SCIENTIFIC RESEARCH PROJECT COORDINATED BY ICP-ANACOM AND ANATEL WITH A FOCUS ON MOBILE BROADBAND

Final Report

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We are pleased to present this report to satisfy the proposal to assist the Autoridade Nacional de Comunicações of Portugal (ANACOM) and the Agência Nacional de Telecomunicações (ANATEL) of Brazil in analyzing the adoption, use, and economic impact of mobile broadband within their countries.

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Executive Summary

A primary goal of this study is to extend the existing research on broadband provision and adoption by comparing the factors that determine mobile broadband adoption with those that determine fixed broadband adoption, the patterns of use for each technology, and the substitutability of mobile and fixed broadband. We also draw conclusions about improved data collection and reporting on fixed and mobile broadband deployment, adoption, and usage patterns, and on the impact of nomadic broadband deployment where such analysis is possible.[1]

The two most important papers that we build on are those by Cardona, Schwarz, Yurtoglu and Zulehner (2007), and Lee and Marcu (2008). Cardona *et al*. analyzes residential demand for Internet access in Austria, with a focus on both fixed and mobile broadband Internet access, specified by type (DSL, cable, mobile, and narrowband). The study uses data from a 2006 survey conducted by the Austrian Regulatory Authority for Broadcasting and Telecommunications to estimate elasticities of demand. Based on the finding that the availability of one technology limits other technology providers' abilities to raise prices, the authors conclude that customers view the different broadband technologies as substitutes. Our study is constructed similarly to the Cardona *et al.* study, using data specific to Portugal and applying econometric models we developed for our study.

The second relevant paper (Lee and Marcu, 2008), uses six years of OECD data to analyze the factors that influence the diffusion of fixed and mobile broadband. The authors focus on policy, socio-economic, and demographic factors that drive fixed and broadband deployment and adoption. To our knowledge, Lee and Marcu (2008) is the first study to decipher differences in fixed and mobile broadband. Our more extensive data set allows us to expand upon Lee and Marcu, but because the data differs slightly across years, we are unable to analyze econometrically how policy impacts adoption.

Our data, which was provided by ICP-ANACOM, are at the household level indicating individual preferences and actions. This allows us to analyze data on households that switched providers, and each household's satisfaction with its current provider, among other possibilities. The data also allows us to estimate mobile broadband adoption and usage both independently and with respect to other broadband options such as fixed and narrowband access.

A primary constraint is that currently we have limited information on pricing plan characteristics and some usage characteristics, such as nominal and actual speed, and volume of traffic.[2] The absence of detailed price data requires us to use imperfect approaches to estimating price elasticities and the degree of substitutability between alternative modes of broadband access, as well as between narrowband and broadband. Our primary data sources are 2006 and 2008 surveys of customers in

[1] Nomadic broadband is defined as wireless access whereby the end-user can move among different access locations, such as hot spots.

[2] We know of no studies to date that have been able to fill all such information gaps, which limits much of the existing research in the same way our progress is affected.

Portugal.[3] While we lack specific price information, we do have some information on pricing plans (provided by ANACOM). We do not have information on actual expenditures. More detailed and customer-specific price data would greatly improve the precision with which we generate empirical results.

Within our study, we analyze the factors that drive mobile broadband adoption. We compare these factors to those that drive fixed broadband adoption, with the goal of determining whether mobile broadband consumers differ from fixed broadband consumers. This is important in at least two respects: the more similar the two groups of consumers, the more likely it is that the two technologies are close substitutes; and, it makes subsequent analyses (such as meaningful comparisons of intensity and patterns of use between technologies) possible, because it allows us to control for individual characteristics, as well as previous intensity and patterns of use.

In the second stage we analyze the intensity and patterns of use of mobile broadband consumers, again with the goal of determining whether such consumers differ significantly from fixed broadband users. If significant differences in intensity and patterns of use exist after controlling for individual characteristics identified to be important drivers of adoption in the first stage, then it is less likely that mobile and fixed broadband are close substitutes.

Our results indicate that higher income (measured by proxy as described within the report) and more years of formal education are the primary consumer characteristics that lead to the choice of mobile broadband over fixed broadband. Other results of interest are the degree to which reliability of service is important to Internet broadband users, the propensity of higher-income and more experienced (in terms of years using Internet) respondents to want to switch providers, and the characteristics of individuals who shop, file taxes, and enjoy entertainment online. Our data primarily are from three studies conducted during 2006 and 2008, with information on nomadic access from 2008, and surveys from both years contributing to analysis of substitutability between methods of Internet access.

The results of these analyses have important implications for the monitoring and construction of indicators of broadband adoption.[4] If mobile and fixed broadband are close substitutes, then it may be appropriate to construct and monitor aggregate measures of broadband achievement that include both. If on the other hand consumers

[3] We also have data from a 2007 survey; however, this paper does not incorporate the 2007 data. We were unable to match survey responses to price data (which would have allowed us to generate price elasticities). We chose to run estimates using the 2006 BCS survey data as a base year and 2008 ICSCE survey data as the most recent year of data and found comparable results to our models. For this reason we chose to report results from the more recent data rather than the 2007 data. (We cannot make a panel of all three years of data because some key variables are coded differently and different households were surveyed across the years, meaning we have three cross-sections that cannot be combined.)

[4] Due to the limited number of mobile broadband users completing the 2008 surveys (105 total mobile broadband consumers surveyed in the Inquérito ao Consumo das Comunicações Electrónicas survey, and 234 mobile broadband consumers surveyed in the European Consumer Satisfaction Index (ECSI) survey) our empirical analysis of mobile and fixed broadband substitutability in Portugal is limited; however, we are able draw some conclusions on substitutability based on the data available. This information is provided in detail in the body of the report.

view mobile and fixed broadband as being meaningfully different from each other, then aggregating across technologies would lack validity.

Additional analyses also are possible. For example, after identifying factors of adoption, a meaningful comparison of intensity of use between customers of different mobile operators may reveal differences in quality of service in terms of actual speeds/throughput and reliability. To be meaningful such comparisons should first ensure that the compared groups of customers of different operators are similar. The Portuguese government's e.iniciativas programs are useful for making such comparisons, but with some important caveats. The programs bundle Internet access with the offer of a portable PC, allowing the possibility that some customers might purchase the service primarily to obtain the PC, not broadband. Also, the characteristics of the customers that qualify for the program -- teachers, trainees and pupils – may not be representative of the general population. Nevertheless, the program makes possible some unique analyses because the nominal speeds and prices of plans do not vary among the three operators in the e.iniciativas programs, and information exists about individuals' characteristics and prior intensity of use. Since in reality actual speed/ throughput may vary considerably from the nominal speed advertised, such inferences about quality of service are particularly important.

This raises a concluding question of the manner in which mobile broadband connections might be included in international comparisons of mobile broadband deployment and adoption if appropriate. Determining the relevant information to collect for both fixed and mobile broadband, as well as the manner in which the data might be utilized to inform policymaking is essential to regulatory policy and the promotion of broadband adoption. The rapid diffusion of mobile broadband in Portugal indicates that it is time to answer some of these critical questions and to lay the groundwork for future research in this area.

In addition to the question of international benchmarking of broadband penetration, the issue of whether mobile and fixed broadband are similar from customers' perspectives is important for studies of broadband impacts. Several empirical studies have linked the use and adoption of broadband technology to various measurements of economic and job growth.[5] However, such analyses have not been undertaken specifically with regard to mobile broadband services. Whether mobile broadband service will have a similar level of impact upon social and economic development as fixed broadband services have had has not yet been determined. While the scope of the current study does not allow a direct analysis of the impacts of mobile broadband on social and economic development, we are able to consider whether the uses of mobile broadband are different from those of fixed broadband. Our current results indicate that the uses are similar across fixed and mobile users, suggesting that they are somewhat substitutable from customers' perspectives and raising the possibility that there may be limited differential effects on innovation and other social goals. Currently, using 2006 BCS survey data primarily, we are able to pinpoint characteristics of consumers who use the Internet for various tasks; we anticipate future analyses may provide more substantive results for mobile versus fixed broadband usage.

[5] For example see, Gillett *et al.* 2006; Crandall *et al.* 2007; Connected Nation 2008; Shideler *et al.* 2007; and Van Gaasbeck *et al.* 2007.

For current purposes it is important to note that the Lisbon strategy proposed to form in the EU Member States the most competitive and dynamic knowledge-based economy through widespread, affordable Internet access. Subsequent reports established specific penetration targets and a Broadband Performance Index designed to benchmark Member States. This strong interest in broadband development implies a widespread acceptance of the notion that broadband adoption has numerous economic and social benefits.

I. Introduction

The economic importance of broadband is well accepted, but there is much that we do not know about how various technologies of broadband delivery differ in their commercial viability, effectiveness, and value. In some countries, such as the United States, customers often can choose between fixed technologies (such as DSL, fiber to the home (FTTH), and cable), and can access wireless broadband through WiFi and third generation mobile (3G). In other countries, where cable television is less well developed, customers generally do not have the option of choosing cable for broadband access. Japan is emphasizing FTTH in its broadband policies, but also relies on DSL. There also are countries, such as Portugal, where wireless broadband is expanding rapidly. Whether customers view these various technologies as providing equivalent broadband access is important for public policy reasons: a country that is predominant in one broadband technology may be so because regulatory policies include technology biases. Such a country could be at a competitive disadvantage if its populace would find a different mix of technologies to be more productive economically and socially. On the other hand, if alternative broadband technologies are close substitutes, then a country could waste resources promoting a change in technology mix.[6]

Another important consideration for understanding the roles of various broadband technologies is the context within which broadband penetration occurs. The Global Competitiveness Index measures economic competitiveness by ranking business competitiveness across approximately 130 countries; the index incorporates many factors that are affected by broadband penetration, including education, legal structures, and government and business use of advanced technologies.[7] According to Schwab and Porter (2007), the most competitive economies in the future will be those that are innovation-driven. Broadband is instrumental in creating opportunities for innovation in a modern economy. A study by Van Ark and Inklaar (2005) supports this assertion, finding that the economies that have experienced the greatest economic impacts from information technologies are those that have leveraged those technologies to create entirely new products and ways of doing business. Still, broadband alone does not promote innovation; the Global Competitiveness Index includes numerous economic and legal features of a country that should be present if broadband is to reach its potential impact.

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[6] For example, some countries have experienced a greater growth in mobile broadband than have other countries, with the result that these countries look less favorable in popular broadband rankings. If citizens of these countries view broadband as equivalent to fixed broadband, then the country could waste resources trying to increase the use of fixed broadband relative to mobile if customers find mobile broadband equivalent in value to fixed, or perhaps even superior in value to fixed.

[7] In the most recent report (2008-2009) Portugal ranks 43rd; in the prior year it ranked 40th. The Global Competitiveness Report is published annually by the World Economic Forum. The rankings are calculated from publicly available data and from an annual survey conducted by the World Economic Forum. The number of countries ranked varies based on available survey data within countries. The report is available at http://www.weforum.org/en/initiatives/gcp/Global%20Competitiveness%20Report /index.htm. According to the most recent report, the main purpose of the ranking and report is to improve the understanding of the key factors that determine economic growth, and to explain "why some countries are much more successful than others in raising income levels and opportunities for their respective populations, offering policymakers and business leaders an important tool in the formulation of improved economic policies and institutional reforms."(page xi).

The issues of substitutability across broadband technologies and the context in which broadband penetration occurs highlight the deficiencies of the Organization for Economic Cooperation and Development (OECD) broadband penetration rankings, which are frequently cited in the media with little filtering and which prompt strong reactions from public officials. For example, these rankings were frequently cited by Barak Obama during his run for the President of the United States as evidence that the government needs to play an activist role in broadband deployment and adoption. They also played a role in the recent elections in Australia, prompting the leading parties to promise extensive broadband subsidies and resulting in what is now a US$31 billion scheme to build a national broadband network without direct involvement by leading telecommunications companies.[8] These rankings too often confuse rather than inform important public policy debates. Wallsten (2008), for example, finds the OECD rankings misleading, and explains that the rankings are distorted by differences in household size across countries, that they miss workplace connections, that they are based on data that are inconsistently reported across countries and over time, and that they omit quality differences. Further, the OECD reports overlook relevant data such as subscription for mobile broadband, the fastest growing mode of connectivity in many countries, including, of primary importance for our purposes, Portugal. Ford, Koutsky, and Spiwak (2008) also find numerous deficiencies in the OECD index and, as we describe in more detail below, demonstrate that the index's rankings lead to erroneous conclusions. Nevertheless, the rankings are widely distributed and frequently cited in the media, creating a faulty foundation for public discussion and debate about broadband development.

Questions of data measurement, interpretation, and comparison are particularly critical with regard to the deployment and adoption of mobile broadband service. Studies of fixed broadband adoption and deployment are numerous. Several empirical studies have linked the use and adoption of broadband technology to various measurements of both economic and job growth; however, such analyses have not been undertaken specifically with regard to mobile broadband diffusion. In part, this is due to data limitations that exist due to the relatively recent emergence of mobile broadband technology. In what appears to be the first study that compares adoption of fixed and mobile broadband, Lee and Marcu (2008) find that factors influencing the diffusion of fixed broadband are different in some instances from factors influencing mobile broadband diffusion. However, Lee and Marcu were unable to fully examine those factors.

Prior studies have shown the social and economic impact of telecommunications and Internet access; however, the impact of mobile broadband has not been analyzed. While our data does not permit us to specifically address this issue, we are able to suggest the importance of mobile broadband on social and economic development based on existing research and the new data we employ.[9] Such information will

[8] See "Broadband Promises Crash Aussie Election," The Inquirer, 18 June 2007, http://www.theinquirer.net/inquirer/news/601/1034601/broadband-promises-crash-aussie-election; and "Australia to Build $31 Billion Broadband Network," The New York Times, April 26, 2009, http://dealbook.blogs.nytimes.com/2009/04/07/australia-to-build-31-billion-broadband-network/.

[9] We are unable to quantify the economic and social impacts of mobile broadband in Portugal because we have no measure of economic progress of the surveyed households before and after getting

accompany our econometric analysis addressing the gap in the research on fixed and mobile broadband.

Our report proceeds as follows. Section II provides an extended review of research on broadband penetration and use, and on the economic and social impacts of advanced communications technologies. Section III describes our data and outlines the econometric models we use to answer our primary questions of interest. Section IV provides the results of our analyses. Section V makes recommendations for further study and Section VI concludes. The Appendix contains outputs of our econometric models. Econometric models use unweighted survey results unless they are noted as using survey design. Tables, charts, and graphs also rely on unweighted survey results unless otherwise indicated. All data in charts, graphs, and tables are from ANACOM surveys unless otherwise noted.

II. Background and Literature Review

In this section we review earlier research relevant to our study. We begin by identifying drivers that impact the supply of telecommunications, in particular broadband. Next we turn our attention to demand for broadband, in particular price elasticities and the demographic and economic factors that influence demand. We then review the impacts of broadband on various economic and social factors and draw conclusions regarding broadband indicators.

A. Supply Drivers[10]

It generally is accepted that costs, competition, and demand expectations[11] drive the supply of telecommunications, including broadband. One of the earliest cross-country analyses for broadband supply was Bauer, Kim and Wildman (2003), which used 2001 data for 30 OECD countries to find that costs of deployment and network unbundling are key determinants of fixed broadband penetration. Using more data and incorporating information on mobile broadband, Lee and Marcu (2008) confirmed that higher network deployment costs decrease supply; Cava-Ferreruela and Alabau-Muňoz (2006) reported a similar result.

Network costs can affect supply in two ways. First, the presence of high fixed costs can limit the number of competitors that can profitably serve a market. Second, high marginal costs, if they are present, limit the number of customers who can be supplied with service profitably: customers who value the service less than the marginal costs of deployment would not be served on a commercial basis without a subsidy.

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broadband. We are able to suggest how such impacts might exist and explain the process and mechanics that generate them.

[10] We are unable to analyze supply drivers empirically because our data represent only one country and include only two years in which many of the variables differ across years.

[11] We address demand and demand expectations in the next section rather than here with the supply drivers.

Several factors can cause higher fixed and marginal costs. The most common factor assessed in empirical studies is the population density, based on the understanding that it is more costly per customer to supply low-density populations than high-density populations, where density is measured in number of potential subscribers in a geographic area. (Prieger and Hu, 2008) License fees that do not vary with revenue or output, such as are typically found for radio spectrum, can limit entry because operators view these fees as additional fixed costs. Universal service obligations, if they take the form of license obligations to expand at a specific rate into areas that are not commercially viable, also would increase fixed costs. Increases in license or universal service fees that vary with output (or revenue), income taxes, wages, interest rates, import fees, and the like would all increase marginal production costs and so would lower output, all other things being equal. (Jamison, 2008)

It generally is presumed that unbundling decreases costs of supply for rivals of incumbent service providers and thus stimulates supply. Indeed most empirical studies of telecommunications find a positive correlation between unbundling requirements and market entry (see, for example, Bauer, Kim and Wildman (2003), Lee and Marcu (2008), and Denni and Gruber (2005)). Garcia-Murillo (2005) generally supports this conclusion, but finds that unbundling results in a substantial improvement in broadband deployment only for middle-income countries, not for high-income countries. As Jamison (2004) showed, unbundling has two opposing effects that researchers should take into consideration. One is the impact on entry costs for entrants, which is the focus of most studies. The other effect is on incumbent profits. Jamison found for the United States that if unbundling policies negatively impact incumbent profits then incumbents discourage entry. Examining both the entrant and incumbent effects, Jamison (2004) and Hauge, Jamison, and Gentry (2008) find that the incumbent effect dominates; in other words, regulatory policies that make providing unbundled network elements less profitable for an incumbent than selling the associated retail services result in less entry than policies that are less damaging to incumbent profits.

Studies consistently show that competition increases supply. This is true for both fixed line broadband (Aron and Burnstein (2003); Denni and Gruber (2005); and Distaso, Lupi, and Manenti (2006)) and mobile broadband (Lee and Marcu (2008)). In particular intermodal competition, namely competition between alternative technology platforms, increases output (Bauer, Kim and Wildman (2003); Aron and Burnstein (2003); Distaso, Lupi, and Manenti (2006); Cava-Ferreruela and Alabau-Muňoz (2006); and Lee and Marcu (2008)). Competition increases output because it limits the effectiveness of a service provider's unilateral strategy to raise prices. Whenever a firm in a competitive market seeks to increase its price unilaterally, it creates a positive externality for its rivals who benefit from the unilateral action because they can both raise their prices and increase their output. The increased output from rivals, even if only in relative terms, limits the profit the first mover can capture from the price increase. Indeed the price increase may even be unprofitable for the first mover. Furthermore, the more market share the rivals have, the less the first mover can benefit from the price increase. This effect of competition results in an inverse relationship between market prices and the intensity of market rivalry, and a positive correlation between output and competition.

The impact of competition is found not only in broadband markets, but in traditional voice markets as well. For example Wallsten (2001) develops an empirical fixed-effects regression model to illustrate that competition improves telecommunications availability in developing countries. Using data from 30 African and Latin American countries from 1984 through 1997, he measures competition as the number of mobile operators not owned by the incumbent.[12] He finds that competition is positively correlated with the per capita number of mainlines, payphones, and connection capacity, and that price falls with an increase in mobile competitors. Likewise, Waverman, Meschi, and Fuss (2005) found that reliance on competitive market forces was a key regulatory policy for developing mobile telecommunications. In his study of telecommunications development in Latin America, Gutiérrez (2003) found that "opening of the market to more competition and the free entry of private investors in basic telecommunications services will propel network expansion and efficiency across the sector."

Competition from privately-owned firms appears to be more effective than competition from government-owned providers. In an early study of the effects of ownership on telecommunications output, Gutiérrez (2003) found that private operators in competitive markets in Latin America expanded output more than did government-owned operators. Focusing on the United States, Hauge, Jamison, and Gentry (2008) found that municipally-owned telecommunications providers appeared to have no impact on market competition in the United States. Government ownership can also result in policy biases: Edwards and Waverman (2006) find that state-ownership of incumbent telecommunications providers in Europe results in regulatory policies that favor incumbents over entrants.

