta_x, \beta_{cost})}{\beta_x * \beta_{cost}}\right)$$

$$WTP_{Xs} = \left(\frac{\beta_x + \beta_s}{\beta_{cost}}\right)$$

$$var(\beta_x + \beta_s) = var(\beta_x) + var(\beta_s) + 2cov(\beta_x, \beta_s)$$

$$cov(\beta_x + \beta_s, \beta_{cost}) = cov(\beta_x, \beta_{cost}) + cov(\beta_s, \beta_{cost})$$

$$var\left(\frac{\beta_x+\beta_s}{\beta_{cost}}\right) = \left(\frac{\beta_x+\beta_s}{\beta_{cost}}\right)^2 * \left(\frac{var(\beta_x)+var(\beta_s)+2cov(\beta_x,\beta_s)}{(\beta_x+\beta_s)^2} + \frac{var(\beta_{cost})}{{\beta_{cost}}^2} - \frac{2(cov(\beta_x,\beta_{cost})+cov(\beta_s,\beta_{cost}))}{(\beta_x+\beta_s)*\beta_{cost}}\right)$$

For some segments, some socio-economic features (β_s), for example age, were found to have a significant impact on WTP. The impact of age has been incorporated in the model through inclusion of covariates. The WTP for this socio-economic group is therefore calculated using the ratio between the overall impact of the "S" socio-economic group of respondents on the estimation of the X attribute $(\beta_x + \beta_s)$ and the cost coefficient (β_{cost}).

The standard errors of the estimates can then be calculated using the formulae provided above. The tables below summarise the WTP valuations and their standard errors (se). In this study, we have used the standard errors to compute the 90% confidence intervals for the average WTP valuations, as discussed in the main report.

[1] For more details, please see: Daly et al., <Calculating errors for measures derived from choice modelling estimate> Transportation Research Part B 46 (2012) 333- 341

Table D.6: WTP valuations for residents, and their standard errors (£/month)

	Not-spot residents							
	2G				3G/4G			
Distance saved (miles)	Quality of signal the same	s.e.	Quality of signal improvement	s.e.	Quality of signal the same	s.e.	Quality of signal improvement	s.e.
Outside								
- Age < 65 years	6.0	3.1	17.3	4.5	7.3	3.6	18.7	2.4
- Age > 65 years	£0.00	0.0	11.4	2.2	1.4	1.4	12.7	2.5
0.25	10.7	2.5	22.0	3.0	12.0	1.7	23.4	3.8
0.5	11.2	2.5	22.5	3.0	12.5	1.8	23.9	3.9
1	12.2	2.5	23.5	3.1	13.5	1.9	24.9	3.9
2	14.2	2.6	25.5	3.3	15.5	2.1	26.9	4.1
5	20.1	3.6	31.5	4.2	21.5	3.1	32.9	5.0
Average distance (0.92)	12.0	2.5	23.4	3.1	13.4	1.8	24.7	3.9

Table D.7: WTP valuations for local visitors, and their standard errors (£/month)

	Not-spot local visitors							
	2G				3G (Age <45)			
Distance saved (miles)	Same signal quality	s.e.	Better signal quality	s.e.	Same signal quality	s.e.	Better signal quality	s.e.
With signal/outside (reference)								
0.25	4.9	2.3	13.6	2.4	11.8	2.8	20.5	4.8
0.5	5.3	2.3	14	2.4	12.2	2.8	20.9	4.8
1	6.1	2.3	14.8	2.5	13	3.0	21.7	5.0
2	7.7	2.5	16.5	2.7	14.6	3.4	23.4	5.3
5	12.6	4.0	21.4	4.1	19.5	5.0	28.3	6.5
Average distance (1.16)	6.3	2.3	15.1	2.5	13.2	3.1	22	5.0

Table D.8: WTP valuations for businesses, and their standard errors (£/month)

	Not-spot businesses							
	2G				3G/4G			
Distance saved (miles)	Same signal quality	s.e.	Better signal quality	s.e.	Same signal quality	s.e.	Better signal quality	s.e.
With signal/outside (reference)								
0.25	17.3	7.15	20.9	9.01	26	10.36	29.6	15.14
0.5	18.6	7.06	22.2	8.81	27.3	10.21	30.9	15.04
1	21.2	6.98	24.8	8.48	29.9	10.07	33.5	14.89
2	26.5	7.26	30.2	8.16	35.2	10.29	38.8	14.79
5	42.4	10.68	46	10.00	51.1	13.61	54.7	16.12
Average distance (0.94)	21	6.98	24.5	8.51	29.6	10.08	33.2	14.90

Table D.9: WTP valuations for tourists (£/day)

	Not-spot tourists							
	2G (<65 years)		2G (>65 years)		3G (<45 years)		4G (<45years)	
Distance saved (miles)	Same signal quality	Better signal quality	Same signal quality	Better signal quality	Same signal quality	Better signal quality	Same signal quality	Better signal quality
With signal/outside (reference)								
0.25	0.10	2.60	0.20	2.70	1.80	4.30	2.20	4.80
0.5	0.10	2.60	0.30	2.80	1.80	4.30	2.30	4.80
1	0.20	2.70	0.50	3.00	1.90	4.40	2.40	4.90
2	0.40	2.90	1.00	3.50	2.10	4.60	2.50	5.10
5	0.90	3.50	2.50	5.00	2.60	5.20	3.10	5.60
Average distance (0.85)	0.20	2.70	0.50	3.00	1.90	4.40	2.30	4.90

Table D.10: Standard errors for the WTP valuations for tourists (£/day)

	Not-spot tourists							
	2G (<65 years)		2G (>65 years)		3G (< 45 years)		4G (< 45years)	
Distance saved (miles)	Same signal quality	Better signal quality	Same signal quality	Better signal quality	Same signal quality	Better signal quality	Same signal quality	Better signal quality
Outside (reference)								
0.25	0.03	0.41	0.06	0.42	0.72	0.87	0.77	0.90
0.5	0.05	0.40	0.13	0.44	0.72	0.86	0.77	0.89
1	0.10	0.40	0.26	0.49	0.72	0.86	0.77	0.89
2	0.21	0.42	0.51	0.67	0.74	0.87	0.78	0.88
5	0.52	0.59	1.28	1.36	0.88	0.96	0.88	0.95
Average distance (0.85)	0.09	0.40	0.22	0.47	0.72	0.86	0.77	0.89