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*Residential Internet and Broadband take-up in Portugal**

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Residential internet and broadband take-up in Portugal: a second study*

Réka Horváth

Governments have long been concerned about making the internet more accessible to residential users. With the availability of broadband technologies, policies to promote residential broadband internet access became the focus of attention.

Fast broadband access allows its users to draw on the internet for learning, shopping, banking and access public services such as paying taxes. It also facilitates telecommuting (i.e. working from home). Users with broadband access therefore have an advantage over those who cannot access the internet this way.

Historically, it is the more educated and more affluent segments that have access to new technologies. If this is the case with broadband access then it is possible that the divide within the society will further escalate unless broadband access is promoted to a wider group of people.

This study aims at analysing which segments of the Portuguese people possess broadband technology to access the internet. Learning about the drivers of internet - and in particular broadband - access will help policymakers to focus their policy interventions on segments which need the most support to become part of the information society.

1. Introduction

This document is a complementary study to a study[1] prepared by the Department of Studies and Strategy of Anacom, the Portuguese telecommunications regulator. The aim of this work is to analyse the characteristics of people who access the internet from their home via dial-up or broadband connections using data from a sample of Portuguese households.

The data come from a telephone survey conducted by EUROSTESTE and Anacom in December 2005. The sampled population was households with a fixed phone[2]. The sample was not fully representative of Portuguese households[3] but nevertheless sheds

* The first study was prepared in 2005. Since then, the questionnaire was improved and an additional question relating to family income was added thus allowing further analysis of the data.

[1] *Inquérito sobre o Consumo do Acesso à Internet em Banda Larga em Portugal* .

[2] This sampling method omitted households without fixed phones who might access the Internet via cable.

[3] Weights were provided to make the sample representative in terms of geographic regions but not in terms of socio-economic factors.

light on the incentives behind internet/broadband subscriptions. The sample size was around 4200 households.[4]

We find that indeed there is a digital divide: respondents with *more schooling* and households with a *higher income* are more likely to have an internet connection. The other important factor that influences internet take-up is *age*: people under 25 years of age are the most likely to have an internet connection and the odds[5] of having a connection are decreasing with age. Also, households with family members that are in secondary and higher-education age are more likely to have an internet access than other households.

These results are similar to results of other studies[6].

In terms of the choice between dial-up or broadband connection we find that in the continental regions of Portugal the odds of choosing broadband over dial-up are not different from the odds in Madeira or in the Azores except in the central region of Portugal and in Alentejo where having a broadband connection is more likely than having narrowband Again, households in larger towns are more likely to have broadband than in smaller towns. There is no important difference between respondents in terms of age when choosing between the two forms of internet connection (which is different from the internet/no internet choice). The social status is important in determining the odds of having a broadband connection as opposed to a dial-up connection: higher social status is linked to higher odds of having a broadband connection. Other explanatory variables like educational attainment were not significant in explaining the choice between different connection types. This is possibly due to the fact that the choice is driven by non socio-economic variables, such as geographical coverage of broadband, availability of broadband at the workplace, etc.

This document is organised as follows: the second section describes the data, the third presents the modelling framework and the fourth the results. The description of the results can be split into two parts: first the characteristics of households with any type of internet connection are studied and then the choice between broadband and narrowband connection will be analysed. Differences between the 2004 and 2005 samples are also discussed in this section. The last section concludes and drafts general policy recommendations.

2. Data

The data is described in detail in the study done by the Department of Studies and Strategy of Anacom. Here only the variables used in this study will be listed and described.

Dependent variables

Internet access: any type of connection

[4] The innovation of this study over the earlier work is the inclusion of the income variable. As many respondents refused to provide this data the estimations with this explanatory variable were performed on a considerably smaller sample size of around 1600.

[5] In this document the term 'odds' will be used extensively. The *odds* of an event are defined as the *probability* of that event divided by the probability of the opposite of that event. Assume, for example, that a Lisbon household has a 27% probability of having an internet connection. The odds of this household having an internet connection therefore are 0.27/(1-0.27)=0.43.

[6] Stanton (2004) finds the same social-economic determinants using a large sample of US households.

Broadband access: people were asked whether they had a broadband connection. Those who said 'yes' to this question or said that their connection was through cable were classified as those with a broadband connection. Unfortunately, not all households are able to have a broadband access due to the lack of geographical coverage. This problem will be discussed below.

Narrowband access: dial-up connection

Explanatory variables

Regional dummies: there are seven regional dummies (variables that take the value '1' if the household in question is from that region and take the value '0' otherwise) for: North of Portugal, Centre of Portugal, Lisbon and the Tejo Valley, Alentejo, Algarve, Azores, and Madeira. The base case in this analysis is Madeira, i.e. that dummy is not included and the interpretation of the coefficients of the other dummies is relative to respondents in Madeira. This will be further explained in the section on results.

Size of settlement: there are four dummies that control for the size of the settlements the household lives at. These are: less than 2000 inhabitants, 2000-10000 inhabitants, 10000-100000 inhabitants, more than 100000 inhabitants. The base category was the smallest settlement size.