B. Demand Elasticity[13]

Demand elasticity provides information about the nature of the product being sold and its market structure. Inelastic market demand could indicate that there are few good substitutes for the product, that the product is important to consumers, and, if regulation is not imposing an upper limit on prices, that markets are constraining market power.

Studies provide inconsistent estimates of demand elasticities for broadband. Cardona, Schwarz, Yurtoglu and Zulehner (2007) show that for Europe, the price elasticity of demand for broadband is as expected with most other goods: it varies with the amount of competition in the market. In two complementary studies of the price elasticity of demand for broadband in the United States, Rappoport *et al*. (2001) found that demand for broadband via cable modems was price inelastic, but that demand for DSL was price elastic. The study also found that DSL and cable modems were substitutes and so attributed the differences in own-price elasticities to differences in penetration. Crandall, Sidak, and Singer (2002) updated the Rappoport *et al*. study and found that the elasticities had not changed substantially. But in their own follow-up study, Rappoport *et*

[12] Brazil is included in the study, which notes that telecommunications reform legislation was passed in Brazil in 1995 and an independent regulator established in 1997; however, as of 1997 there were no mobile telecommunications competitors (see page 10 in Wallsten's work).

[13] Our analysis of demand elasticities is limited by our lack of adequate price data for the primary year of study (2006); some analyses using 2008 data are provided in our results.

al. (2002) found that demand for the services was becoming more price inelastic, perhaps indicating either increasing penetration or that the services were becoming more essential. At about this same time, Varian (2002) examined consumers' willingness to pay for additional bandwidth for an Internet access service offered by the University of California at Berkeley and found that demand was price inelastic. While Varian's study cannot be compared directly with the Rappoport *et al*. studies because Varian considered only users of the Berkeley service, Varian's findings at least are consistent with the latter Rappoport *et al*. study.

Ida and Kuroda (2006) examined the demand for broadband services in Japan. They found that the demand for ADSL in Japan was price inelastic and that the demand for cable modem and fiber to the home was price elastic, perhaps because of the dominance of ADSL in Japan, consistent with the analyses of Rappoport *et al*. (2001, 2002).

C. Demographic and Economic Factors Affecting Demand

Demand studies for broadband access find that demand is positively correlated with income, education, and greater use of other information technologies. Crandall *et al*. (2002), Kridel *et al*. (2001), Garcia-Murillo (2005), and Prieger and Hu (2008) find that lower-income groups are less likely to subscribe to broadband than higher-income groups. Goldfarb and Prince (2008) concur in this finding and add that more highly educated consumers are more likely than less-educated consumers to purchase broadband. Analyzing residential broadband adoption in the United States, Stanton (2004) finds that computer ownership is one of the most significant factors leading to the so-called digital divide. This could have consequences for the effects of race on broadband demand in the US because, as Fairlie (2004) shows using Current Population Survey data in the United States, blacks and Hispanics are less likely to have a computer in the home than are members of other racial or ethnic groups.

Other studies address race and ethnicity more directly. Prieger (2003) and Hu and Prieger (2008) find that race has no impact on suppliers' willingness to deploy DSL, once variations in income and other economic factors are considered. Leigh (2003) finds similar results. However, Flamm and Chaudhuri (2007), GAO (2006), and Prieger and Hu (2008) find that race impacts broadband penetration, perhaps because of differences in computer skills (Krueger, 2003) or network effects (Goolsbee and Klenow, 2002). These race impacts may result from factors correlated with race, but unobserved in the researchers' data or not fully captured in the statistical analysis even if the data are there. For example, Prieger and Hu (2008) discuss whether some blacks and Hispanics lack spare time to be online or find online content less valuable than do other racial groups. Costa (2009) hypothesizes that household income and educational levels may be correlated with race and that the effects of income and education are not fully captured by their respective regression coefficients. It might also be that technology limits may affect supply in some ethnic neighborhoods.

In their survey of 18,439 Americans, Goldfarb and Prince (2008) examine the relationship between demographics and Internet usage. They find that, conditional on

adoption, low-income, less-educated consumers spend more time online than their higher income, more educated counterparts, a result that is best explained by differences in the opportunity cost of leisure time according to the study.[14]

In their study of fixed broadband adoption, Ford, Koutsky, and Spiwak (2008) study the per capita broadband subscription rate for each OECD country as found in the OECD Factbook and the World Bank's World Development Indicators, and include demographic explanatory variables such as country-specific data on income, age, education, and household size, among others. Using stochastic frontier analysis, the authors estimate a broadband efficiency index that indicates the technical efficiency with which a country is able to convert its demographic and economic endowments into broadband subscriptions. Given the developed index, they conclude that most (two-thirds of all) countries perform very well in terms of converting their endowments into broadband subscriptions, and that Belgium, Iceland, and Portugal are exceptional performers.[15] A key result is that such demographic and economic endowments are found to explain 91 percent of the variation in broadband subscriptions across countries. The authors state that "demographic and economic conditions so pervasively drive the broadband subscription per capita number that utilizing the 'ranking' of OECD countries, conditioned only on population, to advocate for or against broadband policy changes is nonsensical."[16] They assert that public policy aimed at reducing adverse effects of poor economic conditions may be more appropriate than any particular broadband policy.

D. Impacts of Broadband on Various Economic and Social Factors

We now turn our attention to the impacts of broadband on a variety of factors. The economic importance of broadband is well accepted, and studies of fixed broadband deployment are numerous. Holt and Jamison (2008) provide an overview of various economic impact studies, but such studies of broadband's effects always suffer from the problem of endogeneity (i.e., information that comes from the model cannot be used to explain the model). For example, if it is observed that economic development and broadband adoption are positively correlated, how does one know whether economic development results from broadband adoption, leads to broadband adoption, or both? The accepted wisdom is that broadband is both a cause and an effect of economic development. This means that the important research question is to determine the net impact of broadband on an array of economic and social variables, given that certain qualities of these variables must be in place before broadband can make its impacts.

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[14] Our findings indicate that broadband usage is increasing in income and education. This contrasts with the Goldfarb and Prince study, but does not contradict it. Their finding relates to all Internet usage and shows that time is less valuable for lower income and less educated households. This time preference could lead lower income, less educated customers to use more dialup Internet than broadband, leaving open the possibility that once a customer has adopted broadband, the customer's usage might be positively correlated with income and education.

[15] "Portugal, with a raw subscription rank of 23rd, is actually the 3rd best performer with a BEI [broadband efficiency index] of 0.983." The country's expected subscription is reduced by its unfavorable endowments for GDP, GINI and education (Ford *et al.*,(2008), page 15).

[16] See Ford *et al*, (2008), page 16.

We begin our discussion of the effects of broadband by considering the impacts on productivity and innovation. We then turn our attention to effects on national wealth or income, job and business development, education, healthcare, and the like.

i. Productivity, Investment, and Innovation Effects

We begin our review of the effects of broadband on productivity and innovation by examining the literature related to the effects of information and communications technologies (ICT) overall.

Economists were long puzzled by an apparent disconnect between the anecdotal evidence of the impact of ICT on productivity and the measureable effects of such impact. This disconnect has not been entirely resolved, but in his Presidential Address to the American Economic Association in 2001, Jorgenson (2001) observed, "The development and deployment of information technology is the foundation of the American growth resurgence." Research by Jorgenson and other prominent academicians has shown that this assertion applies not just to the United States, but to almost every country of the world.

Consider a study by Röller and Waverman (2001) that examined how telecommunications development affected economic growth in the OECD countries from 1971 through 1990. The study's central finding was the existence of a significant positive causal link between telecommunications development and economic growth, especially prevalent when telecommunications infrastructure hits a critical mass, namely the level at which it has achieved nearly universal service. Röller and Waverman found that telecommunications development was the cause for about one-third of the economic growth in the OECD economies from 1971 through 1990, amounting to about US $1,700 per person per year on average. This represents an improvement of about 10 percent in per capita gross domestic product over the base year.

Röller and Waverman explain that the link between telecommunications development and economic growth generally is attributed to spillovers and externalities: when one portion of the economy adopts telecommunications to improve its productivity, this adoption has positive spillovers on the productivity of other portions of the economy. For example, improved methods for managing inventory lower costs for businesses, which lead to lower prices for consumers. These lower prices give consumers additional discretionary income that they can then use for savings, investment, education, or other pursuits that improve their standard of living. Furthermore, when one portion of the economy, say banking, increases its use of telecommunications, other portions of the economy also adopt the use of telecommunications so as to better work with the banking sector.

Waverman, Meschi, and Fuss (2005) addressed similar issues for developing countries. They examined mobile phone development from 1996 through 2003 and found that it had a positive and significant impact on economic growth, and that "this impact may be twice as large in developing countries compared to developed countries." The authors further deduced that "differences in mobile penetration between developing countries

might generate significant long-run growth benefits for the mobile leaders." Because there are significant differences in the penetration and diffusion of mobile telephony across developing countries, the study "results suggest that this gap will feed into a significant difference in their growth rates in the future."

ICTs improve productivity by creating opportunities for further investment and growth, saving costs, and improving labor force skills. According to the International Institute for Communication and Development, ICT development provides small- and medium-sized enterprises (SMEs) with the ability to boost productivity, access international markets, and improve customer service. These opportunities have come about in part because of the drastic fall in ICT prices in the past 10 years, which has made computing, telephony, and Internet affordable for SMEs (iConnecT Online, 2007). In India, for example, mobile phones are enabling fishermen to find the most profitable market in which to sell their daily catch. This opportunity to sell where demand is greatest has eliminated much waste and variations in market prices, causing consumer prices to fall by 4 percent and the fishermen's profits to rise by 8 percent. (Economist.com, 2007).

Using data from 1984-1996, Correa (2006) examined the effects of ICT in the United Kingdom. She found that most industries benefited from the incorporation of advanced telecommunications technology. Advanced ICT had spillover effects for the economy as a whole, in no small part because of lower prices for numerous products. For example, investments in advanced telecommunications lowered prices for basic utilities by 4.3 percent, for transportation services by 10.8 percent, for financial institutions by 27.3 percent, and for telecommunication providers by 56 percent. Overall, prices in the economy were 14.1 percent lower because of the application of advanced telecommunications. In terms of productivity, Correa (2006) found that applying advanced telecommunications improved productivity in the manufacturing sector 31 percent, improved productivity in construction 59 percent, and improved productivity in the financial sector a dramatic 486 percent. Productivity overall improved over 100 percent.

Another way that ICT development has stimulated economic growth is through encouraging investment. Jorgenson (2001) and Jorgenson and Vu (2007) show that declines in information technology (IT) prices were key drivers in the resurgence in economic growth around the world and that the greatest gains were from businesses investing in information technologies, not from changes in those businesses' productivity. For example, in Jorgenson and Vu's study of 14 major economies in the world and the world's seven primary economic regions, he finds that productivity growth accounted for less than one-fifth of the total (economic growth) during 1989-1995, while investment accounted for more than four-fifths. "Similarly, investment growth contributed almost three-quarters of growth from 1995-2000 and more than three-fifths from 2000-2004" (Jorgenson and Vu, 2007). In summary, Jorgenson's and Vu's research demonstrates that IT contributes to growth primarily by transforming an economy. This transformation provides growth by stimulating investment, not merely by making businesses more productive in doing the same thing.

As Holt and Jamison (2008) explain, the impacts of ICT include innovation in addition to productivity and investment. Indeed, as Schwab and Porter (2007) explain, countries

with the most competitive economies are those that are innovation-driven. Success in innovating depends on a country's speed in adopting the latest communications technologies and incorporating such technologies into their businesses to create new products and processes.

Van Ark and Inklaar (2005) provide further insights into the relationship between ICT investments, productivity, and innovation. They find that the effects of ICT within a country may be U-shaped. An initial upswing in productivity is followed by negative productivity growth for a period as businesses learn how to exploit the new technology. During that period, businesses invest in ways that do not immediately translate into added productivity as they reorganize their operations and make personnel changes. After this learning period, the businesses are able to create new products and new ways of doing business, resulting in a higher overall impact of ICT.

ii. ***Impacts on National Income, Jobs, and Business Development***

The studies on productivity, investment, and innovation to date have focused on the impacts of ICT, presumably because the impacts take time to develop and the history of broadband is short. However, some studies are beginning to show that broadband can impact national income.

Crandall *et al*. (2007) applied a cross-sectional data analysis of US broadband penetration data to determine the economic impact of broadband deployment on growth in state-level gross domestic product (GDP) and other economic variables, finding that increasing broadband lines per capita increases GDP. Ford and Koutsky (2005) corroborate this finding with their analysis of a Florida county served by municipal (as opposed to privately provided) broadband. Ford and Koutsky assert that the county experienced a 128 percent growth in sales per capita more than its peers due to the municipal broadband network.[17]

Gillett *et al*. (2006) performed a study for the US Department of Commerce using a cross-sectional panel data set of communities disaggregated by zip code, to analyze the effects of broadband on US communities between 1998 and 2002. The analysis was based on communities with broadband availability in December 1999, and did not distinguish between the type of provider, technology, or speed level. The authors found that broadband contributed to greater job growth and a greater number of businesses than otherwise would be expected without broadband. Crandall *et al*. (2007) also examined job impacts, concluding that increasing broadband penetration increases the number of jobs.

Like the study by Gillett *et al*. (2006) and Crandall *et al.* (2007), Shideler *et al*. (2007) does not address broadband use but rather broadband deployment, and none of the studies differentiate broadband speeds. Still, Shideler *et al*. find that broadband availability contributes to employment growth in most industries to some degree. Ford

[17] As Holt and Jamison (2008) explain, such studies face challenges with respect to the selection of comparable counties because the economies of Florida's counties were affected differentially by the aftermath of attacks on the World Trade Center in New York in 2001 and by hurricanes in 2004.

and Koutsky (2005) corroborate this finding. Additionally, Van Gaasbeck *et al*. (2007) perform a similar analysis using counties in California during the years 2001 – 2006. They find that broadband deployment contributed to employment growth and total payroll growth.

Clearly research has proven that advanced communications technologies have a significant economic impact across countries and increasingly so, as such advanced technologies are more rapidly deployed. Unfortunately, rarely does any research include usage or adoption patterns, and deployment may be considered an imperfect proxy for actual broadband use.

iii. ***Impacts on Education and Health Care***

We do not attempt to provide a comprehensive review of the effects of broadband on education and health care; instead, we highlight some key studies that inform us on the merits of developing broadband indices, which we address below.

One set of studies on the impact of broadband on education has been the reports commissioned by Becta (British Educational Communications and Technology Agency). In the first commissioned report, Underwood *et al*. (2004) focused on largely qualitative evidence from a small sample of schools in the U.K. The goal of the study was to identify potential benefits of a broadband-enhanced learning environment including effective use of video conferencing and online interactions. In the second study (Underwood *et al*., 2005), the authors found that broadband changes the way pupils learn and construct their work, changes the ways teachers organize lessons and work with colleagues, and changes the way schools administer courses. Following the studies of how ICT changes businesses, the study found that broadband technologies increasingly are seen as a catalyst for curriculum change, and that such technologies challenge the current assessment system.

A Canadian survey (Selouani and Hamam, 2007) found similar impacts of broadband use in education. The survey respondents indicated that broadband provided e-learning opportunities, increased research capabilities for students, and allowed for increased long distance interactions for students.[18]

In early research on the impacts of broadband on health care, Wright (1992) showed that broadband could improve management and bring production efficiencies. In a study of the effects of mobile wireless for CTIA-The Wireless Association®, Entner (2008) found that "In 2005, productivity improvements due to use of mobile broadband solutions across the U.S. health care industry were worth almost $6.9 billion. By 2016, that number will triple to $27.2 billion, or twice the size (according to Bizstats.com) of the current vocational rehabilitation sector of the health care industry." A U.K. report (Broadband Stakeholders Group, 2004) found that broadband can improve healthcare for the elderly by allowing them "the support they need to live at home, rather than in

[18] The study also found that broadband decreased travel, gave access to online newspapers, and allowed for financial transactions.

hospital or care homes." Applications include tele-monitoring of health conditions and scheduling appointments.

E. Implications for Broadband Indices and Rankings

As we indicated previously, broadband indices and rankings have proven to be problematic and controversial. Wallsten (2008) and Ford, Koutsky, and Spiwak (2008) highlight problems with the OECD's broadband index, including problems of variations in household size, geographic and economic endowments, and incomplete data. In addition to these deficiencies specific to the OECD index, any broadband index would suffer from the intellectual misconduct of valuing in a single number the multiple effects of the variety of broadband services. The impact studies that we cite above show that broadband affects jobs, income, productivity, education, and the like, and that the effects are not uniform across segments of the economy. A scalar cannot adequately express these multidimensional effects, and indeed may not even be informative. Furthermore as our immediate study and some of the studies that we review above indicate, while different broadband technologies are at least somewhat substitutable, they are not homogeneous, meaning that they cannot easily be combined into a single numerical representation without first converting their quantities into comparable units. Lastly, even if such conversions are made, no single conversion factor can represent all impacts that are of importance.

F. Consideration of Reports and Studies Particularly Relevant to Portugal

In March 2000 the Lisbon strategy proposed to create among the EU Member States the most competitive and dynamic knowledge-based economy by 2010. The strategy included a focus on extending Internet connectivity to result in widespread Internet access availability at reasonable prices. In 2007, the Strategic Report on the renewed Lisbon strategy set targets for high speed Internet usage of 30 percent by 2010, and the June Council Conclusions added a target penetration rate of at least 15 percent. Finally, the Council Conclusions commissioned a Broadband Performance Index designed to benchmark Member States on factors deemed important (such as speed and affordability). Two primary drawbacks, however, are that wireless is not included in the index (or data measuring compliance with the Council Conclusions), and penetration rates do not include information on availability. It is within these conditions that the Portugal broadband Internet access market operates.

Broadband access to the Internet was offered in Portugal through cable modem technology beginning in 1999. In 2000, the telecommunications industry was fully liberalized, and local loop unbundling was mandated in 2001. Subsequently, the telecommunications incumbent Portugal Telecom (PT) began offering broadband Internet access through ADSL, and currently offers broadband Internet access both through DSL and cable.[19]

[19] Pereira and Ribeiro (2006).

Among EU Member States, Portugal has the highest ratio of fixed broadband subscribers using a provider other than the incumbent. However, Portugal also has one of the lowest growth rates in fixed broadband. In fact, by the broadband performance index developed, Portugal ranks poorly - in the fourth of five clusters. The 2008 ITIF Broadband Rankings listed Portugal as 18th, with a composite score only slightly higher than average (10.15 compared to an average of 10.00).[20] These seeming discontinuities can be reconciled with consideration of mobile broadband Internet access. Currently Portugal residents increasingly are using mobile broadband. Portugal makes intensive use of mobile communications services with 58 percent of voice traffic originating from mobile networks. The mobile market also is credited with exhibiting low churn and high customer loyalty. It appears, then, that mobile technologies are important to consider in any measure of broadband Internet access within the country.

A 2008 working document (Indexing Broadband Performance) defines broadband penetration as the number of fixed broadband lines divided by the national population. This measure excludes mobile broadband, which for Portugal may be significant. Pereira and Ribeiro (2006) estimate demand elasticities for broadband Internet access and find that broadband and narrowband access are substitutes in Portugal. This suggests that mobile broadband Internet access should be included in datasets and measurements of deployment and adoption. Two recent studies will be useful in helping to identify whether mobile broadband Internet access is indeed an important component to Portugal's broadband Internet deployment and adoption, and in calculating the magnitude of that importance, if any.

The first paper is a 2007 study by Cardona, Schwarz, Yurtoglu and Zulehner. This paper analyzes residential demand for Internet access in Austria, with a focus on both fixed and mobile broadband Internet access, specified by type (DSL, cable, mobile, and narrowband). The study analyses residential demand for Internet access in Austria using survey data collected by the Austrian Regulatory Authority for Broadcasting and Telecommunications. They include DSL, cable, and mobile broadband via Universal Mobile Telecommunications Service (UMTS) or High-Speed Downlink Packet Access (HSDPA) to determine appropriate market definitions for these advanced services. Results of the study indicate that the different broadband technologies are in fact substitutes in that the technologies constrain one another. Elasticity for DSL is given as -2.545, and elasticities for mobile broadband and cable are similar, though broadband services are found to be more elastic than narrowband services (as found by others).The authors assert that because mobile broadband was not highly utilized, it was not evaluated against DSL and cable together (i.e., it was singled out as narrowband was).