Gender: a dummy variable that takes the value '1' if the respondent is male.

Employment status: a dummy variable that takes the value '1' if the respondent performs an activity for which she gets paid.

Age of respondent: there are six age categories depending on the age of the respondent. These are: less than 25 years old, 25-35 years old, 35-45 years old, 45-55 years old, 55-65 years old, older than 65. The base category is less than 25 years old.

Children living at home: there are five dummy variables that take the value '1' if there are children in the household who are less than 6 years old, 7-11 years old, 12-15 years old, 16-26 years old or older.

Social class: there are five categories based on how the respondent classified the social status of her household. These are: 'high', 'upper-middle', 'middle', 'lower-middle', 'low'. The base category is 'high'.

Educational attainment: there are three categories: not more than basic education, up to medium-level education or not (yet) completed higher education, and completed higher education. The base category is 'not more than basic education´.

Family income: there are five categories based on family income: less than 350 euros/month, 350-750 euros/month, 750-1500 euros/month, 1500-2500 euros/month, over 2500 euros/month.

3. Specification and estimation

Two different sets of equations will be estimated:

1. The first equation analyses the choice of having an internet connection irrespectively of the type of this connection (see Figure 1). The estimation results of this equation will be presented in Section 4.1.

2. The second set of equations analyses the choice among not being connected to the internet, having a dial-up or having a broadband connection (see Figure 2). The estimation results of these equations will be presented in Section 4.2.

Figure 1: The choice of having or not having an internet connection

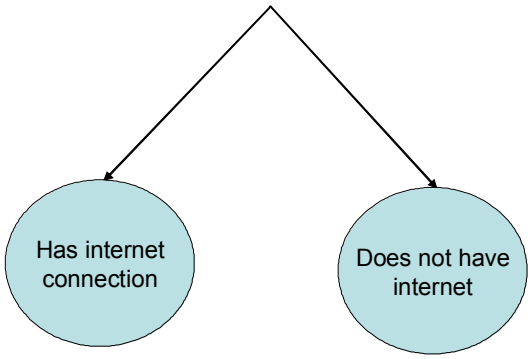
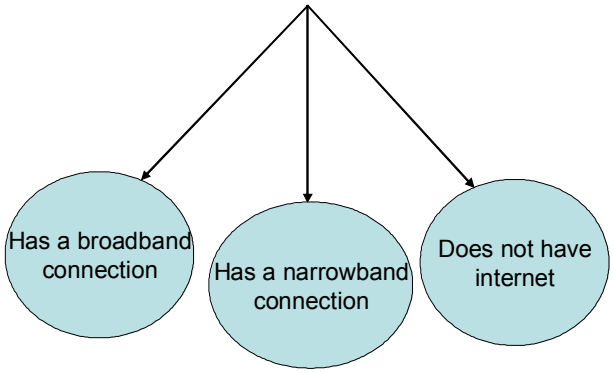


Figure 2: The multiple choice between types of connection



The household characteristics that are associated with internet take-up are studied in a simple binary choice model framework. This means that the probability of having an internet connection is explained using a set of explanatory variables. The results will enable us to answer questions of the following type: does a household in Lisbon have a higher probability of having an internet access than another household with the same characteristics in Madeira?

There are two econometric models used in general to approach such problems, the so-called logit and probit models. In our case the logit and probit models give qualitatively similar results. Here the results of the logit model will be presented.

When analysing the choice between broadband and narrowband connection or no internet at all, the binary choice model is not applicable (as there are three different options a household can choose). In this case two models are estimated: a simple 3-choice multinomial logit, and binary logit performed on the subsample of households with internet connection where the probability of having a broadband connection vs. having a dial-up connection is estimated[7].

[7] The drivers behind the choice between dial-up and broadband in theory could be uncovered from the 3-choice multinomial logit. However, readers might be more comfortable with interpreting the results of

Broadband is not available for all households. Unfortunately, we do not have information about the availability of the service for all survey respondents. Only those with a narrowband connection were asked whether the reason for not having broadband was the lack of availability. The lack of this information for the whole sample will impact on the reliability of results because for some people narrowband is not their choice but the only available technology.

Technical details:

The *logistic regression* or logit model assumes that:

$$\text{odds(having an internet connection)} = \exp(x_j b + b_0),$$

where x_j is the vector of explanatory variables (e.g. demographic factors) and b is vector of coefficients to be estimated (with b_0 being a constant). The interpretation of the odds (as explained earlier): odds = p/(1-p) where p is the probability of the event. It is also possible to express the probability of the event rather than the odds:

$$\text{probability(having an internet connection)} = \exp(x_j b + b_0)/[\ 1+ \exp(x_j b + b_0)].$$

In the *multinomial logistic regression* there are 3 outcomes: no internet connection, narrowband connection, and broadband connection. The 'no internet connection' outcome is chosen as the 'base outcome'. The model is:

$\text{odds[broadband if (broadband or no internet connection)]} = \exp(x_j b^1 + b_0{}^1)$
$\text{odds[narrowband if (narrowband or no internet connection)]} = \exp(x_j b^2 + b_0{}^2)$
odds[no internet connection if (no internet connection or no internet connection)] = 1,

where b^1 and b^2 and two sets of coefficients to be estimated.