The second relevant paper is by Lee and Marcu (2008). This paper uses 1999-2005 OECD data to analyze the factors that influence the diffusion of fixed and mobile broadband. The authors focus on variables capturing the unbundling of the local loop and the existence of platform competition, as well as socio-economic and demographic factors. They find that PC penetration, population density, and broadband content are associated with faster fixed broadband diffusion, and that market-based multiple

[20] ITIF 2008.

standards policy contributes to the diffusion of mobile broadband services. The paper also provides an informative summary of primary empirical studies on fixed and mobile broadband studies; however, almost all of the studies of mobile broadband were conducted in 2002 or before, prior to mobile broadband Internet access being utilized in any statistically significant degree.[21] Lee and Marcu attempt to discern whether fixed and mobile broadband are substitutes or complements, but the results are inconclusive.

These studies are the primary references that inform the models that we develop. Following is a discussion of the data that we use for our study.

III. Data

In this section we describe the data that we use for our analysis. We draw upon data largely obtained from three surveys conducted in Portugal in 2006 and 2008.[22] The surveys were stratified by geographic regions of the country that correspond generally with the Nomenclature of Territorial Units for Statistics (NUTS II) geographical coding used by the European Union to indicate divisions of countries for statistical purposes.[23]

A. Socio-Economic Characteristics of Regions in Portugal

In order to properly analyze our data, it first is important to characterize that data so that we may fully understand socio-demographic and possibly geographic factors that might affect broadband diffusion and adoption. In the OECD's Territorial Review (2008), Portugal was described as having the fourth highest level of regional disparity in terms of GDP in the OECD.[24] Such disparity indicates that significant differences in other characteristics may exist, and therefore caution must be taken to correctly analyze broadband adoption and diffusion across regions. Below we provide a brief discussion of the representation of respondents in our sample.

Our data is disaggregated into nine regions that correspond generally to the seven regions indicated in Map 1[25]. Map 1 does not differentiate Grande Porto or Interior (which are part of Centro), and Grande Lisboa (which is part of Lisboa). Table 1 maps

[21] See Lee and Marcu (2008), page 19.

[22] Specifically, we use data from the following surveys: 2006 Consumo de Banda Larga survey (broadband consumption survey, abbreviated as BCS), 2008 Inquérito ao Consumo das Comunicações Electrónicas survey (survey of consumption of electronic communication services, abbreviated as ICSCE), and 2008 Índice Europeu da Satisfação de Consumidor (European consumer satisfaction index, abbreviated as ECSI). Surveys also were conducted in 2007 however that data was not utilized in our analyses because we were unable to match survey responses to price data (which would have allowed us to generate price elasticities) and could not generate a panel of all three years of data due to differences in survey design (see the Executive Summary for additional detail).

[23] Although there is a NUTS II categorization in the 2006 survey, we chose to use an alternate geographic segmentation from that survey because the latter allowed more categories and the methodology section of the survey presented the number of observations by region according to that categorization. A listing of the number of observations and frequency by region for each categorization is provided in the Appendix (Tables A.2.1 and A.2.2)

[24] See OECD (2008), page 41.

[25] Map from ICP_ANACOM from the Instituto Nacional De Estatistica available at www.ine.pt.

the nine regions from the survey to the regions shown in Map 1, and provides population per square kilometer and per capita GDP for each region.

Name in Survey	Alternate Name in Above Map	Population in Millions (% of the total)	Area (km^2)	Population Density 2007 (No./ km^2)	GDP per Capita - Current Prices 2007 (base 2000 - €1.000)
Açores	Região Autónoma dos Açores	0.2 (2%)	2,322.00	105.1	13.7
Alentejo	Alentejo	0.8 (7%)	31,551.40	24.1	14.7
Algarve	Algarve	0.4 (4%)	4,996.00	85.3	16.1
Centro Litoral	Centro	2.4 (22%)	28,200.40	84.6	13.1
Grand Lisboa[a]	[Sub region of Lisboa]	0.6 (6%)	85.00	6,650.9	25.2
Grand Porto[b]	[Subregion of Norte]	1.6 (15%)	817.00	1,924.3	n/a
Interior[c]	[Subregion of Centro]	n/a	n/a	n/a	15.3
Madeira	Região Autónoma de Madeira	0.2 (2%)	801.00	308.0	19.6
Norte Litoral	Norte	3.7 (35%)	21,284.60	176.0	12.2

a., b, c.: population density data from Instituto Nacional de Estatistica, available at ww.ine.pt; GDP data from Eurostat News Release (2009). Remaining data provided by ANACOM.

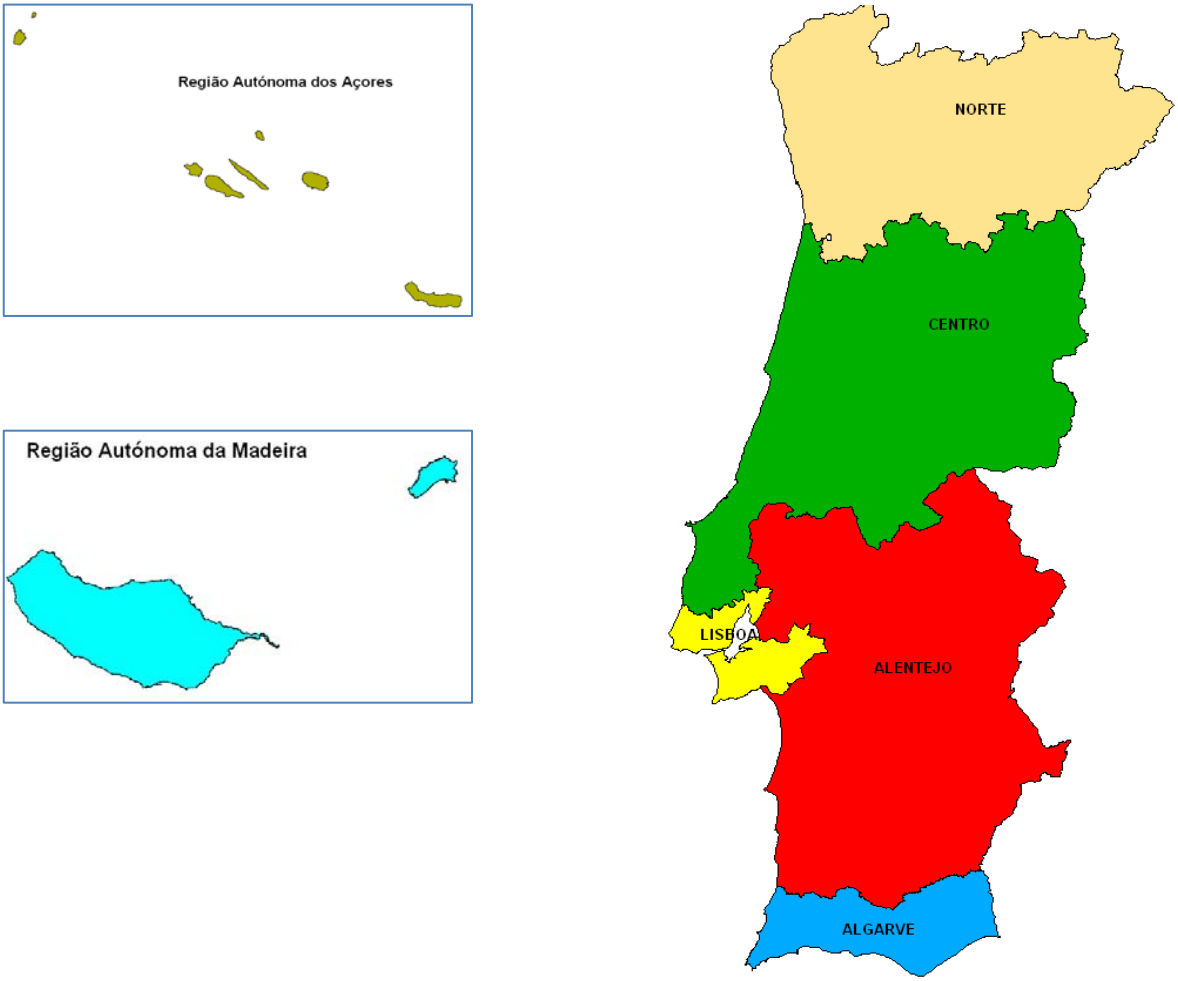
Table 1. Primary indicators by region, 2006

Our analyses are based on the regions as named in the survey rather than on the geographical designations shown in Map 1. Therefore, the primary demographic indicators provided in Table 1 should be considered as reference information useful for categorizing results of our analyses rather than precise factors used in such analyses.

B. Socio-economic Characteristics of Data Included in Our Analyses

Our data are largely obtained from the surveys conducted in Portugal. The 2006 survey titled “Consumo de Banda Larga” was conducted through telephone interviews using a computer assisted telephone interview (CATI) system. The questionnaire was

developed by ICP-ANACOM to obtain information on broadband deployment, adoption, and customer satisfaction, and was adapted by MetrisGfK, which undertook the survey. The field work was completed between 27 October and 21 December 2006 by 65 interviewers, who were recruited and trained by MetrisGfK to conduct the study. All calls were initiated between 18h and 22h.



Map 1. Regions of Portugal

The sample consists of approximately 8,600 responses from interviewees aged 15 and older who reside in Portugal. Households that were called were selected randomly starting from a stratification matrix that included the region and habitat of the population settlements. The matrix crossed the variables gender, age, and education in agreement with the categorization requested by ICP-ANACOM in order to guarantee a proportional distribution of the sample for each region relative to the Portuguese population in general. This method of selection appears to have been successful. Tables 2.1 and 2.2 provide summary statistics of key demographic and socio-economic indicators by region as represented in our 2006 Consumo de Banda Larga (BCS) survey and 2008

Inquérito ao Consumo das Comunicações Electrónicas (ICSCE) survey samples, respectively.

Region	Number Obs. & (% of total)	Age	Education[a]	Two or More Cars[b] *(1 = yes)*	Home Internet Use	Access Internet by Phone (given home use)	No Computer
Açores	189 (2.1%)	42.07	4.69	0.13	29%	84%	6%
Alentejo	421 (4.8%)	49.53	4.74	0.15	30%	60%	2%
Algarve	325 (3.7%)	47.19	4.22	0.09	31%	74%	7%
Centro Litoral	1355 (15.6%)	47.46	4.19	0.24	41%	48% (50% cable)	2%
Grande Lisboa	2244 (25.9%)	46.41	3.80	0.20	46%	46% (51% cable)	4%
Grande Porto	1106 (12.7%)	43.56	3.96	0.34	49%	81%	4%
Interior	1241 (14.3%)	48.04	4.60	0.35	36%	72%	4%
Madeira	197 (2.3%)	43.68	4.62	0.03	43%	80%	1%
Norte Litoral	1598 (18.4%)	42.42	4.46	0.40	40%	38% (61% cable)	3%
Total/Average	8676	45.73	4.22	0.27	41%	61%	3%

a. 1 indicates that the head of the household has a university education (and is the reference group); 2 = polytechnical institute graduate; 3 = high school graduate; 4 = completed nine years of study; 5 = completed six years of study; 6 = completed elementary school; 7 = uneducated/illiterate.
b. This variable serves as an indicator of wealth in our analyses.
Source: authors' calculations based on 2006 BCS.

Table 2.1 Means of responses by region for key socio-economic variables, BCS, 2006

Education levels vary across the regions, with the highest education levels (indicated by low means in Tables 2.1 and 2.2) being in the most urban and highest income areas (Grande Lisboa and Grande Porto), and the lowest education levels being in some of the lowest income regions (for example Madeira and Alentejo). In our econometric models we use cars per household and ownership of a dishwasher as indicators of wealth or income. Other factors influence both these choices, such as whether the household is in an urban area and how many people reside in the household; however,

our models control for these factors, so the remaining variation should be an indicator of income.

Region	Number Obs. & (% of total)	Age	Education[a]	Dish-washer[b] *(1 = yes)*	Home Internet Use	No Computer
Açores	780 (21.67%)	48.17	5.92	0.31	30%	48%
Alentejo	170 (4.72%)	51.76	5.71	0.42	31%	55%
Algarve	87 (2.42%)	47.62	6.06	0.25	14%	85%
Centro	493 (13.69%)	51.83	6.22	0.33	21%	60%
Lisboa	591 (16.42%)	47.47	5.32	0.49	39%	43%
Madeira	780 (21.67%)	43.99	5.96	0.17	32%	49%
Norte	699 (19.42%)	41.33	5.71	0.26	22%	62%
Total/Average	3600	46.48	5.82	0.31	29%	53%

a. 1 indicates that the head of the household has a university education (and is the reference group); 2 = polytechnical institute graduate; 3 = high school graduate; 4 = completed nine years of study; 5 = completed six years of study; 6 = completed elementary school; 7 = uneducated/illiterate. In this table we provide disaggregation by region; in the estimates we use three categories (primary school, high school, and university) because we have too few observations to split the data into as many categories as is done with the 2006 data.
b. This variable serves as an indicator of wealth in our analyses.
Note: There is no column for "Access Internet by Phone" as in Table 2.1. This is because only 103 individuals reported having narrowband. Of these, 77 did not say whether they had another type of Internet access or not. Of the other 26, all but 5 had another type of access that was their main type of access. Hence, the small number of observations and many missing observations render this information unreliable in our view if we further split it by region.
Source: authors' calculations based on 2008 ICSCE.

Table 2.2. Means of responses by region for key socio-economic variables, ICSCE, 2008

On average, in 2006 about 40 percent of Portugal households accessed the Internet from their homes. Of those with home Internet access, 61 percent on average used dial-up Internet access (as indicated by the "Access Internet by Phone" column), but that proportion is shrinking. Norte Litoral, Grande Lisboa and Centro Litoral had greater home Internet access via cable than by phone (as indicated in parentheses in the second-to-last column of Table 2.1). Lack of a computer at home does not appear to be an obstacle to Internet access as on average only 3 percent of households reporting not having a computer.

Table 3 provides summary statistics for the primary characteristics data and additional variables for the aggregated sample from the 2006 survey.

Variable (2006 BCS survey data; all respondents)	Observations	Mean	Standard Deviation	Minimum	Maximum
Age	8676	45.73	18.82	15	97
Gender (1=male; 2=female)	8676	1.52	0.50	1	2
Education (1= university; 7=illiterate)	8676	4.22	1.95	1	7
Employed (1=employed; 2=unemployed)	8676	1.61	0.64	1	2
Number in Household	8619	3.70	1.30	1	20
Child in Household (1=yes;2=no)	8676	1.59	0.49	1	2
Have TV (1=yes)	8676	0.99	0.07	0	1
Have Two or More Cars (1=yes)	8676	0.27	0.44	0	1
Have Two or More Homes (1=yes)	8676	0.07	0.26	0	1
Home Internet Use (1=yes)	8676	1.59	0.49	1	2
No Computer (1=has no computer)[a]	5058	0.03	0.18	0	1
Work Access (1=has work access)[b]	5058	0.02	0.15	0	1

a. Question P.6 in the 2006 survey asks respondents who stated they did not have Internet at home the following question: Could you please tell me what is the main reason why you do not have Internet at home? Those who answered "We don't have a computer" are coded 1 here.
b. Question P.6 in the 2006 survey asks respondents who stated they did not have Internet at home the following question: Could you please tell me what is the main reason why you do not have Internet at home? Those who answered "Have access at work" are coded 1 here.
Source: authors' calculations based on 2006 BCS.

Table 3. Summary statistics for survey data, BCS, 2006

The 2008 survey, titled "Inquérito ao Consumo dos Serviços de Comunicações Electrónicas" or survey of consumption of electronic communication services (ICSCE), was conducted by TNS-Euroteste for ICP-ANACOM. Those surveyed were individuals 15 years of age or older, living in a residential household in Portugal. The sample is representative to level NUTS I.[26] There are a total of 3,600 respondents, the majority (approximately 57 percent) from the continent (rather than Açores or Madeira).

[26] NUTS I stands for the Nomenclature of Territorial Units for Statistics, the statistical regions of Europe as defined by the European Union. Additional information is available at: http://ec.europa.eu/eurostat/ramon/nuts/home_regions_en.html. It is the broadest method of geographical coding in that it divides Portugal between the mainland and the autonomous regions of the Azores and Madeira archipelagos. NUTS II (upon which our more detailed geographic data is based) includes the seven regions referenced above.

Households were selected through a proportional random sampling stratification as was done for the 2006 survey, in accordance with the General Census of the Population (2001) of the National Institute of Statistics (I.N.E.). Surveys were conducted by personal interview attended by computer using Computer Assisted Personal Interviewing (CAPI). All surveys were conducted between November 5 and December 29, 2008.

A primary benefit of the 2008 ICSCE data is that nomadic broadband users are included. While the raw number (133 nomadic respondents total) is too small for most empirical models, we are able to discuss possible patterns and compare nomadic usage factors and socio-demographic characteristics with those of fixed and mobile respondents.[27]

We categorize nomadic users based on their responses to 2008 ICSCE survey question Q.93, "What type of Internet connection do you use at home?" Responses were as follows: modem or ISDN (1), ADSL or other XDSL access (2), cable (3), mobile phone or PDA with broadband Internet connection (4), phone connected to Internet through narrowband (5), broadband wireless connections other than mobile phone and PDA (6), data transmission cards (7), and other or do not know, which also were coded responses. By these categories, respondents answering (6) were considered nomadic users (those answering 4 and 7 were considered mobile).[28] Table 4 provides summary statistics for the 133 respondents reporting nomadic broadband use in the 2008 ICSCE survey.

Figures 1 and 2 provide additional insights into patterns in nomadic usage. Nomadic usage is most prominent in the Alentejo region. This region is characterized by average income for the country, relatively low educational attainment, the lowest population density of all regions, and low home Internet penetration. It also has the highest average age. This may indicate that nomadic is a useful form of access for areas for which fixed line broadband is costly to provide (for example due to high marginal cost in the sparsely populated areas) or difficult to afford (as evidenced by relatively low income and education). The data in Figure 2 also indicate that nomadic broadband is more common among highly educated individuals than among others, perhaps indicating that professionals find nomadic access to be suitable to their careers and lifestyles.[29] We examine the relationship between nomadic subscription and hotspot availability later.

Because there are so few observations of nomadic broadband users, statistical significance is not measurable. Our figures do provide guidelines for further consideration of relevant characteristics of nomadic broadband users as data becomes increasingly available.

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[27] Of these 133 respondents, ten also had other types of access that they reported using more frequently than nomadic (from question 94). Therefore, for 122 respondents, nomadic was the reported as being the primary method of Internet access.

[28] The frequency of responses is provided in the Appendix in Tables A.3.1 and A.3.2.

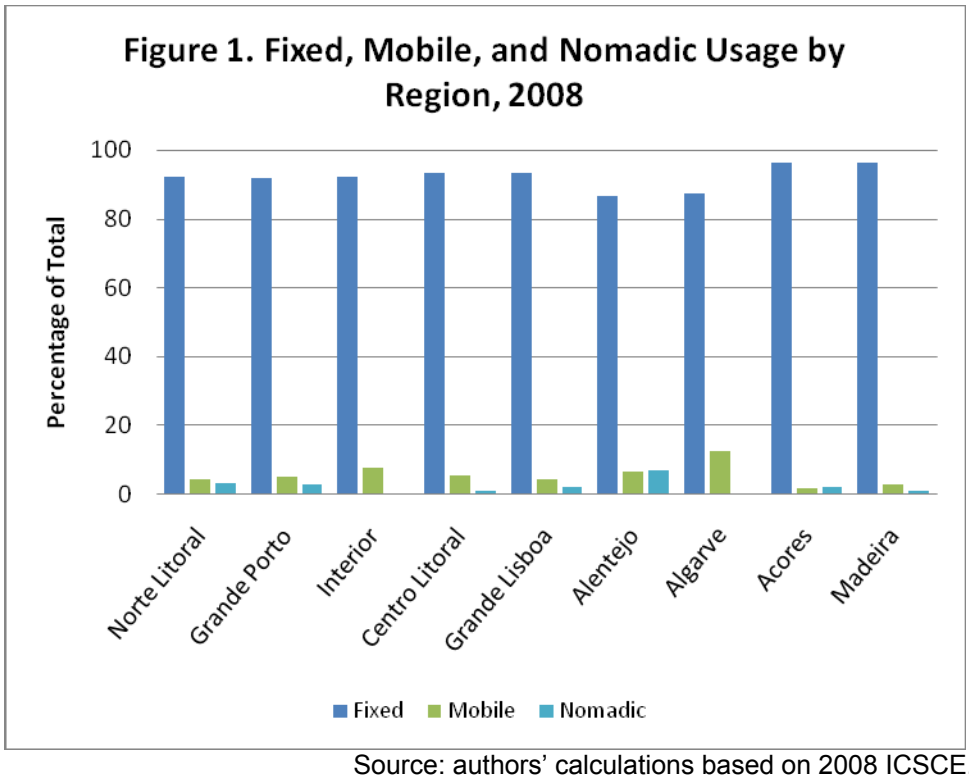
[29] Future research may not compare directly with our data because some education designations in Portugal are changing.

We also obtained data from the 2008 Survey of Consumers of Electronic Communication Services (ECSI), which provides additional information used in various models that follow. Those surveyed were individuals older than 15 years of age living in Portugal in households with fixed or mobile telephone. Surveys were administered over the phone. Households surveyed were randomly selected with equal probability and without replacement. There are a total of 1,243 respondents.

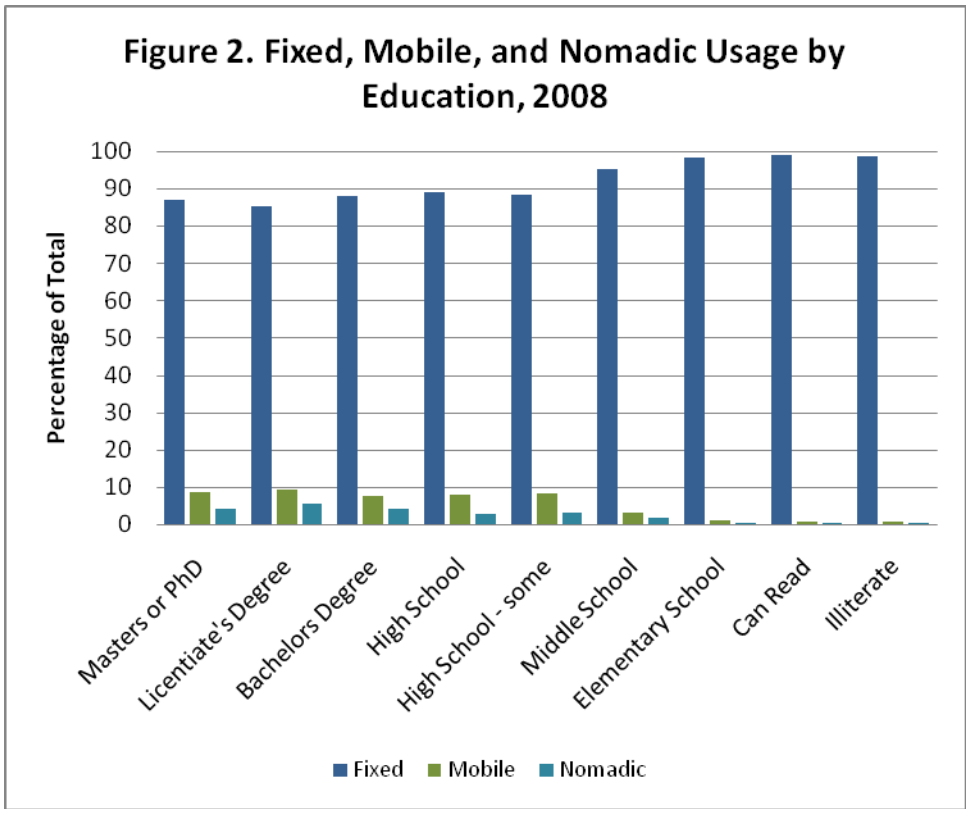
Variable (2008 ICSCE survey data; nomadic respondents)	Mean	Standard Deviation	Minimum	Maximum
Age	32.90	12.80	15	65
Education (1= university; 7=illiterate)	4.51	1.60	1	9
DVD (1 = have)	0.83	0.38	0	1
Gamebox without Internet Access[a] (1 = have)	0.35	0.48	0	1
Frequency of Use (1=daily+; 4= less than weekly)	1.83	0.95	1	4
Level of Overall Satisfaction (1=dissatisfied; 10 = satisfied)	7.14	1.53	1	10
Level of Satisfaction with respect to Speed (1=dissatisfied; 10 = satisfied)	6.97	1.75	1	10
Complaint Filed (1 = yes)	0.076	0.27	0	1
Switched Provider (1 = yes)	0.097	0.30	0	1

a. There are two questions in the 2008 ICSCE survey about the use of a gamebox: one considers gamebox without Internet access (P12_6), and one considers gamebox with Internet access (P12_7). We used the mean and standard deviation of the former variable. Of the 132 users who had nomadic access, 47 (approximately 36 percent) had a gamebox without Internet access, whereas only 14 (approximately 10 percent) reported having a game box with Internet access. The mean and standard deviation of those (133 users) reporting to have either type of gamebox (with or without Internet access) is 0.402 and 0.492, respectively.
Source: authors' calculations based on 2008 ICSCE.

Table 4. Summary statistics for nomadic broadband users, ICSCE, 2008



Source: authors' calculations based on 2008 ICSCE.



Source: authors' calculations based on 2008 ICSCE.

While this survey data does not include household specific demographic data segregated by region, we do have a limited amount of socio-demographic information. Of the sample, 691 respondents (approximately 56 percent) were male, and the majority (57 percent) was employed; approximately 25 percent were students. Finally, we have information on the educational attainment of respondents. Approximately 33 percent had completed high school, 21 percent completed ninth grade, and 30 percent had earned a licentiate's degree. While the data allow us to conduct some analyses, we are limited in our ability to use models comparable to those employing the BCS, ICSCE, and ECSI data.[30]

Also, while the ICSCE survey data have information about plan speed and type of tariff (prepaid, post-paid, billing by minute), that data does not include how much households actually spent on broadband; therefore, it is not possible to match the data on plan characteristics with the household survey because there are no common identifying variables.[31]

C. Strengths and Weaknesses of the Data

We have identified what we believe to be the strengths of the data with respect to its usefulness for studies that inform mobile broadband adoption and usage patterns. First, household level data allows us to capture socio-economic and demographic characteristics that can be tied to patterns of adoption and usage. Also, we know which respondents switched providers (either due to dissatisfaction or to other reasons) and often, which providers lost and gained customers. Finally, we know the main reason respondents chose a particular Internet provider, or chose not to subscribe to any Internet plan.[32]

We also have identified a number of limitations of the data. The primary drawback is that similar to prior studies and as mentioned above, we have limited information regarding plan characteristics (price primarily, nominal and actual speed[33], and volume of traffic). Indeed the 2006 BCS survey contains no price information. Limited price measures adversely affect our ability to produce robust estimates of demand and the degree of substitution between fixed and mobile broadband, as well as between

[30] The ECSI survey indicates the operator and has some dummies for speed, although this is missing for 569 of the approximately 1200 Internet users. The ECSI survey data does include plans for the same operator with the same speed, and combinations of different bundles, among other data.

[31] Approximately 170 households that have Internet at home could be matched to the plan information collected by ANACOM.

[32] Of note, a consumer with Internet bundled with other services has a lower predisposition to switch providers, and may be tied to fixed rather than mobile broadband due to the nature of bundled options offered in Portugal; therefore, bundles represent an important factor to include in the models. However to date, we have been unable to include the existence of bundles available to residential consumers as only respondents who did not know (or report) the name of their plan were asked questions with respect to bundling. If we include a dummy for bundling we lose approximately 1500 of 2200 observations. We chose to exclude bundling and run the models without the dummy variable because it was insignificant in those cases in which we did incorporate it.

[33] We understand that there may be important differences between business and residential speeds that should be considered. To date, we have been unable to find separate information for residential and business users.

narrowband and broadband. Also, while the 2006 data varies by household, it does not contain information on Internet plan chosen. This prevents us from modeling the choice of different plans, and also the choice between major access categories like narrowband and broadband. Other limitations of the data include too few respondents in several categories (for example only five respondents have broadband over power line, which is not enough observations to include in analysis), and non-informative responses, such as "no particular reason."

IV. Analyses and Results

In this section we provide our analyses and model results.[34] The results of the models are robust and provide interesting insights into broadband usage. These results are provided and discussed based on the objectives as set forth by ICP-ANACOM. Complete model results are provided in the Appendix, also separated by objective.

A. Identification, Comparison, and Analysis of the Adhesion Factors of Fixed, Nomadic, and Mobile Broadband.[35]

Analysis of adhesion, or customers' propensity not to change service providers, is important for understanding how markets are performing. A tendency for customers to change providers implies that customers perceive that the possible benefits of changing providers are greater than the cost and risk of changing providers. The possible benefit of changing is the difference between what the customer experiences as his or her net consumer surplus with the current provider and the expected net consumer surplus with a new provider, where net consumer surplus is the difference between value that the customer believes the operator provides and the price the customer pays. If the benefit provided by the current provider is close to what the customer thinks might be provided by alternative operators, then customers are less likely to change providers. This might happen, for example, if customers perceive that operators provide nearly homogeneous services and similar prices. A customer might perceive significant differences in provider benefits if the customer has recently had a negative experience with a provider such as a significant service outage or impolite customer service representative; service quality

[34] We note at the outset of our analysis that some of the data represents subjective opinions and impressions of the respondents, including statements about what they intend to do. For example, in the next section we examine respondents' statements about their intent to change service providers. Survey respondents' answers to such questions can be imprecise. Cummings et al. (1995) find that when survey respondents are asked whether a product is worth a particular price, more respondents will say "yes" if they are told they have no obligation to buy the product at the stated price than if there is an obligation to purchase at the price. In the case of the survey data we use, respondents' statements concerning their satisfaction, usage and uses, and intent to switch providers might be imprecise. If the errors in their answers are random, then the effect on our research is to decrease the confidence we can place in our statistical results leading us to understate the validity of our findings. If the errors are systematic, in other words, if respondents consistently understate usage, then the effect on our research is to bias our results either up or down, depending on the direction of error. Since we cannot know whether respondents made errors in their answers and, if they did, the direction of those errors, we cannot do better than report our results with this caveat.

[35] Nomadic broadband will be considered at the end of each relevant section where feasible. Nomadic data are from the 2008 ICSCE survey.

has declined, possibly leading to the belief that the decline is unique to the current provider; fresh advertising by alternative providers extol value that the customer does not receive from the current provider; or acquaintances have strong recommendations for alternative providers. Note that a perception of nearly equal benefits does not mean that quality and satisfaction are high; the perception simply means that the current experience is thought to be equivalent to the alternatives.

In addition to benefit analysis, customers consider the costs of change and the risks when assessing whether a switch in service providers might be beneficial. There are at least two types of costs. One type of cost is the switching costs, including any service termination fees, costs of establishing new payment systems, and any new equipment that might be required, for example, in the case of switching from DSL to cable modem. The second type of cost is search costs, namely the cost a customer would incur to learn about service alternatives. Search costs would be high if operators did not advertise or if service territories were unclear. Risks of service change reflect the uncertainty that customers assign to the benefits they perceive and the costs. Uncertainty exists because the customer cannot completely experience the service before purchasing it. For example a customer might expect that an alternative operator has better service and prices than the customer's existing provider, but if the customer believes there is a high probability that the alternative provider's service quality might actually be worse, the customer's risk aversion might keep him or her from switching providers.

To analyze customers' propensity to change providers, we use 2006 BCS survey data to first consider factors that influence a customer's decision to subscribe to home Internet access and then address the decision to subsequently consider switching methods of access, and/or switching providers. Customers are characterized by preferences and limitations. Among those preferences for broadband access is the degree to which they are satisfied with using Internet access elsewhere, for example at work, school, or a library. Limitations include income,[36] time availability, computer capacity, and broadband availability.[37] Of those survey respondents who were not considering changing their Internet access type from narrowband to broadband, the vast majority (72 percent) indicated that none of the possible limitations for upgrading to broadband affected their decision to remain with their current provider; they simply had no reason to switch. The greatest limit to switching to broadband cited was high price (12 percent reported that the broadband price is high and/or is not worth the price). Finally, approximately 13 percent were satisfied with their home Internet access because they have alternate access elsewhere (primarily work, then school, then library) and presumably therefore do not have as great a need for broadband at home.

In the 2008 ICSCE survey, the majority (82.3 percent) of respondents without home Internet access stated they were not considering getting such access within the next

[36] The data do not include reports on household income. As stated earlier, in our analyses, we use other indicators, such as the number of cars the household owns and whether the household owns a dishwasher as our gauges for household income.

[37] Computer capacity refers to the technological ability of the computer to effectively operate via broadband connection.

twelve months;[38] only 12.4 percent stated they did not know or did not respond. Of those with home Internet access, the vast majority (1,086 of 1,309 respondents, or approximately 83 percent) had not switched and had not tried to switch. Of those who did switch (only approximately 7 percent), the primary reason was dissatisfaction with their initial provider's price (27 respondents, or 31 percent of those who did switch, reported price as the main reason for switching providers).

In addition to upgrading to broadband, customers may switch providers either to change access type or to obtain better price or quality (as measured in speed, reliability, and billing). As described above, we assert that each customer makes choices between services and between providers based on the difference between the value the customer expects to receive and the price the customer expects to pay, that is to say, net consumer surplus. We anticipate that customers' expectations of greater net consumer surplus from better prices, better quality, or both will be affected by their actual experiences. These expectations could be shaped by many factors, including the length of time that the customer has experienced his or her current provider, knowledge of communications technologies, and exposure to alternative service providers and other consumers.

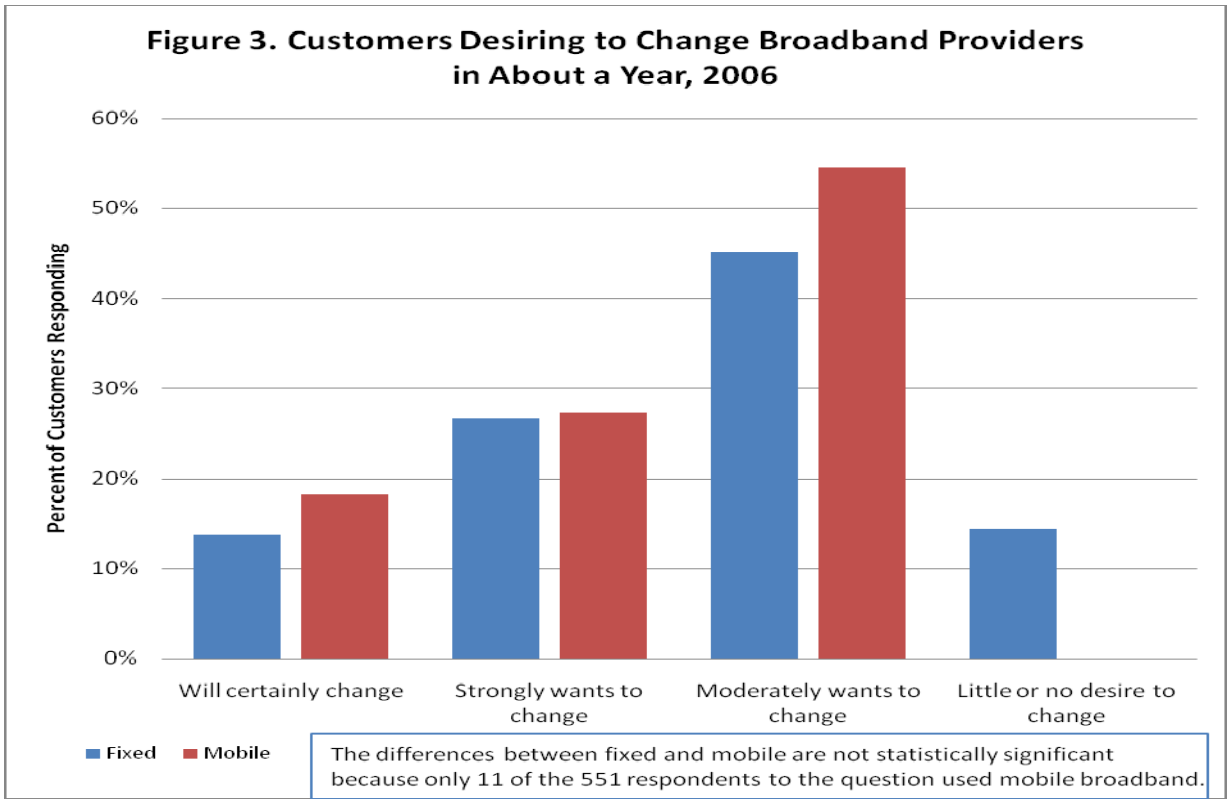
We examine the factors that influence consumers' propensity to switch providers by focusing first on customers who indicated that at some point they have felt that they wanted to change providers. The 2006 BCS survey asked respondents, "To what extent would you say you want to change provider in a year or so?"[39] This question measures the intensity of the desire to switch through four options: will certainly change, strongly wants to change, moderately wants to change, and has little wish to change. We can view the intensity to switch in two ways: as a binary choice in which the first two options imply the respondent is likely to switch and the last two options imply he is unlikely to switch; or, we might view the intensity to change as ordinal in which a higher number (the fourth option – little wish to change) indicates greater satisfaction with the current provider and therefore lower desire to switch.

Figure 3 indicates the responses of fixed and mobile customers with respect to their desire in 2006 to change broadband providers within one year. Interestingly, mobile broadband users are slightly more inclined to want to change providers, although the difference between fixed and mobile broadband users is not statistically significant.

Modeling the decision of mobile and fixed broadband customers to switch providers in 2006 is carried out using consumer characteristics because we do not observe the characteristics of the previous provider or the respondent's satisfaction with the previous operator. Individual and household characteristics are important control variables, but crucial in the decision to switch is the satisfaction of the respondent with the operator's services. We therefore have modeled the impact of dissatisfaction with the operator's services on the respondent's intention to switch providers in the 12

[38] ICSCE 2008 Question Q.119 asks "Is your household considering getting the Internet at home within the next 12 months?" Of the 63.64 percent (2,291 of 3,600 respondents) who reported not having Internet at home, 82.3 percent (1,886 of 2,291 respondents) did not intend to do so within the next year.
[39] Question P.50, 2006 BCS survey.

months following the interview. A drawback of using the intention to switch is that we do not know if the individuals actually do switch.



Source: authors' calculations based on 2006 BCS.

We employ two logit models to analyze the 2006 and 2008 ICSCE survey responses; the first is a standard logit model in which we analyze the intention to switch providers, and the second is an ordered logit model in which we consider the intensity with which a respondent intends to switch providers.[40] The major weakness of the logit is that the choice between alternatives depends solely on the characteristics of those alternatives being compared, excluding the characteristics of any other alternatives possible. In our first model the dependent variable is binary, indicating whether the respondent reported intent to switch providers. Explanatory variables include socio-economic and demographic characteristics, plus data on dissatisfaction with the quality of service and service aspects that induce individuals to switch providers.