Explanatory variables which were significant at the 10% level were included (in case of grouped dummy variable the joint significance was the inclusion criteria). The only exception was the dummy for employment status which was kept in the specification even when it was not significant. The reason for this was that other studies found this variable an important factor in obtaining internet access. In our case the reason for this variable not having much explanatory power might stem from the fact that the age variable – that is likely to be somewhat collinear with the 'employed' dummy - is also included. Indeed, when alternative specifications without the age dummies are estimated the employment status becomes an important explanatory variable.

While most explanatory variables in the specification refer to households, the variables 'age', 'employed', 'educational attainment' and 'gender' refer to the respondent, i.e. the person the interviewer found at home or the person from the household who 'knows about internet'. It might be somewhat problematic to use respondent-specific variables alongside the household variables, but it is not too implausible to assume that the interviewee was likely the person who uses the internet at home the most.

4. Results

the binary-choice model between broadband and narrowband. In any case, results are very similar using the two methods.

68% of households in the sample had no internet connection. 22% of those with an internet connection had a dial-up connection (which translates into 7% of the total), 78% a broadband connection (25% of the whole sample) while 1% of respondents did not know the type of connection they had (see Table 1 for the overview).

Table 1: Internet connection by type

Connection type	
Dial-up connection	7%
Broadband connection	25%
No internet connection	68%

Based on 4079 observations in the sample

4.1. Internet access

Table 2 presents the results of the logit regression for the probability of having an internet connection. The results in the second column are presented as odds ratios. The interpretation of the odds ratios:

$$\frac{\text{odds of having internet connection(if the corresponding variable is incremented by 1)}}{\text{odds of having internet connection(if variable not incremented)}}$$

For example, the estimated *odds ratio* associated with the Lisbon region is 1.6. This means that the odds of having an internet connection for a family in Lisbon are 60% higher than for a household in Madeira (Madeira being the base category for the regional dummies).

It is a useful property of the logit model that the odds ratio of an effect is constant regardless the values of the other variables. This is why it is convenient to present these odds ratios. Although to some it might seem more intuitive to think in terms of probabilities rather than in terms of odds, it is somewhat complicated to present changes in probabilities associated with a change in particular variables as these depend on the values of all other variables. For example, the *odds* of having an internet connection for a family in Central Portugal are 97% higher than for a household in Madeira. However, the difference in *probabilities* of having such connection for the Central Portugal and the Madeira family depend on the social status of these families, the size of the city they live in, etc.

Nevertheless, it is possible to calculate such probability differences taking the values of all other explanatory variables at their means[8]. For example, the marginal probability associated with the Central Portugal regional dummy is 0.08. This means that on

[8] All of the explanatory variables are dummy variables. It is somewhat questionable to use the means of these variables as a reference point. For example, in case of the regional dummies the average would be a household whose place of living is a 'mixture' of all regions. The interpretation of the odds ratios is more reliable and therefore the relative probabilities are only presented to help the reader who is not familiar with the odds.

average, households in the region of Central Portugal have an eight percentage point higher probability of having an internet connection than a household in Madeira.

The tables in this section present odds ratios and marginal changes in probability. Whenever the odds ratios are less than 1 the corresponding dummy variable is associated with lower odds of having an internet connection than households belonging to the base category. Whenever the marginal probabilities are negative the corresponding dummy variable is associated with a lower probability of having an internet connection than households belonging to the base category.

Table 2: Internet usage and demographic factors

Variable	Odds ratio	Standard error[+]	Marginal probabilities[++]
North Portugal	1.07	0.31	0.01
Central Portugal*	1.97	0.58	0.08
Lisbon and the Tejo Valley	1.66	0.50	0.06
Alentejo*	2.01	0.59	0.08
Algarve*	2.69	0.81	0.11
Azores	1.54	0.44	0.05
Madeira			
Less than 2000 inhabitants			
2000-10000 inhabitants	0.69	0.15	-0.04
10000-100000 inhabitants	1.37	0.26	0.04
More than 100000 inhabitants	1.11	0.39	0.01
Gender*	2.28	0.37	0.09
Employed	1.15	0.23	0.02
Less than 25 years old			
25-35 years old*	0.54	0.16	-0.07
35-45 years old*	0.41	0.12	-0.10
45-55 years old*	0.27	0.08	-0.15
55-65 years old*	0.20	0.07	-0.18
Older than 65 years*	0.05	0.02	-0.34
Households with less than 6 years old children	0.93	0.20	-0.01
Households with 7-11 y/o children	0.93	0.21	-0.01
Households with 12-15 y/o children*	1.79	0.43	0.07
Households with 16-26 y/o children*	1.92	0.40	0.07
Households with more than 26 years old children	1.01	0.33	0.00
Low social status	0.40	0.40	-0.10
Lower-middle class	0.62	0.61	-0.05
Middle class	1.35	1.31	0.03
Upper-middle class	1.84	1.87	0.07
High social class			
Basic education or less			
Up to medium-level education*	1.65	0.28	0.06
Completed higher education*	5.18	1.39	0.19
Family income less than 350 euros/month			
Family income 350-750 euros/month*	3.22	1.43	0.13
Family income 750-1500 euros/month*	5.75	2.57	0.20
Family income 1500-2500 euros/month*	9.12	4.23	0.25