Because there are only 105 mobile broadband observations in the 2006 BCS data and 209 such observations in the 2008 ICSCE data, we have limited ability to address intention to switch among mobile broadband users. Thirty-four of these 105 mobile broadband users in 2006 did switch providers; however, we do not have plan specific information, in particular, information about the prior plan (for example satisfaction with the previous plan speed, billing, or reliability) to be able to determine the cause of the switch. Further, as noted above, in the 2008 ICSCE survey while there are more total

[40] A logit regression model represents the choice between mutually exclusive options: for any binary dependent variable y_i and a continuous independent variable x_i, $Pr(y_i=1)=F(x_i' b)$ where b is a vector of parameters to be estimated, and F is the logistic cumulative density function.

mobile observations (209), they represent only 5.81 percent of respondents, and the vast majority of these (approximately 84 percent) have not switched providers and have no intention of doing so in the foreseeable future. Table 5 provides the odds ratios from the 2006 regressions.

Dependent Variable: Intent to Switch Providers	Intent to Switch (n = 2,258)	Intensity of Intent to Switch (n = 471)
Age 66 to 75		7.34** (5.86)
Completed polytechnic school	1.98** (0.65)	
Number in household	0.67** (0.15)	
In Grande Porto= 1 if respondent in Grande Porto		0.35* (0.21)
Norte Litoral	1.76*** (0.35)	1.91** (0.59)
Grande Porto	1.50* (0.31)	2.47*** (0.80)
Interior	1.42* (0.29)	
Centro Litoral	0.58*** (0.12)	
Alentejo	0.33** (0.15)	
Madeira	0.09** (0.10)	
Acores	0.33* (0.21)	
Population > 100,000	1.83** (0.62)	
Complaint = 1 if respondent filed complaint	3.14*** (0.41)	1.58** (0.31)
Satisfied with speed (1 – 4, 4 being very satisfied)	0.49*** (0.06)	0.73** (0.10)
Satisfied with reliability (1 – 4 , 4 being very satisfied)	0.75*** (0.08)	
Satisfied with bill clarity (1 – 4, 4 being very satisfied)		0.76** (0.10)

Only those variables that were significant are reported; complete results are in the Appendix: A-IV.A. 1 and 2. Standard errors are in parentheses.
* Significant at the 5% level; ** Significant at the 1% level; *** Significant at the .1% level
Omitted age group is age 15 to 25.
Omitted education level is university degree.
Omitted region and habitat is Grande Lisboa.
Source: authors' calculations based on 2006 BCS.

Table 5: Intent and intensity of intent to switch providers, 2006

Odds ratios measure the likelihood of an event occurring relative to another event occurring. In this model, the odds ratios represent the likelihood of an event occurring

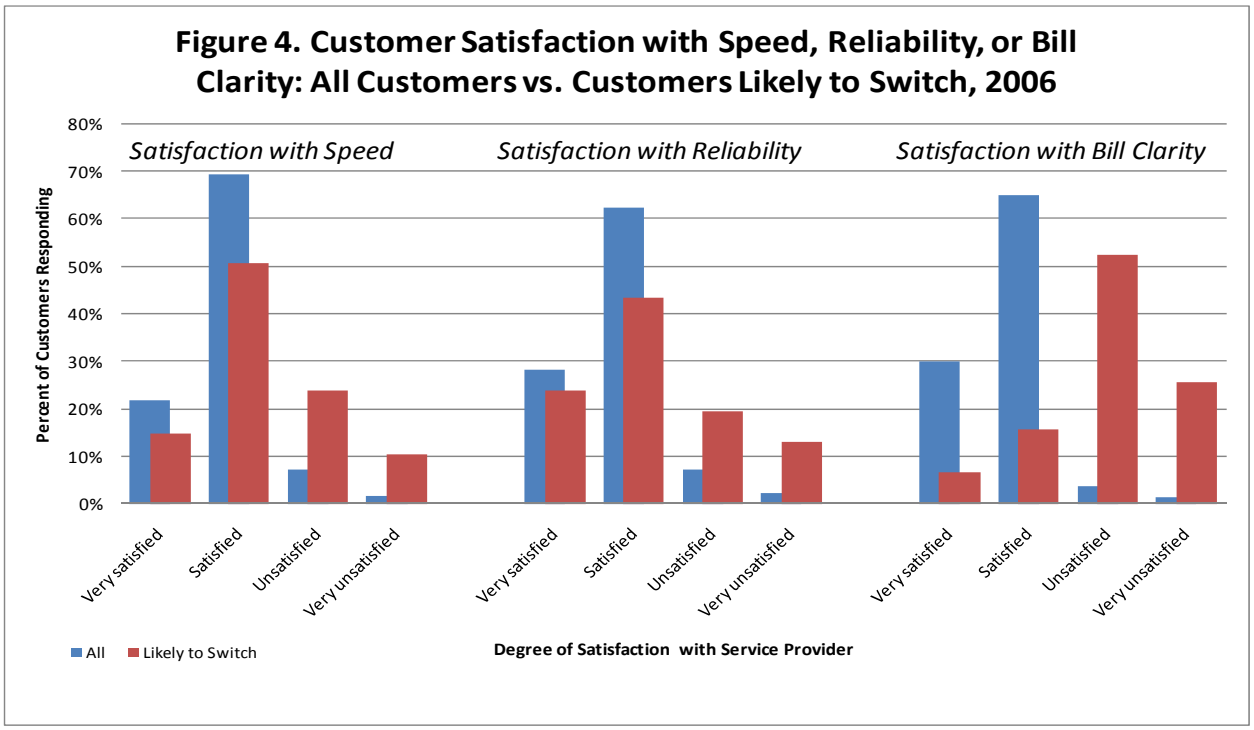
compared to the omitted age group, education level, and region. For example, the omitted region is Grande Lisboa, so the 2.47 odds ratio for Grande Porto in the second column indicates that customers in that region are more than twice as likely as customers in Grande Lisboa to intend to switch providers. If the odds ratio is less than 1, the event is less likely to occur than such occurrence in the omitted group; i.e., a positive association has an odds ratio greater than 1; a negative association as an odds ratio less than 1.

As might be expected, satisfaction with speed and reliability of service make individuals less likely to want to switch. For example, an average customer who is very satisfied with speed is about 50 percent less likely to want to switch providers than is a customer who is merely satisfied with speed. Having filed a complaint also makes one more likely to switch. Regarding education, an interesting result is that those who graduated from a polytechnic institute are more likely to have the intention to switch than those completing a university degree, perhaps because they are more likely to believe that they understand their alternatives, implying a lower risk of change. It also may be that people with university degrees are more traditional than the polytechnic institute graduates, making the university graduates less likely to change their service. Higher income individuals also are slightly more likely to have the intention to switch.

To more closely examine the intensity of intent to switch providers given the empirical results that satisfaction with speed, reliability, and billing clarity affect consumers' desire to switch, we plot customer satisfaction in these three areas against the satisfaction of those more likely to switch. Figure 4 reflects the empirical results provided in Table 5.

Figure 4 illustrates that customers who are likely to switch are similar to all customers in their satisfaction with speed and reliability, but are much less satisfied with bill clarity. Bill clarity affects the intensity of the desire to switch, but not the basic intent (consistent with the regression analyses in Table 5). Among the subset of respondents who reported to be considering switching to broadband, 11 percent connected via cable, 83.7 percent connected via telephone facilities, and 4.4 percent connected via 3G.[41]

[41] This subset of respondents is comprised of those answering yes to question P.16 in the 2006 ICCE survey which asked: "Are you considering switching to broadband in the next 12 months?" Ninety-three people chose yes.

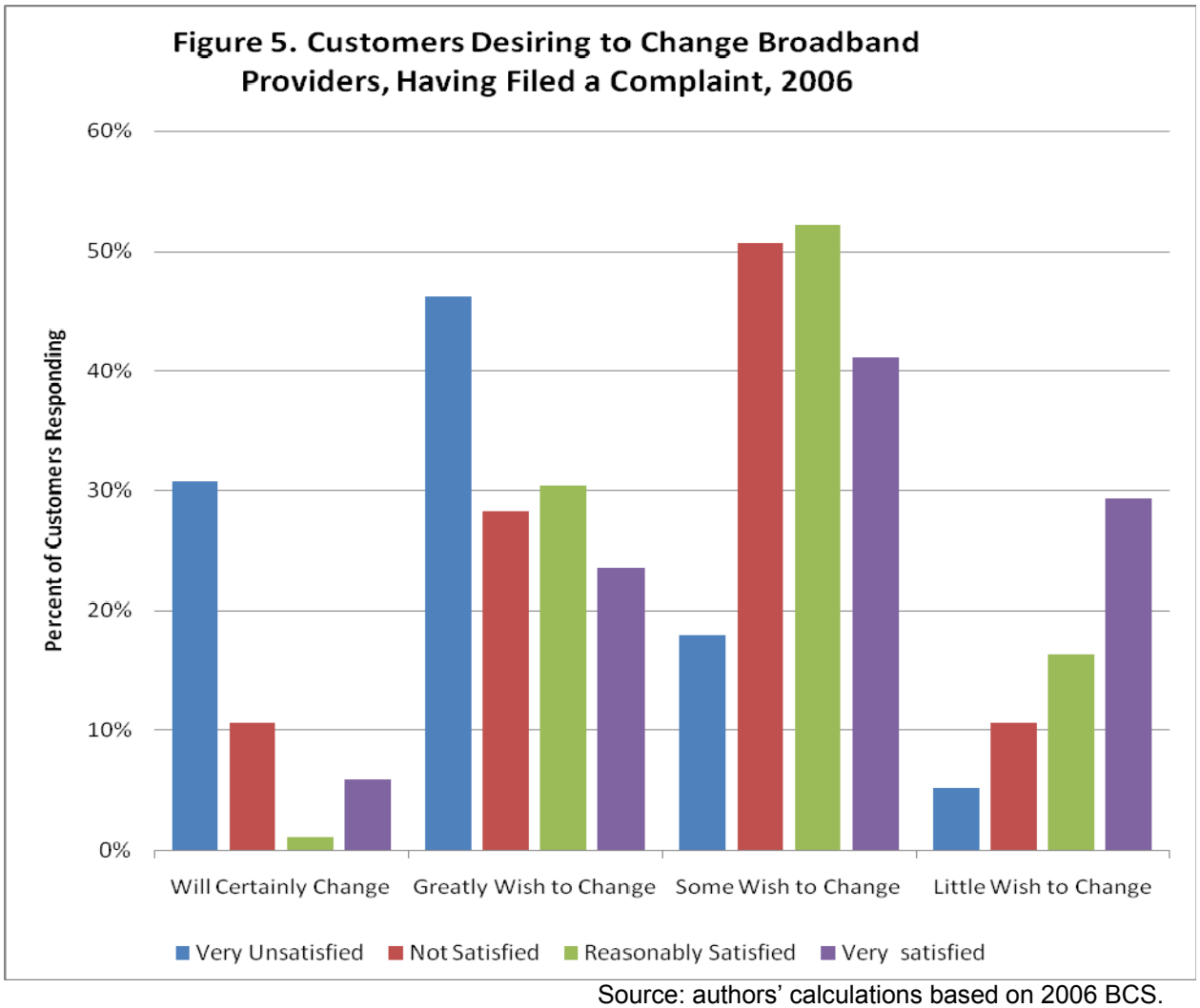


Source: authors' calculations based on 2006 BCS.

Figure 5 indicates those customers who filed a complaint and wanted to change providers, given their level of satisfaction with how the complaint was settled. The figure suggests that customers continue to assess their options for home Internet access regardless of their experiences with complaint resolution. As might be expected, those who were very dissatisfied with how their complaints were handled (only 35 customers in total) were most decidedly interested in changing providers; however, the other groups displayed similar propensity to change overall.

We conclude that customers value speed and reliability more than they do bill clarity. Furthermore, customers who are unhappy with their service are proactive and file complaints with their service providers, although it appears that this does not keep them from planning to change providers.

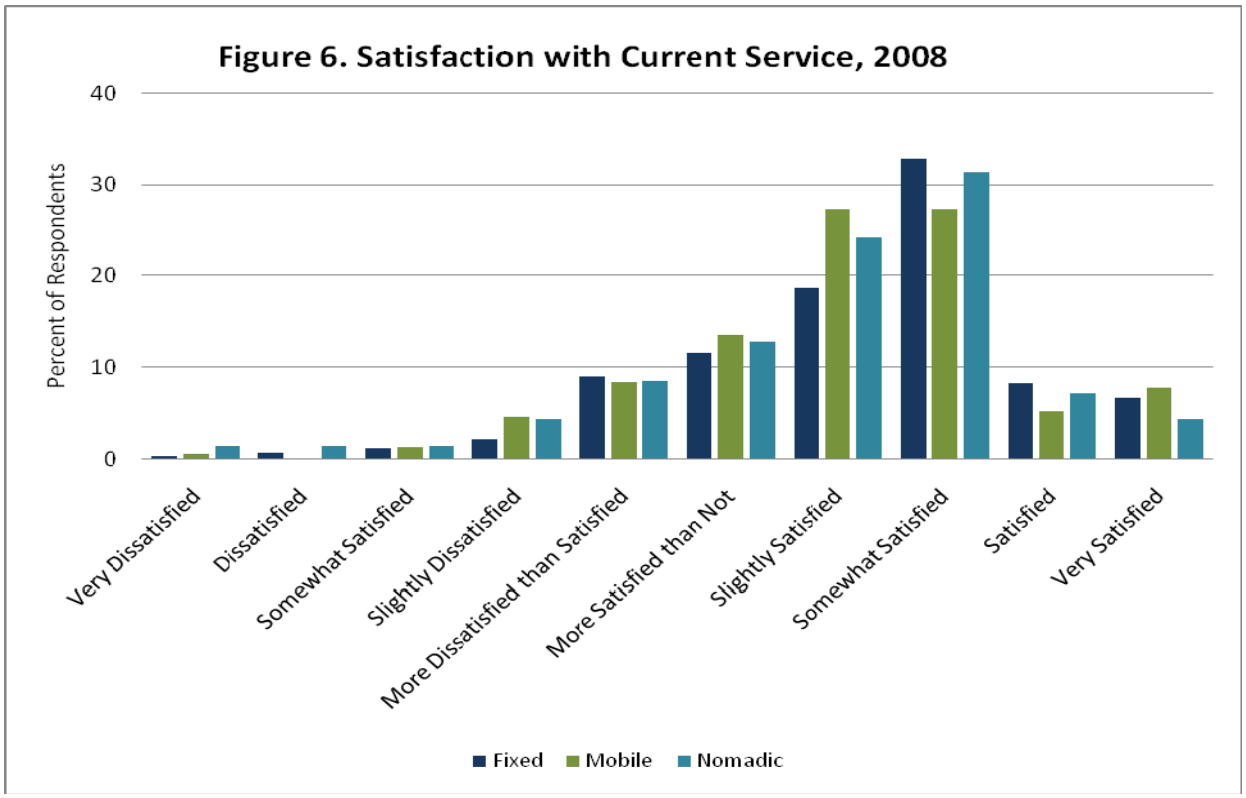
With respect to the 2008 ICSCE survey data, satisfaction with speed is the only comparable variable to the 2006 BCS data characterizing reasons customers might have an intention to switch providers (i.e., the 2008 ICSCE survey does not address reliability and billing). In lieu of the categories of speed, reliability, and billing, overall satisfaction is reported. Figures illustrating these results, and empirical results using satisfaction with overall service from the 2008 ICSCE data are provided in the Appendix (see section A-IV.A).



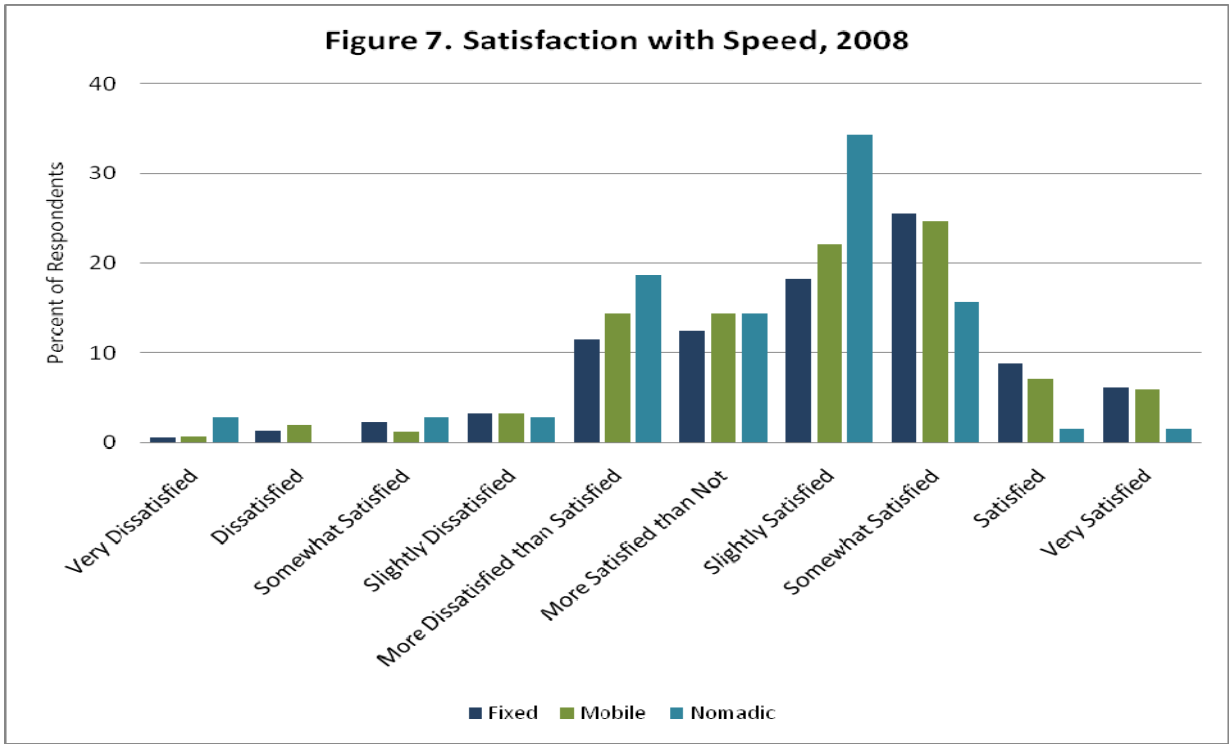
Source: authors' calculations based on 2006 BCS.

Satisfaction with their chosen mode of Internet access also is important with respect to satisfaction. Figure 6 shows respondents' general level of satisfaction with their Internet access in 2008. Customers of all modes of access show similar satisfaction patterns. A large majority are satisfied with their service, although only a few categorize their satisfaction in the range of very satisfied.

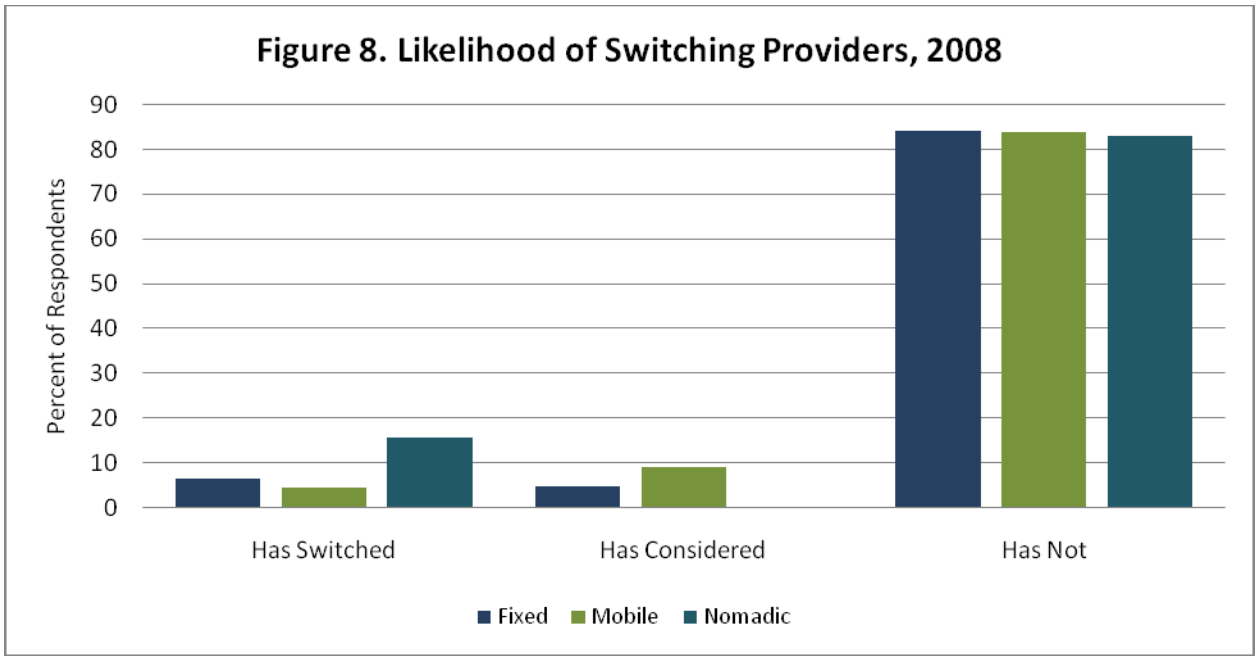
Figures 6, 7, and 8 are based on the 2008 ICSCE survey. Figure 7 relates satisfaction with speed. The pattern here appears very similar to that seen for overall service satisfaction, implying that either speed is an important determinant of satisfaction, or that overall satisfaction is interpreted by customers as satisfaction with speed.



Source: authors' calculations based on 2008 ICSCE.



Source: authors' calculations based on 2008 ICSCE.



Source: authors' calculations based on 2006 BCS.

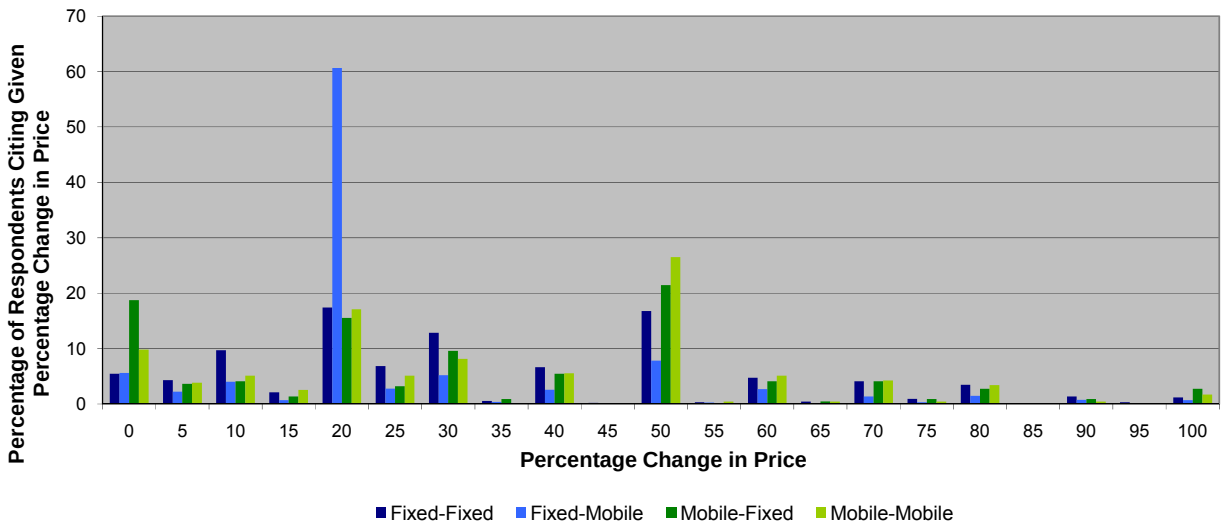
Figure 8 illustrates the likelihood of switching providers, which is relatively constant across access types. It also shows that most customers do not switch providers; however, the nomadic users had a much greater likelihood of switching providers.[42] Interestingly, none of the nomadic users reported intention to switch and then not doing so. This is an interesting result in that it appears those with nomadic access act upon their desire to switch, while fixed and mobile had a greater likelihood of reporting a desire to switch and yet not doing so. Perhaps this indicates that switching is easier with nomadic access than with other forms.

Alternatively, the difference we do find between nomadic customers and fixed and mobile customers in their propensity to switch might in part be explained by differences in how the service is offered. Some WiFi hotspot providers, such as PT WiFi, offer service bundles that combine mobile voice service with nomadic broadband. This could create a switching cost for nomadic users if the bundling caused them to have to either change mobile providers or change mobile service plans if they wanted to change nomadic service providers. The result could be more stable demand for PT WiFi. In addition the service bundles may encourage customers to purchase nomadic service, thus stimulating demand. It may also be the case that some customers have more than one nomadic service provider, making the notion of switching providers have a different meaning than it would for fixed and mobile broadband customers. More fully understanding the nomadic customers' propensity to switch, and what constitutes nomadic switching, would require more extensive data gathering.

[42] Those respondents reporting nomadic access had approximately the same propensity to file a complaint as their fixed and mobile counterparts: 11 percent compared to 10.9 percent for both fixed and mobile.

To obtain additional information regarding consumers' likelihood of switching providers, we utilized the 2008 ECSI data. Respondents were asked the minimum percentage change in price that would induce them to switch providers.[43] Figure 9 illustrates respondents' reported percentage changes in price, which may be viewed as proxies for switching costs. Figure 9 shows that fixed and mobile respondents had similar reported minimum price changes required to induce a change in either a provider of the same type (i.e., fixed to fixed) or different type (fixed to mobile); it indicates that respondents across access types had similar perceived costs of switching providers with the exception of the large percentage of respondents with fixed Internet access citing a 20 percent price change would entice them to change to a mobile Internet access provider.

Figure 9. Minimum Change in Price to Change Provider, 2008



Source: authors' calculations based on 2008 ECSI.

The ECSI survey was useful in further analyzing the effect of price on intention to switch. The survey included questions regarding satisfaction with the respondent's current provider, perceived overall quality, and fulfillment of expectations (which serve as primary explanatory variables in determining switching costs as indicated in Figure 9). To analyze the data we employed a bivariate tobit model which is appropriate because the data indicates that people who are more likely to switch to another fixed operator for a small percentage price difference are also those who are more likely to switch to a mobile operator for a small percentage difference. The variables are correlated, so the model is estimated with two joint equations. The tobit model is used because some individuals indicated they would not switch to an alternative operator

[43] Specifically, we focus on responses to ECSI 2008 survey question Q13_1 Price Sensitivity: "Suppose that other 'fixed' broadband Internet providers decided to reduce their prices, but your 'fixed' broadband operator would continue to charge the current price. Starting from what price difference would you choose another 'fixed' broadband operator? Your answer should be given in percentages, that is, up to 100%." A clarifying statement also was added; "What is the percentage reduction from the price you are currently paying that would make you switch operator?" This question was asked in four combinations: fixed-fixed, fixed-mobile, mobile-fixed, and mobile-mobile.

regardless of the percentage price difference.[44] Results of the model are provided in Table 6.

Each of the quality variables are statistically significant determinants of switching costs, but the impact of each is difficult to disentangle from the impact of the other two. For this reason we have chosen to report those results in which the perceived overall quality is our key explanatory variable.[45]

Dependent Variable: Minimum Percentage Change in Price to Change Provider, ECSI 2008	**Fixed to Fixed (n = 772)**	**Fixed to Mobile (n = 772)**	**Mobile to Mobile (n = 194)**	**Mobile to Fixed (n = 194)**
Provider Clix_ADSL	-13.173** (4.468)	-17.250* (7.532)		
Provider SAPO_ADSL	-11.080* (4.735)			
Provider TMN			-22.191* (11.260)	
Perceived Overall Quality (1-10, with 10 being the highest quality)	5.457*** (0.974)	8.131*** (1.646)	8..531* (3.022)	12.665*** (4.470)
Age 45 – 64	15.256* (6.047)			
Age 65_up	33.725** (10.600)			
No High School	10.387** (3.990)			
High School	11.054** (3.719)			

Only those variables that were significant are reported; complete results are in the Appendix: A-IV.A. 3)
Standard errors are in parentheses.
* Significant at the 5% level
** Significant at the 1% level
*** Significant at the .1% level
Omitted age group is age 15 to 25.
Omitted education level is university degree.
Source: authors' calculations based on 2008 ECSI.

Table 6. Measure of switching costs, ECSI 2008

Table 6 indicates that the largest percentage change in price would be needed to entice mobile Internet access customers to switch to a fixed access provider. This may also indicate that fixed access customers differ from mobile customers in their price sensitivity, which in turn would imply services are not perfect substitutes.[46]

[44] For individuals who reportedly would not switch providers, we do not have an actual percentage, yet they have to be taken into account. The tobit model is made precisely for such situations; in this instance the censoring is on the right hand side, and not accounting for those who would not switch would bias the coefficient estimates for the explanatory variables we include in the regression.
[45] The full results of all models are provided in the Appendix, section A-IV.A. 3a and 3b.
[46] The limited customer information associated with this data precludes our ability to test the extent to which the populations differ in terms of demographic and socio-economic characteristics.

B. Estimation and Analysis of Own and Cross-Price Elasticities of Fixed, Nomadic, and Mobile Broadband.

Examination of price elasticities provides useful information on market performance. We first address the theoretical background of price elasticity in order to more clearly frame our results. Price elasticity of demand (also called own-price elasticity of demand) measures how sensitive one's consumption of a particular good is to a change in that good's price. Generally it is represented by the percentage change in consumption of a good given a one percent increase in the good's price. It is a negative number because the quantity consumed of a product is inversely related to the product's price.

Cross-price elasticity is related to own-price elasticity. It measures the change in consumption of one good given a change in the price of another potentially related good. When the cross-price elasticity of demand for two goods, for example fixed and mobile broadband, is positive, those goods are substitutes. If the cross-price elasticity is negative, the goods are complements (i.e., they tend to be goods that are used together).

Elasticities are useful measures of the degree of market power a firm has. If customers can easily substitute away from a particular firm's product when the price of that product increases or when the price of another firm's substitute product falls, the first firm's market power is deemed to be relatively low. If, however, a change in this firm's price has little effect on the consumption of potential substitutes or on the sales of its own product, the firm is presumed to have greater market power and the market is considered to be relatively non-competitive.

The market power of a profit maximizing firm can be estimated by what is commonly called the elasticity rule. When a profit-maximizing firm optimally produces such that its marginal revenue of production equals its marginal cost of production, the following holds: $[P - MC] / P = 1/\varepsilon$, where P equals the price, MC equals marginal cost, and ε is the price elasticity of demand. The rule implies that a firm with market power should set a price-cost margin that is greater the lower is the price elasticity of demand.[47]

Ramsey pricing also frequently is cited in telecommunications industry regulation. Ramsey pricing is a linear pricing scheme for a multiproduct natural monopolist, where price mark-ups vary with the elasticity of demand for a good. With Ramsey pricing, the price that maximizes social welfare subject to a profit constraint should exceed marginal cost by an amount that is inversely proportional to elasticity of demand.[48]

None of the survey data allow us to estimate price elasticities for subscription because the surveys do not capture price data. However, as we show in the Background and Literature Review section, there are a number of studies that have made such elasticity estimates, one even for Portugal. We believe that it would be important to update the

[47] This also is known as the Lerner Index, named after A.P. Lerner (1934). An additional example of measuring market power in the telecommunications industry can be found in Ward (1995).
[48] Ramsey pricing is attributed to F. Ramsey (1927). Additional references are Baumol and Bradford (1970), Sheshinski (1986), and Brown and Sibley (1986).

Portugal study given that technologies and services have advanced, but we cannot do this with our data.

Since we cannot estimate price elasticities for subscription from our data, we instead approximate price elasticities for fixed broadband speed and usage using service provider prices as our guide without knowing how many subscribers purchase at the various prices. This has not been done in other studies, so is a useful contribution to our understanding of broadband demand. More specifically, using the pricing plans for fixed broadband providers in Portugal, we analyze the demand curves that are implied by these pricing plans in June 2008.[49] This does not provide price elasticities for markets or for providers because we do not have data on how many customers pay each price. Instead the price plans indicate how fixed broadband service providers believe a customer values speed and usage given that the customer has already decided to purchase fixed broadband access. Figure 10 shows the results of this analysis. The points on the graph show the prices on a megabit per second (Mbps) basis according to the various pricing plans offered in Portugal for fixed broadband. The fitted curve shows the results of a regression analysis on these points. The fitted curve implies a price elasticity of demand with respect to speed for fixed broadband capacity of -1.283.[50] This elastic demand implies that substitutes are available for broadband usage and is consistent with some studies in the U.S., although as we note above, these U.S. studies were for broadband access and not for bandwidth.

Figure 10 reflects prices that customers pay for fixed broadband for up to 25 Mbps. From the ICSCE and ECSI surveys, we estimate that this accounts for about 95 percent of the fixed broadband subscribers in Portugal. Of this 95 percent, about two-thirds purchase services with bandwidths of 8 Mbps or less.

Additional information can be used to shed light on the competitiveness of the Internet access market in general and on customers' perception of the availability of close substitutes across access types. For example, in 2006 the range of fixed broadband prices for a monthly subscription in Portugal was US$37.44 to US$74.16, a relatively small range compared to all other OECD countries, with only Iceland, Korea, and the United Kingdom having a smaller range.[51] However, when one considers the price at various speeds (i.e., price per Mbps), the range of prices in Portugal is much larger (US$12.49 to US$236.44); in 2006 of OECD countries only Mexico and Spain had a wider range of prices.[52] Evaluating broadband prices with respect to speed adds a price factor for the different speeds; in other words, a customer paying US$50 per month for a 2 Mbps connection is considered equivalent to a customer paying US$37.50 per month for a 1.5Mbps connection. This suggests that there is a greater variety of speeds available at a larger range of prices.

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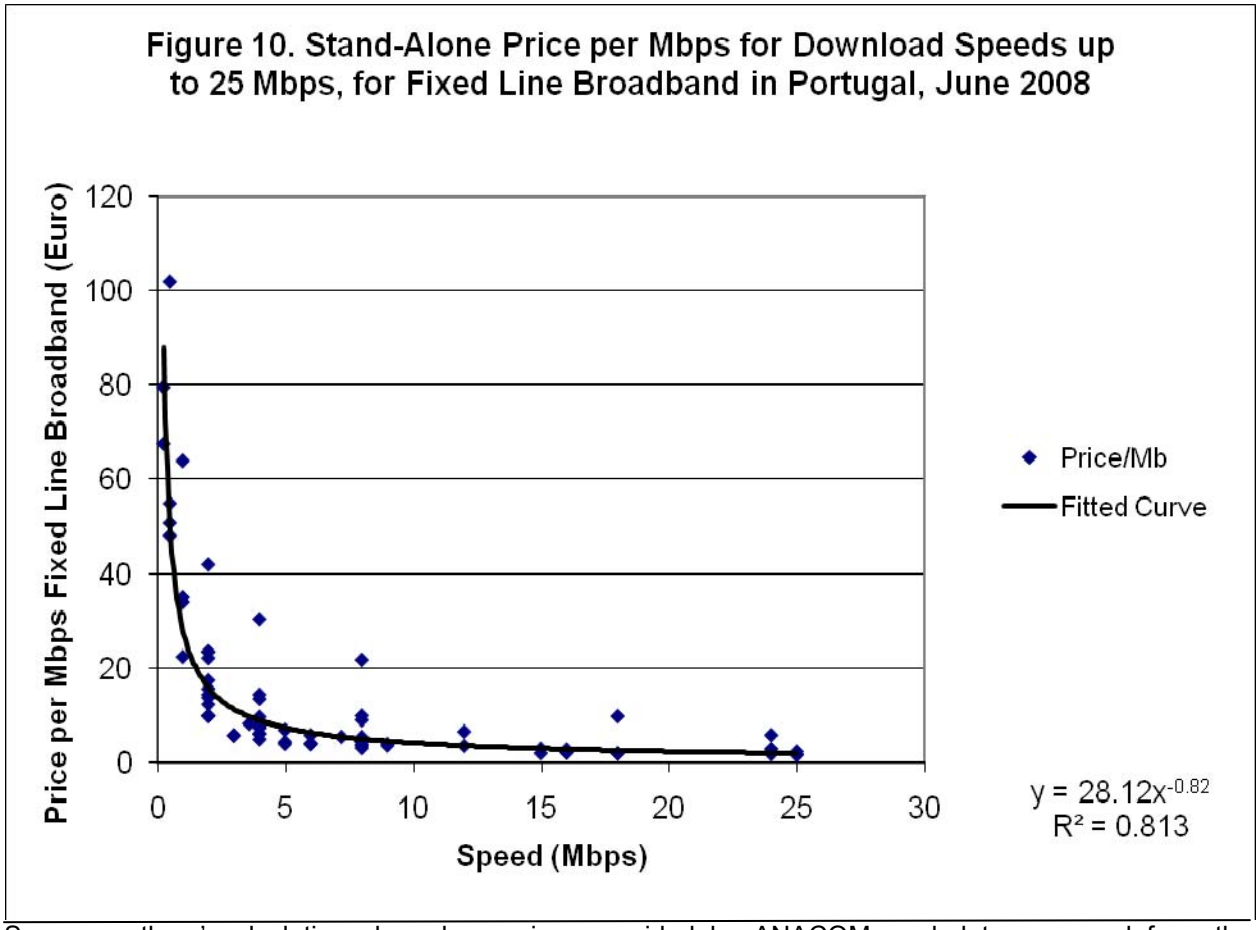
[49] Prices were provided by ANACOM. Companies included AR Telecom, Bragatel, Cabo Tv Madeirense, Cabovisão, Interacesso, Optimus (3G), Pluricanal, Sapo, TMN (3G), TVTel, VipVoz, Vodafone (3G), and ZON.

[50] Figure 10 shows the regression results. "Y" is the price charged and "X" is Mbps. No other explanatory variables are needed because the data represent price plans, not actual customer purchases. The -0.813 coefficient estimated for Mbps is the reciprocal of the price elasticity, i.e., -1.230 = 1 ÷ -0.821. The regression has an R^2 of 0.8429, implying a high goodness of fit.

[51] OECD (2007), Figure 7.16, page 222.

[52] OECD (2007), Figure 7.17, page 223.



Source: authors' calculations based on prices provided by ANACOM, and data accessed from the following websites: Wi-FiHotSpotList.com, Trustive.com, and jiwire.com.