Family income over 2500 euros/month*	16.72	8.58	0.32
Wald X^2 (df=31)	347.65		
Pseudo R^2	0.40		
Observations	1589		

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics
[+]The standard errors of the odds ratios
[++]Marginal probabilities are calculated at the means of the explanatory variables

The regions where internet take-up is significantly greater than in Madeira is Central Portugal, Alentejo and the Algarve.

Men have over twice as high odds of having an internet connection than women.

Employment status of the respondent does not seem to affect the odds of having an internet connection. However, when an alternative specification is estimated (not presented here) where the age variable is not used, the odds ratio associated with this variable becomes significant and greater than 1. Therefore, we can safely say that the effect of being employed is picked up by the age variable in the above specification.

The odds of having an internet connection decrease with age, the highest odds of having a connection are associated with the less than 25 year-olds. This might suggest that students in the household impact heavily on having an internet connection. The probability of having an internet connection is up to 34 percentage point lower for the elderly than for the under 25's.

Having children that are older than 12 years also significantly increases the odds of having an internet connection (again the 'students effect').

More schooling increases the odds of having a connection. Moreover, the magnitude of this effect is huge: a person with completed higher education has over five times greater odds than someone with basic education to have an internet connection.

Finally, family income is a very important determinant in having an internet connection: families with a monthly income that is greater than 2500 euros have 17-times larger odds to have an internet connection than a family in the lowest income group (less than 350 euros/month).

4.2. Broadband/narrowband choice

As discussed before, two equations will be estimated. The first is a 3-choice multinomial logit where the three choices are: no internet connection, dial-up, broadband. The second equation is a simple binary choice logit between broadband and dial-up access.

Multinomial logit

The first model explains the choice of narrowband and broadband connections compared to not having an internet connection (see Table 3).

As in case of the binomial logit, the odds ratios associated with a certain variable are constant and easily interpreted. The only difference between the binomial and the

multichoice model is that in the latter the so-called 'conditional odds ratios' are constant. The word 'conditional' refers to the fact that effect of a variable is interpreted with regards to the base outcome. In this case the base outcome is not having any internet connection. Thus, the probability of having a dial-up or a broadband connection is measured against not having an internet connection.

The interpretation of the conditional odds ratios in the second column:

$$\frac{\text{odds of having narrowband [if the variable is incremented by 1 and (the outcome is narrowband or no internet)]}}{\text{odds of having narrowband [if the variable is not incremented and (the outcome is narrowband or no internet)]}}$$

The interpretation of the odds ratios in the sixth column:

$$\frac{\text{odds of having broadband [if the variable is incremented by 1 and (the outcome is broadband or no internet)]}}{\text{odds of having broadband [if the variable is not incremented and (the outcome is broadband or no internet)]}}$$

Marginal probabilities will also be presented. Again, these have to be interpreted with caution as they are calculated at the means of the explanatory variables.

This set of results sheds light on the possible different drivers behind buying a narrowband or a broadband connection.