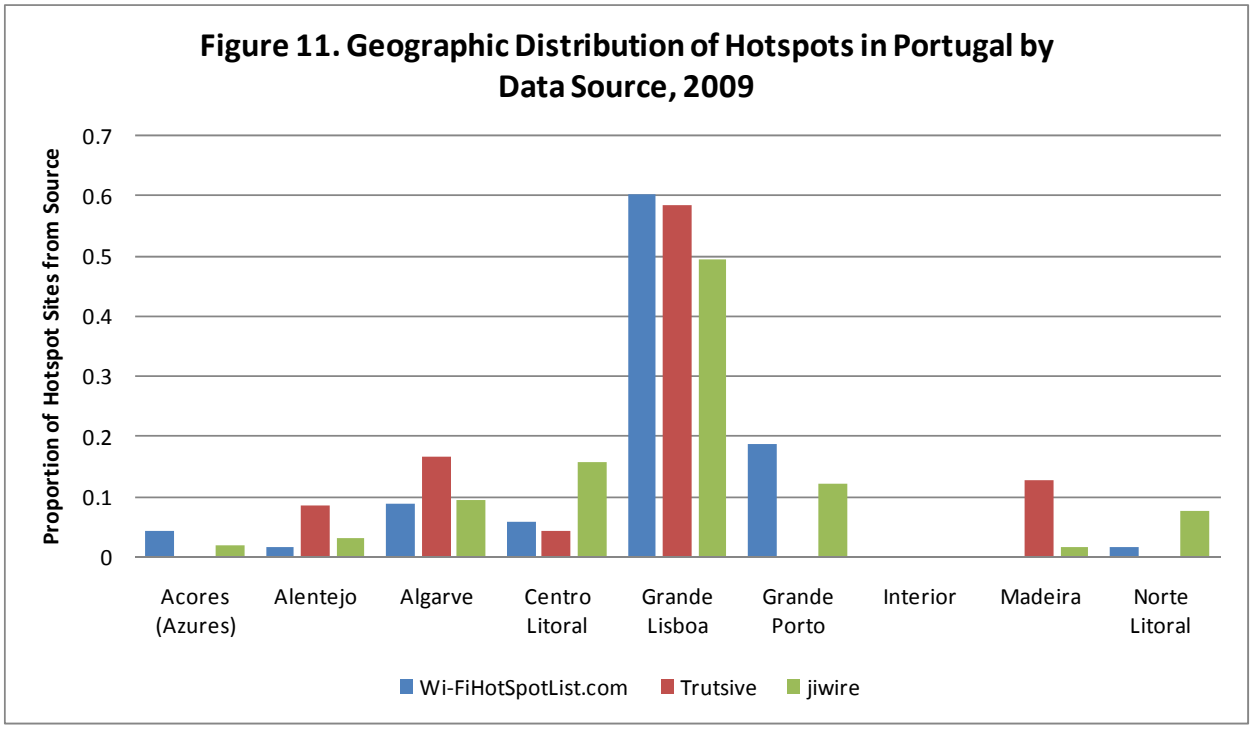
Next we consider the impact of hotspots across the regions of Portugal. We obtain data on hotspot locations from three sources: Wi-FiHotSpotList.com; Trustive; and jiwire.[53] The sources varied greatly in the hotspots reported and no source claimed to include every hotspot in Portugal. Wi-FiHotSpotList.com showed 70 hotspots, Trustive showed 24 hotspots, and jiwire showed 2,855. The sources also varied in where they found hotspots. Wi-FiHotSpotList.com located hotspots largely in Grande Lisboa, Grande Porto, and Algarve, with Grande Lisboa making up 60 percent of the sites. Trustive located hotspots largely in Grande Lisboa, Algarve, and Madeira, with Grande Lisboa making up 58 percent of the hotspots cited. jiwire found most of its hotspots in Grande Lisboa, Centro Litoral, and Grande Porto, with Grande Lisboa making up 49 percent of the sites found. Figure 11 shows these proportions.

Wi-FiHotSpotList.com provides details on service providers for the hotspots it cites. Of the 70 hotspots, 48 are served by PT WiFi, 8 are served by Boingo, 6 are served by Cisco, and the remaining 8 are served by a mix of providers. Most of the hotspots are

[53] Available at http://www.wi-fihotspotlist.com/browse/intl/2000110/, http://www.trustive.com/hotspots/Portugal/, and http://v4.jiwire.com/browse-hotspot-portugal-pt.htm, respectively. Accessed April 23, 2009.

located in hotels or restaurants (cafes and fast food rather than full service establishments).

It appears that WiFi providers charge uniform prices across broad regions. Across Portugal, PT WiFi charges €0.03 per minute for pay per use, €5.00 per month plus €1.49 per 100 megabits (MB) for use above 2 gigabits (GB) for Telepac ADSL or Sapo customers, and €5.00 per month plus €0.015 per 1 MB for use above 2 GB for TMN customers. Boingo's As You Go service charges US$19.95 per day across Europe. Wayport (AT&T) charges €30.00 per day across Europe.[54] Trustive reports that the sites it identifies all charge €0.08 per minute.



Source: authors' calculations based on data accessed from Wi-FiHotSpotList.com, Trustive.com, and jiwire.com.

The price lists imply market segments that we can analyze, but the data do not permit us to estimate price elasticities with any precision. Consider, for example, the PT WiFi price list. A customer who expects to consume about 1 GB per month has a willingness to pay of at least €5.00 per GB, while a customer who expects to consume about 2 GB per month has a willingness to pay of at least €2.50 per GB. These would constitute the low end customers. There also are higher end customers – those who consume more than 2 GB – who are willing to pay at least €14.90 per GB for consumption in excess of 2GB. The price structure allows us to identify these two market segments and to observe at least the lower bounds of customers' willingness to pay, but we cannot draw any conclusions about how they would respond to changes in price.

[54] Available at http://www.ptwifi.pt/content/articledetail.aspx?ida=754428&selectedculture=en, http://www.boingo.com/boingo-faq.php, and http://www.wayport.com/ respectively. Accessed April 23, 2009.

Boingo's price list also allows us to observe willingness to pay, but for hours of access rather than for GB of transmission. Boingo's price in Portugal (indeed, all across Europe) is US$19.95 per day. This uniform price structure reveals nothing about customers and customer segments other than at least some customers have a willingness to pay of at least US$19.95 per day. In the Americas, Boingo offers two pricing plans: an hourly rate of US$4.95 and a daily rate of US$7.95. This implies a low end market of customers who, perhaps because of low interest or because of time limitations, wish to use WiFi no more than one hour per day and are willing to pay at least US$4.95 for the service. Higher end customers pay less per hour, consistent with the notion in information economics that optional pricing plans provide information rents to higher end customers.

The Wayport price list provides an opportunity for further analyses of customer segments. Here low end customers pay substantially more than for PT WiFi or Boingo service, implying that customers using Wayport probably do not find PT WiFi or Boingo as competitive options in their situations. This might happen, for example, at hotels where business travelers are unfamiliar with nearby hotspots that might offer better prices, or if such business travelers simply place a high value on working in their hotel guest rooms and so are willing to pay the higher prices rather than change hotspots. As in the case of Boingo, the lower end Wayport customers pay more per unit (in this case the unit is days rather than hours) than do the higher end customers. But as is the case for PT WiFi and Boingo, we do not observe how any of the customer segments react to different prices so we are unable to estimate demand elasticities.

Without specific information on plans used by nomadic customers and their usage levels, we cannot determine price elasticities of demand for nomadic access. The hotspot locations identified by Wi-FiHotSpotList.com and by Trustive (jiwire did not identify specific locations) were largely hotels, eating establishments, or camping facilities. At least with respect to hotels and camping facilities, but perhaps also with some eating establishments, the nomadic users accessing the broadband at those locations are probably unfamiliar with the area and so might expect to incur high search costs in checking the availability of hotspots and their access prices. Furthermore, because service providers' prices do not vary except between broad regions, such as between Europe and Asia, it would appear that operators are competing on a regional or global basis for customers, not for customers at specific hotspots.

C. Identification of the Usage Objectives and Usage Patterns of Fixed, Nomadic, and Mobile Broadband; Analysis of Differences Among Each One of the Usage Patterns; and Explanation of the Main Differences.

The value of understanding usage patterns lies in finding potential differences among consumers for various broadband technologies. Usage is an indirect indicator of the value consumers place on their Internet access; that value is expected to vary across types of consumers (i.e., across ages and education levels) as well as across types of applications (i.e., filing taxes versus downloading music). Table 7 reports the number of hours of use and the relative frequency for the most frequent answers for both fixed and mobile Internet use from the 2006 BCS survey.

There are different ways of measuring usage. In our econometric analysis we focus primarily on hours and types of usage as there are enough observations to compute valid results; however, access bandwidth also is important. For example, respondents were asked the name of the operator providing their broadband Internet access to their home. Upon choosing the appropriate provider, respondents then were asked which package they had chosen. In some instances the package information obtained in the survey included bandwidth (e.g., Sapo offers a 2MB, 4MB, and 8MB package, among others; TvTel offers 256 1GB, 256 3GB, 256 SL and 512 SL; Via Networks offers 512K, 768K, and 1024K, among others), but in other instances only the name of the plan was given, not the features.

Hours of Use	Percent of Respondents	Fixed Access Respondents	Mobile Access Respondents
1	4.05%	97	2
5	7.09%	166	8
10	8.93%	214	7
15	6.01%	146	4
20	8.65%	205	10
25	3.61%	88	2
30	4.97%	115	7
35	2.64%	63	2
40	3.13%	75	2
50	1.52%	37	1

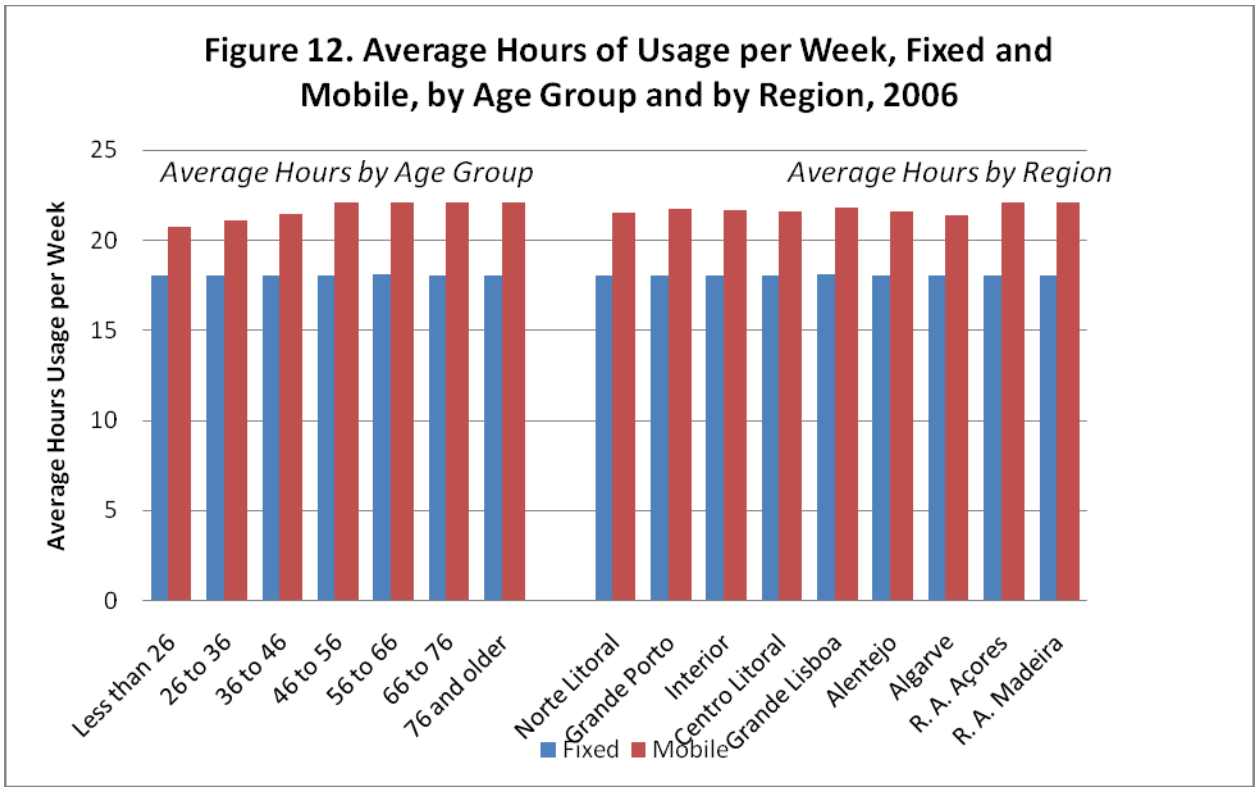
Source: authors' calculations based on 2006 BCS.

Table 7. Summary of hours of use raw numbers and associated frequencies, BCS, 2006

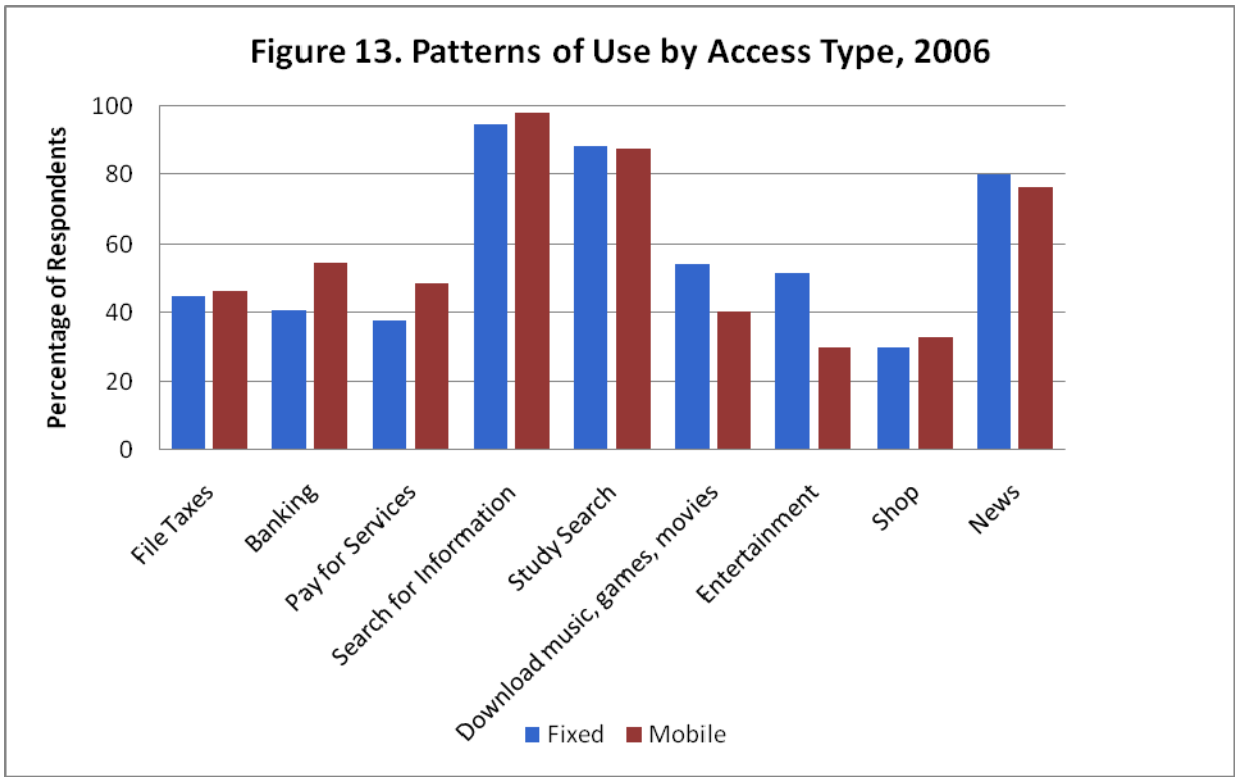
Our focus on hours of use results in the determination that hours of use are fairly consistent across age groups and regions in Portugal. Hours of use are approximately 18 hours per week for fixed broadband and 21 hours per week for mobile broadband. Similarly, types of usage are similar across access types. Figures 12 and 13 show these results.

Figure 12 shows that usage is consistent across age groups and geographic regions, even though variations are statistically significant in econometric models (details of which are below). Mobile usage is consistently higher than fixed usage as well.

Figure 13 illustrates that fixed and mobile broadband Internet users have very similar patterns of use. Mobile access is slightly greater for financial applications than fixed access is, and fixed acces is slightly greater for entertainmet, news, and downloading of music, games, and movies. This might occur because, as we show in section D below, mobile broadband is associated with higher-income users than is fixed broadband.



Source: authors' calculations based on 2006 BCS.

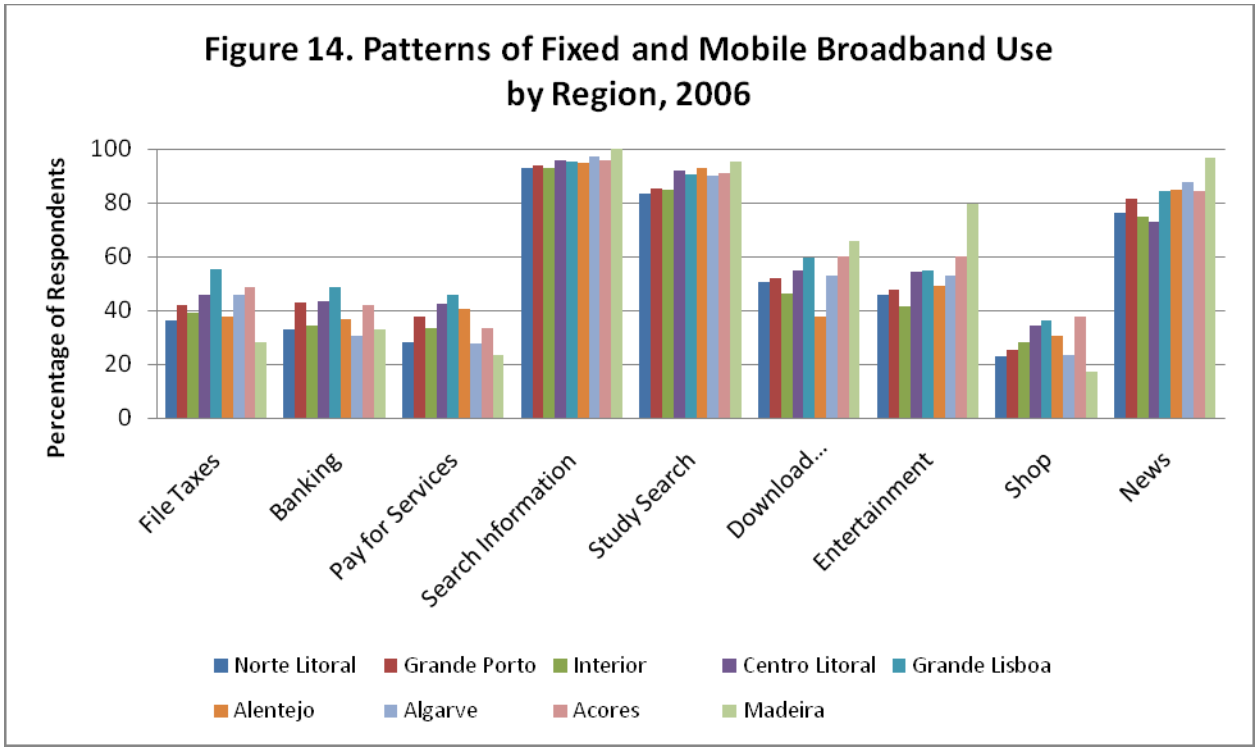


Source: authors' calculations based on 2006 BCS.

Next, we consider patterns of use by region in an effort to determine whether any particular area has an affinity for a particular application. As Figure 14 shows, there are

very few dissimilarities across regions as well. Madeira seems to have somewhat greater information usage, while Grande Lisboa appears to have greater financial usage patterns; these differences are not statistically significant, however.

Our empirical models analyzing the difference in usage between narrowband and broadband users consider both the impact of fixed versus mobile access on hours of use and the purpose of use (making purchases, bank transfers, filing taxes), after controlling for individual/household characteristics. This suggests the extent to which narrowband and broadband are substitutes, and similarly the extent to which fixed and mobile broadband are used for similar purposes.



Source: authors' calculations based on 2006 BCS.

The empirical results provided in Table 8 are as anticipated. As shown in Table 8, older respondents tend to have lower hours of use; this result coincides with analysis of the 2008 ICSCE data as well, in which those age 25 to 44 have the highest usage among various age groups.[55] Wealthier respondents in 2006 have higher hours of use.[56] More densely populated or urban areas have higher usage as well. The more densely populated areas of Portugal also have higher per capita GDP and the marginal cost of providing broadband should be lower in more densely populated areas than in less densely populated areas. Finally, it is interesting to note the negative relationship

[55] Results are provided in the Appendix, section 1b. In the 2008 ICSCE survey we do not have a question asking hours of use; Q92 asks "How often do you usually use Internet in your home?" with possible responses of: several times a day, once a day, two to three times a week, and less than once a week. The 2008 estimation is therefore an ordered logit instead of a negative binomial model as used for the 2006 analysis.

[56] This finding is consistent with other studies of broadband use. Some studies find that lower income customers spend more time on the Internet than higher income customers, but the low income customers in those studies appear to be using narrowband access.

between satisfaction with speed and hours of use. When considering regions, Alentejo and Algarve have less usage.