Table 3: Narrowband/broadband choice and demographic factors

	Narrowband choice				Broadband choice		
Variable	**Conditional odds ratio**	**Standard error[+]**	**Marginal probabilities[++]**		**Conditional odds ratio**	**Standard error[+]**	**Marginal probabilities[++]**
North Portugal	2.32	1.36	0.02		0.92	0.29	-0.01
Central Portugal*	3.96	2.38	0.03	*	2.04	0.65	0.04
Lisbon and the Tejo Valley	3.15	1.91	0.03		1.73	0.58	0.03
Alentejo*	4.33	2.66	0.04		1.84	0.60	0.03
Algarve*	3.81	2.29	0.03	*	2.72	0.86	0.05
Azores	1.69	1.06	0.01	*	1.87	0.59	0.03
Madeira							
Less than 2000 inhabitants							
2000-10000 inhabitants	0.57	0.21	-0.01		0.70	0.16	-0.02
10000-100000 inhabitants	0.69	0.22	-0.01	*	1.50	0.31	0.02
More than 100000 inhab.	0.71	0.42	-0.01		1.37	0.53	0.02
Gender*	2.04	0.57	0.02	*	2.81	0.50	0.06
Employed	1.24	0.46	0.01		1.06	0.24	0.00
Less than 25 years old							
25-35 years old	0.67	0.32	-0.01	*	0.51	0.16	-0.04
35-45 years old	0.43	0.21	-0.02	*	0.41	0.13	-0.05
45-55 years old*	0.28	0.15	-0.03	*	0.28	0.09	-0.07
55-65 years old*	0.39	0.19	-0.02	*	0.14	0.05	-0.11
Older than 65 years*	0.05	0.05	-0.07	*	0.03	0.01	-0.20
Households with less than 6 years old children	0.86	0.31	0.00		0.85	0.20	-0.01
Households with 7-11 y/o kids	0.56	0.25	-0.02		0.99	0.25	0.00
Households with 12-15 y/o children	1.47	0.65	0.01	*	1.90	0.49	0.04
Households with 16-26 y/o children*	2.44	0.80	0.02	*	1.50	0.35	0.02
Households with more than 26 years old children	0.16	0.16	-0.05		1.01	0.37	0.00
Low social status	0.39	0.26	-0.02	*	0.12	0.06	-0.12
Lower-middle class	0.34	0.21	-0.03	*	0.31	0.13	-0.07
Middle class	0.53	0.29	-0.02		0.72	0.28	-0.02
High and upper-middle class							
Basic education or less							
Up to medium-level ed.*	2.05	0.64	0.02	*	1.76	0.33	0.03
Completed higher education*	6.78	2.78	0.05	*	5.63	1.66	0.10
Family income less than 350 euros/month							
Family income 350-750 €/m	1.65	1.15	0.01	*	6.47	4.33	0.11
Family income 750-1500 €/m	2.87	2.05	0.02	*	10.31	7.02	0.13
Family income 1500-2500 €/m*	7.80	5.65	0.05	*	15.05	10.46	0.15
Family income over 2500 €/m*	9.30	7.48	0.05	*	31.88	23.50	0.19
Wald X^2 (df=60)	405.96						
Pseudo R^2	0.36						
Observations	1558						

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics

[+]***The standard errors of the odds ratios***

[++]***Marginal probabilities are calculated at the means of the explanatory variables***

While the (conditional) odds of having a narrowband connection are greater in Central Portugal, in Alentejo and in the Algarve than in Madeira, households in the central region, in the Algarve and the Azores have significantly greater odds to have a broadband connection than in Madeira. This is similar to the results for the internet/no internet choice. The possible difference between the two connection types might be explained by different availability of the broadband technology in the different regions.

While settlement size does not influence narrowband choice, households in greater cities have higher odds to have a broadband connection (similarly to the internet/no internet choice). This, however, might reflect wider availability of the technology in big towns.

Interestingly, social status is important in defining the odds of broadband connections but not in narrowband choice.

The rest of the odds ratios are similar in significance to those of the simple logit choice for having an internet connection (i.e. men are more likely to have any connection type than women, younger people have higher odds of being connected using any type of connection, more education and income imply a greater probability of having any type of internet connection).

However, the broadband (conditional) odds ratios tend to be more pronounced (greater when above one and smaller when below one) than the narrowband odds ratios thus suggesting that social factors are more important in the choice of broadband technology than in narrowband usage. For example, having a family income of over 2500 euros/month is associated with nine-times higher odds (five percentage point increase in probabilities) of having a dial-up connection (as opposed to not being connected) than only having a family income of under 350 euros/month. In case of broadband these odds are 32 times (and the average probability 19 percentage point) higher.

Binary logit on type of connection

As in case of the internet/no internet logit model (in Table 2) the results are presented in terms of odds ratios and marginal changes in probabilities. While the results of Table 2 refer to the odds of having any internet connection compared to not being connected, the model behind Table 4 is constructed to measure differences in odds of having a broadband connection as opposed to having dial-up internet access.

The results of this section shed light on the differences in household and individual characteristics of users of broadband and dial-up connections.

Table 4: Logit for broadband choice (compared to narrowband)

	Odds ratio	Standard error[+]	Marginal probabilities[++]
North Portugal	0.77	0.22	-0.04
Central Portugal*	0.58	0.15	-0.09
Lisbon and the Tejo Valley	0.93	0.27	-0.01
Alentejo*	0.53	0.15	-0.10
Algarve	1.15	0.32	0.02
Azores	1.12	0.33	0.02
Madeira			
Less than 2000 inhabitants			
2000-10000 inhabitants	1.38	0.28	0.05
10000-100000 inhabitants*	1.86	0.32	0.10
More than 100000 inhabitants*	1.85	0.57	0.10
Gender*	1.46	0.21	0.06
Employed	0.88	0.13	-0.02
Low social status*	0.27	0.10	-0.22
Lower-middle class *	0.42	0.13	-0.14
Middle class*	0.62	0.17	-0.08
High and upper-middle class			
Wald X^2 (df=14)	58.73		
Pseudo R^2	0.05		
Observations	1300		

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics
[+]***The standard errors of the odds ratios***
[++]***Marginal probabilities are calculated at the means of the explanatory variables***

The odds of having a broadband connection are smaller in Central Portugal and in Alentejo than in Madeira.

Again, the odds of having a broadband connection increase with settlement size (up to 1.9 times). Probabilities of having a broadband connection are up to ten percentage point higher in big towns than in villages with less than 2000 people.

Men have higher odds of having a broadband connection than women (as is the case for all previous estimations).

Age, children at home, education and income does not play an important role in having broadband vs. a dial-up connection (and are thus not included in the preferred specification). This is quite different from the results for the internet choice equation in Section 4.1. It turns out that these variables are 'responsible' for having an internet connection but not for the type of connection.

Social status does affect the broadband/narrowband choice. Higher social classes are more likely to choose broadband over narrowband than lower classes.

4.3. Comparison with results for the 2004 sample

In the one year between the two sample collections more people opted to be connected to the internet. Within the population of people connected a greater percentage chose broadband over narrowband.

It is interesting to see how (if at all) the significance of the explanatory variables changes between the two samples. As the 2004 sample did not have the income variable this was also omitted from the estimation of the 2005 data (see Annex) for this exercise.

In the internet/no internet choice estimates the only difference between the two years is that while in the 2004 sample the Lisbon region had higher odds than the other parts of the country of being connected to the internet in the 2005 sample it is Central Portugal and the Algarve that is associated with higher odds of having internet connection.

The differences between the multinomial logit estimates are more intriguing. While in 2004 broadband odds were *smaller* for several regions than for Madeira, in 2005 this was the opposite: several regions were ahead of Madeira in terms odds of having abroadband connection. This seems to suggest that geographical coverage was improved in these other regions more significantly than in Madeira.

The other important difference in this specification is that while broadband odds ratios are generally more pronounced than narrowband odds ratios, the difference is less striking in the 2005 sample. This implies that the digital divide is not so important in the sense of what type of internet connection is chosen but only whether *any connection* is being bought by a household.

5. Conclusions

This study tries to uncover the drivers of internet and in particular broadband access in order to help policymakers to focus their policy interventions on segments which need the most support to become part of the information society.

The most important drivers behind internet take-up appear to be age, education and income. Furthermore, the digital divide does not appear to be very improtant in terms of which connection type (narrowband or broadband) is used but it is significant in whether households are at all connected to the internet

Therefore, the most effective policy interventions to promote the information society would promote internet - and broadband in particular - to the least educated and affluent people.

This latter policy might involve subsidised computer purchases and subsidised connections.

Annex

This annex contains the estimation results without the income variable for 2005 and 2004. The explanatory variables are somewhat different between the two years because of differences in the questionnaire.

Table A1: Internet usage and demographic factors, 2005 sample

Variable	Odds ratio	Standard error[+]	Marginal probabilities[++]
North Portugal	0.87	0.14	-0.02
Central Portugal*	1.80	0.28	0.10
Lisbon and the Tejo Valley	1.35	0.22	0.05
Alentejo	1.34	0.22	0.05
Algarve*	1.93	0.30	0.11
Azores	1.00	0.16	0.00
Madeira			
Less than 2000 inhabitants			
2000-10000 inhabitants	0.99	0.11	0.00
10000-100000 inhabitants*	1.56	0.16	0.08
More than 100000 inhabitants*	1.86	0.35	0.11
Gender*	2.42	0.21	0.15
Employed	1.21	0.12	0.03
Less than 25 years old			
25-35 years old*	0.63	0.09	-0.08
35-45 years old*	0.46	0.07	-0.13
45-55 years old*	0.29	0.05	-0.21
55-65 years old*	0.16	0.03	-0.31
Older than 65 years*	0.03	0.01	-0.58
Households with less than 6 years old children	0.89	0.11	-0.02
Households with 7-11 y/o children	0.90	0.11	-0.02
Households with 12-15 y/o children*	1.64	0.22	0.09
Households with 16-26 y/o children*	2.01	0.24	0.12
Households with more than 26 years old children*	1.48	0.27	0.07
Low social status*	0.04	0.04	-0.55
Lower-middle class*	0.10	0.09	-0.39
Middle class	0.21	0.19	-0.27
Upper-middle class	0.55	0.51	-0.10
High social class			
Basic education or less			
Up to medium-level education*	1.92	0.18	0.11
Completed higher education*	7.31	1.09	0.34
Wald X^2 (df=27)	872.02		
Pseudo R^2	0.33		
Observations	4221		

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics
[+]***The standard errors of the odds ratios***
[++]***Marginal probabilities are calculated at the means of the explanatory variables***

Table A2: Narrowband/broadband choice and demographic factors, 2005 sample

	Narrowband choice				Broadband choice		
Variable	**Conditional odds ratio**	**Standard error[+]**	**Marginal probabilities[++]**		**Conditional odds ratio**	**Standard error[+]**	**Marginal probabilities[++]**
North Portugal	1.150	0.310	0.01		0.94	0.16	-0.01
Central Portugal*	2.748	0.687	0.05	*	1.71	0.30	0.05
Lisbon and the Tejo Valley	1.577	0.445	0.02	*	1.53	0.29	0.04
Alentejo*	2.157	0.583	0.04		1.20	0.23	0.02
Algarve*	1.912	0.517	0.03	*	2.19	0.38	0.08
Azores	1.092	0.311	0.00		1.18	0.22	0.02
Madeira							
Less than 2000 inhabitants							
2000-10000 inhabitants	0.743	0.143	-0.01		1.01	0.13	0.00
10000-100000 inhabitants	0.949	0.160	-0.01	*	1.76	0.20	0.06
More than 100000 inhabitants	1.098	0.346	0.00	*	2.03	0.42	0.08
Gender*	2.139	0.306	0.03	*	2.98	0.30	0.12
Employed	1.287	0.219	0.01		1.09	0.13	0.01
Less than 25 years old							
25-35 years old*	0.617	0.136	-0.02	*	0.65	0.10	-0.04
35-45 years old*	0.468	0.108	-0.03	*	0.46	0.08	-0.08
45-55 years old*	0.342	0.083	-0.04	*	0.28	0.05	-0.14
55-65 years old*	0.162	0.049	-0.08	*	0.15	0.03	-0.20
Older than 65 years*	0.046	0.021	-0.12	*	0.02	0.01	-0.40
Households with less than 6 years old children	0.981	0.193	0.00		0.85	0.12	-0.02
Households with 7-11 y/o children	0.830	0.170	-0.01		0.94	0.13	-0.01
Households with 12-15 y/o children	1.189	0.280	0.00	*	1.75	0.26	0.06
Households with 16-26 y/o children*	2.256	0.400	0.04	*	1.67	0.22	0.05
Households with more than 26 years old children	0.888	0.320	-0.01		1.19	0.26	0.02
Low social status*	0.162	0.062	-0.07	*	0.05	0.01	-0.33
Lower-middle class *	0.317	0.106	-0.04	*	0.14	0.03	-0.21
Middle class*	0.537	0.170	-0.02	*	0.33	0.08	-0.12
High and upper-middle class							
Basic education or less							
Up to medium-level education*	2.032	0.325	0.03	*	1.94	0.21	0.07
Completed higher education*	7.811	1.669	0.09	*	7.62	1.24	0.21
Wald X^2 (df=52)	889.17						
Pseudo R^2	0.28						
Observations	4075						

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics

[+]***The standard errors of the odds ratios***

[++]***Marginal probabilities are calculated at the means of the explanatory variables***

Table A3: Internet usage and demographic factors, 2004 sample

Variable	Odds ratio	Standard error[+]	Marginal probabilities[++]
North Portugal	0.89	0.17	-0.01
Central Portugal	0.98	0.20	0.00
Lisbon and the Tejo Valley*	1.60	0.32	0.06
Alentejo	0.86	0.24	-0.02
Algarve	1.26	0.30	0.03
Azores	1.01	0.25	0.00
Madeira			
Less than 100 inhabitants			
100-500 inhabitants	0.91	0.19	-0.01
500-1000 inhabitants	0.89	0.21	-0.01
1000-2000 inhabitants	1.13	0.27	0.01
2000-5000 inhabitants	1.39	0.30	0.04
5000-10000 inhabitants	1.39	0.32	0.04
10000-30000 inhabitants*	1.60	0.33	0.06
30000-80000 inhabitants*	2.08	0.49	0.09
80000-125000 inhabitants*	1.89	0.45	0.08
125000-500000 inhabitants*	1.85	0.54	0.07
More than 500000 inhabitants	1.49	0.43	0.05
Gender*	2.09	0.19	0.09
Employed	1.10	0.12	0.01
Less than 25 years old			
25-40 years old*	0.77	0.10	-0.03
40-55 years old*	0.57	0.08	-0.07
55-65 years old*	0.37	0.06	-0.12
Older than 65 years*	0.09	0.02	-0.29
Households with less than 10 years old children	0.98	0.11	0.00
Households with 11-17 years old children*	1.59	0.17	0.06
Households with more than 17 years old children*	1.63	0.16	0.06
High social class			
Upper-middle class	1.41	0.53	0.04
Middle class	0.65	0.22	-0.05
Lower middle class*	0.41	0.15	-0.11
Low social status*	0.18	0.07	-0.21
Basic education or less			
Up to medium-level education*	3.85	0.57	0.16
Incomplete higher education*	12.89	2.32	0.31
Completed higher education*	20.74	3.63	0.36
Wald X^2 (df=32)	970.58		
Pseudo R^2	0.38		
Observations	4614		

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics
[+]***The standard errors of the odds ratios***
[++]***Marginal probabilities are calculated at the means of the explanatory variables***

Table A4: Narrowband/broadband choice and demographic factors, 2004 sample

	Narrowband choice				Broadband choice		
Variable	**Conditional odds ratio**	**Standard error[+]**	**Marginal probabilities[++]**		**Conditional odds ratio**	**Standard error[+]**	**Marginal probabilities[++]**
North Portugal*	2.15	0.63	0.05	*	0.46	0.10	-0.04
Central Portugal*	1.91	0.59	0.04	*	0.63	0.15	-0.02
Lisbon and the Tejo Valley*	2.66	0.81	0.06		1.15	0.27	0.00
Alentejo*	2.64	0.97	0.07	*	0.33	0.12	-0.06
Algarve*	2.57	0.88	0.06		0.79	0.22	-0.01
Azores	1.42	0.51	0.02		0.83	0.25	-0.01
Madeira							
Less than 100 inhabitants							
100-500 inhabitants	0.96	0.23	0.00		0.98	0.26	0.00
500-1000 inhabitants	1.10	0.31	0.01		0.85	0.28	-0.01
1000-2000 inhabitants	1.04	0.30	0.00		1.47	0.47	0.02
2000-5000 inhabitants	1.28	0.33	0.01	*	1.88	0.53	0.03
5000-10000 inhabitants	0.92	0.27	-0.01	*	2.34	0.70	0.04
10000-30000 inhabitants	1.17	0.29	0.01	*	2.47	0.66	0.04
30000-80000 inhabitants	1.17	0.34	0.01	*	4.02	1.18	0.07
80000-125000 inhabitants	1.02	0.33	0.00	*	3.35	0.98	0.06
125000-500000 inhabitants	0.97	0.37	-0.01	*	3.58	1.26	0.06
More than 500000 inhabitants	0.89	0.34	-0.01	*	2.50	0.89	0.04
Gender*	1.68	0.20	0.03	*	2.56	0.28	0.04
Employed	1.08	0.14	0.00		1.19	0.15	0.01
Less than 25 years old							
25-40 years old	0.91	0.15	0.00	*	0.68	0.11	-0.02
40-55 years old*	0.65	0.11	-0.03	*	0.53	0.08	-0.03
55-65 years old*	0.42	0.09	-0.05	*	0.33	0.07	-0.05
Older than 65 years*	0.12	0.04	-0.13	*	0.07	0.02	-0.12
Households with less than 10 years old children	0.98	0.14	0.00		0.98	0.13	0.00
Households with 11-17 years old children*	1.31	0.18	0.02	*	1.89	0.24	0.03
Households with more than 17 years old children*	1.57	0.19	0.03	*	1.73	0.20	0.02
High social class							
Upper-middle class	1.47	0.77	0.02		1.38	0.58	0.01
Middle class	1.06	0.52	0.01		0.51	0.20	-0.03
Lower middle class	0.62	0.32	-0.03	*	0.32	0.13	-0.05
Low social status*	0.25	0.14	-0.08	*	0.11	0.06	-0.10
Basic education or less							
Up to medium-level ed.*	2.94	0.58	0.06	*	7.04	1.73	0.09
Incomplete higher ed*	9.63	2.18	0.13	*	24.61	6.63	0.15
Completed higher ed*	15.97	3.49	0.16	*	38.32	10.16	0.16
Wald X^2 (df=64)	1082.82						
Pseudo R^2	0.32						
Observations	4596						

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics

[+]***The standard errors of the odds ratios***

[++]***Marginal probabilities are calculated at the means of the explanatory variables***

Table A5:: Logit for broadband choice (compared to narrowband), 2004 sample

	Odds ratio	Standard error[+]	Marginal probabilities[++]
North Portugal*	0.19	0.06	-0.38
Central Portugal*	0.29	0.10	-0.29
Lisbon and the Tejo Valley*	0.40	0.14	-0.21
Alentejo*	0.12	0.06	-0.49
Algarve*	0.28	0.11	-0.29
Azores	0.63	0.26	-0.11
Madeira			
Less than 100 inhabitants			
100-500 inhabitants	1.07	0.35	0.02
500-1000 inhabitants	0.76	0.30	-0.06
1000-2000 inhabitants	1.44	0.53	0.09
2000-5000 inhabitants	1.48	0.50	0.09
5000-10000 inhabitants*	2.56	0.94	0.22
10000-30000 inhabitants*	2.22	0.72	0.19
30000-80000 inhabitants*	3.63	1.27	0.30
80000-125000 inhabitants*	3.48	1.31	0.29
125000-500000 inhabitants*	3.97	1.66	0.32
More than 500000 inhabitants*	3.05	1.29	0.26
Gender*	1.61	0.21	0.11
Employed	1.12	0.19	0.03
Less than 25 years old			
25-40 years old	0.71	0.15	-0.08
40-55 years old	0.78	0.16	-0.06
55-65 years old	0.74	0.19	-0.07
Older than 65 years*	0.41	0.17	-0.21
Households with less than 10 years old children	1.01	0.16	0.00
Households with 11-17 years old children*	1.43	0.21	0.08
Households with more than 17 years old children	1.15	0.16	0.03
High social class			
Upper-middle class	1.01	0.50	0.00
Middle class	0.53	0.25	-0.15
Lower middle class	0.52	0.27	-0.15
Low social status	0.65	0.43	-0.10
Basic education or less			
Up to medium-level education*	2.38	0.74	0.20
Incomplete higher education*	2.55	0.87	0.22
Completed higher education*	2.66	0.86	0.23
Wald X^2 (df=32)	145.22		
Pseudo R^2	0.11		
Observations	1286		

Coefficients that are significant at the 5% level are marked with a '*'. The standard errors are robust to a general form of heteroskedasticity. The base dummies are in italics
[+]***The standard errors of the odds ratios***
[++]***Marginal probabilities are calculated at the means of the explanatory variables***

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