Explanatory Variables, 2006 BCS (Negative binomial Model)	Hours of Use n = 2,329	Explanatory Variables, 2008 ICSCE (Ordered logit model)	Internet Usage n = 1,166
Satisfaction with speed	-0.11** (0.05)	Female	1.67* (0.47)
Satisfaction with billing	0.13** (0.05)	Household 5+people	3.01* (1.82)
Age 36 to 45	-0.18* (0.09)	Age 25 to 44	2.75** (1.24)
Age 56 to 65	-0.39*** (0.11)	High school education	0.25* (0.19)
Age 66 to 75	-0.29** (0.17)	University education	0.12** (0.10)
Population < 2,000	0.43*** (0.12)	Student	0.17*** (0.09)
Population < 10,000	0.53*** (0.12)	Retired	0.17** (0.15)
Population < 100,000	0.48*** (0.11)		
Population > 100,000	0.56** (0.16)	Açores	0.17*** (0.09)
Grande Porto	0.79*** (0.17)	Lisboa	0.24** (0.12)
Two or more cars	0.25*** (0.05)	Madeira	0.24** (0.11)
Alentejo	-0.49*** (0.11)	Alentejo	0.20** (0.12)
Algarve	-0.49* (0.26)	Algarve	0.07** (0.07)

Only those variables that were significant are reported; complete results are in the Appendix: A-IV.C.1, and A-IV.C.1b. Standard errors are in parentheses.
* Significant at the 5% level** Significant at the 1% level *** Significant at the .1% level
Omitted age group is 16 – 25 in 2006, 15 – 24 in 2008.
Omitted household size is 1 in 2008.
Omitted education level is primary in 2008.
Omitted region and population (habitat) is Grande Lisboa in 2006; Norte in 2008.
Source: authors' calculations based on 2006 BCS and 2008 ICSCE.

Table 8: Hours of use, BCS, 2006 and Intensity of Use, ICSCE, 2008[57]

[57] Types of access indicator variables were not included in this estimation because the choice of type of access and hours of use are endogenous; we do not have instruments to estimate a model that can distinguish the impact of type of access on hours of use.

We employed logistic regressions to examine differences in the likelihood of uses such as online banking and online shopping among subscribers accessing the Internet through different technologies. We included narrowband, cable and mobile binary indicator variables for uses such as Internet banking, tax filing and online shopping (among others). The linear regression model was chosen as it is more reliable than other models when dealing with a small number of observations. Table 9 provides results of these estimates for business and finance related activities; Table 10 provides results for entertainment related activities.

Our analyses suggest that mobile subscribers are not different from other broadband subscribers with respect to financial applications; only narrowband proved to be significant in terms of access mode. Education remains a primary indicator of Internet usage. There are variations across regions once other socio-economic characteristics are controlled for, for example, almost all regions, Madeira being the exception, have lower propensity to use Internet financial services than Grande Lisboa (the reference region).

With respect to non-financial uses, in general a few trends stand out. First, age is significant for entertainment uses (those reporting downloading music, games, and videos, as well as entertainment); younger users consistently access the Internet for non-financial uses at a greater level than older users. Also, education is significant for news-related uses; users with more years of education access the Internet for news at a greater level than less-educated users. Also, the variable years, which quantifies the length of time the respondent has had home Internet access, is significantly correlated with online shopping, perhaps indicating that those more familiar with Internet use become more trusting of Internet shopping opportunities. Mobile broadband users are less likely than DSL broadband users to use broadband for most of the non-financial uses.

Lastly, we compare mobile usage as a percentage of fixed usage by age group and across regions. Figure 15 shows that per customer usage in 2006, measured in hours per week, for mobile is higher relative to fixed in older age groups, perhaps due to these groups having higher income and therefore greater ability to pay for mobile broadband. With respect to the regions, the figure indicates that differences between fixed and mobile usage are lowest in Algarve, although it is not clear why. Conversely, differences are most dramatic in Açores and Madeira, both island regions. This is to be expected as mobile communications are less costly on the margin than fixed communications due to the geography.

Explanatory Variables	Dependent Variables				
	File Taxes	Internet Banking	Paying Services	Study Related Materials	VOIP
	n=1,678	n=1,678	n=1,678	n=2,324	n=2,281
Years household has had home Internet access	1.12*** (0.03)	1.10*** (0.03)	1.14*** (0.03)		1.12*** (0.03)
Narrowband				0.29** (0.16)	
Reliability of service	1.32** (0.15)				
Age 26 to 35		4.75*** (2.08)	2.47** (1.10)	0.37*** (0.11)	
Age 36 to 45		2.78** (1.22)		0.48** (0.15)	
Age 46 to 55		2.15* (0.95)		0.40*** (0.14)	
Age 56 to 65		2.59** (1.16)		0.34*** (0.13)	
Age 66 to 75	a	a	a	0.14*** (0.07)	
Age 76 up					19.45* (32.73)
Completed 12th grade (high school)	0.74** (0.11)	0.75** (0.10)		0.50*** (0.10)	
Completed 9th grade	0.51*** (0.08)	0.66** (0.11)	0.59*** (0.10)	0.41*** (0.09)	
Completed 6th grade	0.38*** (0.09)	0.37*** (0.08)	0.51** (0.12)	0.36*** (0.11)	0.29** (0.13)
Completed elementary school	0.29*** (0.05)	0.37*** (0.07)	0.50*** (0.09)	0.39*** (0.12)	0.43** (0.14)
Employed				0.53** (0.14)	
Two or more cars	1.66*** (0.19)	1.49*** (0.17)	1.46*** (0.17)		1.64*** (0.21)
Number in household			0.62** (0.14)	2.11*** (0.54)	
Number in household^2				0.92** (0.03)	
Population > 100,000		0.53** (0.16)	0.35*** (0.11)		
Norte Litoral	0.67* (0.14)			0.64* (0.17)	
Grande Porto	0.48*** (0.10)		0.65** (0.13)	0.42*** (0.10)	0.66* (0.16)
Interior	0.52*** (0.11)	0.50*** (0.10)	0.53*** (0.10)		0.67* (0.16)
Centro Litoral	0.65** (0.12)				
Alentejo	0.52* (0.17)	0.52* (0.18)			
Algarve		0.45** (0.15)	0.47** (0.16)		
Madeira				6.59* (7.24)	

Only those variables that were significant are reported; complete results are provided in the Appendix: A.IV.C.2, a, b, and c.

a. The variable was dropped from the model because of collinearity.

b. Standard errors are in parentheses.

* Significant at the 5% level; ** Significant at the 1% level; *** Significant at the .1% level

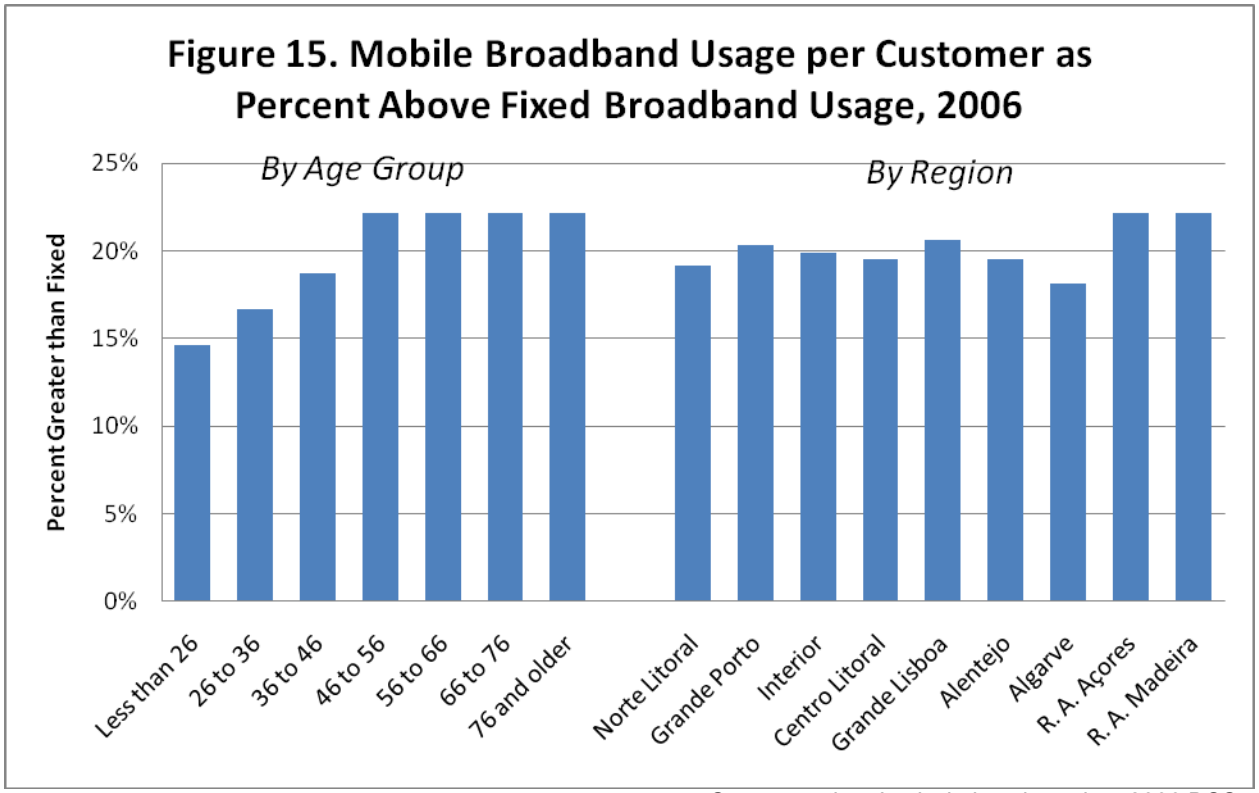
Omitted method of Internet access is DSL; Omitted age group is 16 – 25.
Omitted education is university degree; Omitted employment status is unremunerated activity.
Omitted population (habitat) and region is Grande Lisboa.
Source: authors' calculations based on 2006 BCS.

Table 9: Usage patterns of those older than 25 with Internet in the home: financial applications, BCS, 2006

Explanatory Variables	Dependent Variables			
	Downloading music, games, videos	Entertainment	Online News	Online Shopping
	n=2,324	n=2,319	n=2,319	n=2,314
Years household has had home Internet access			1.05* (0.03)	1.21*** (0.03)
Mobile	0.63* (0.17)	0.39*** (0.12)	0.58* (0.18)	
Narrowband		0.44* (0.20)		
Cable		1.27** (0.12)		
Satisfaction with Speed		1.22** (0.11)		
Reliability of service	0.84* (0.07)			
Age 26 to 35	0.68** (0.10)		1.54** (0.31)	1.34** (0.21)
Age 36 to 45	0.60*** (0.09)	0.76** (0.11)		
Age 46 to 55	0.45*** (0.08)	0.65*** (0.11)	1.47* (0.33)	
Age 56 to 65	0.32*** (0.07)	0.49*** (0.11)		
Age 66 to 75	0.19*** (0.08)	0.27** (0.11)	0.28*** (0.12)	
Age 76 up	0.09** (0.10)			
Completed polytechnic			0.48* (0.19)	
Completed 12th grade (high school)	1.25** (0.14)	1.38*** (0.16)	0.52*** (0.08)	0.79** (0.09)
Completed 9th grade			0.43*** (0.08)	0.73** (0.11)
Completed 6th grade			0.27*** (0.07)	0.62** (0.15)
Completed elementary school			0.26*** (0.06)	0.42*** (0.10)
Employed	0.73** (0.10)	0.56*** (0.08)	0.75* (0.13)	
Two or more cars	1.20** (0.12)			1.31** (0.14)
Norte Litoral	0.73** (0.12)			
Grande Porto	0.71** (0.12)	0.65*** (0.11)		0.41*** (0.08)
Interior	0.67** (0.11)	0.60*** (0.10)		
Alentejo	0.35*** (0.10)			
Madeira	2.23* (0.92)	3.94*** (1.89)	13.97** (14.91)	

Only those variables that were significant are reported; complete results are in the Appendix: A-IV.C. 2. D through k. Standard errors are in parentheses.
* Significant at the 5% level
** Significant at the 1% level
*** Significant at the .1% level
Omitted method of Internet access is DSL.
Omitted age group is 16 – 25.
Omitted education is university degree.
Omitted employment status is unremunerated activity.
Omitted population (habitat) and region is Grande Lisboa.
Source: authors' calculations based on 2006 BCS.

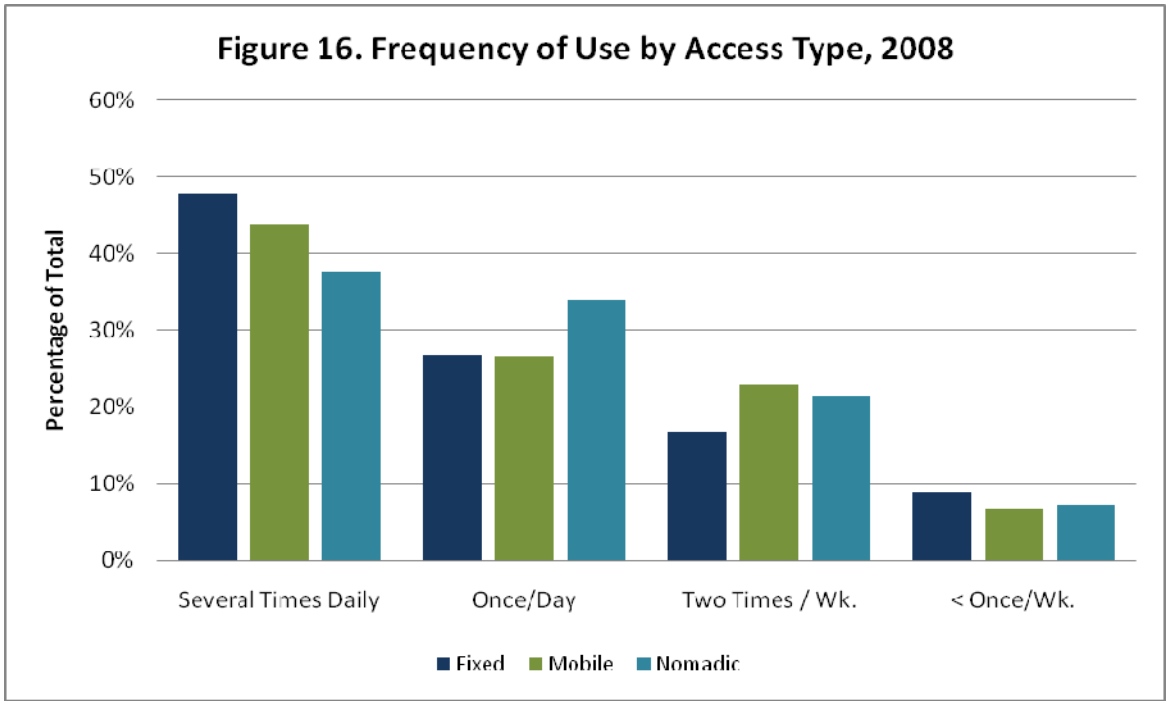
Table 10: Usage patterns of those older than 25 with Internet in the home: non-financial applications, BCS, 2006



Source: authors' calculations based on 2006 BCS.

With respect to the 2008 ICSCE data, the survey considered only VOIP. Our logistic regression (1,199 observations) provided few significant results with respect to characteristics of those using VOIP. Only age 65 and up, and employment status proved to be statistically significant, with older age decreasing usage, and being employed increasing usage. Full results are provided in the Appendix (A.IV.C.2)

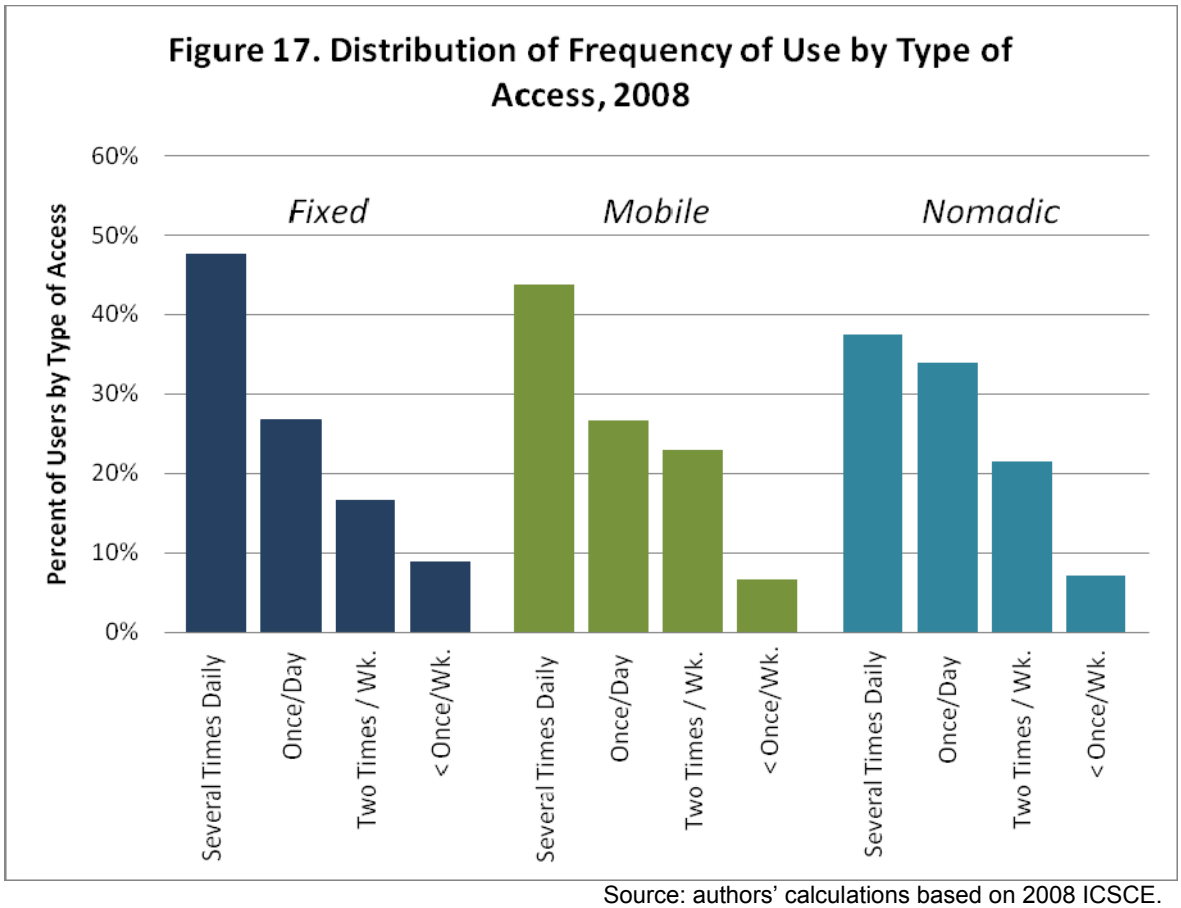
The 2008 ICSCE data does allow us to compare the usage profiles of fixed and mobile customers with nomadic customers. Figure 16 shows the distribution of users in each usage category. Fixed service subscribers are slightly more likely than the mobile or nomadic users to be the most frequent users; however, no clear patterns emerge with respect to variation by access mode.



Source: authors' calculations based on 2008 ICSCE

Figure 17 shows the data slightly differently, giving the distribution of frequency of use within each access type. It confirms that fixed service customers appear more likely to be frequent broadband users than other access customers, but it also indicates that nomadic customers may be different than fixed or mobile customers. Both fixed and mobile show similar usage profiles: between 40 and 50 percent of the customers of each access type use broadband several times each day, a little more than 25 percent use it at least once each day, and less than 10 percent use it less than once per week. The nomadic customers have a flatter distribution: less than 40 percent use it several times a day, more than 30 percent use it once per day, and over 20 percent use it twice per week. This is consistent with what we might expect of nomadic users: at least some of them would have to physically go to a hotspot to access the Internet and this inconvenience would lower the number of times they use broadband relative to users that have it available at home (i.e., fixed and mobile subscribers) or with them as they move about (i.e., mobile subscribers).[58]

[58] Respondents are asked what type of home Internet access they use, and those responding "nomadic" may therefore interpret this question as asking what type of Internet access they use either most frequently for personal reasons, or access other than at and for work.



Source: authors' calculations based on 2008 ICSCE.

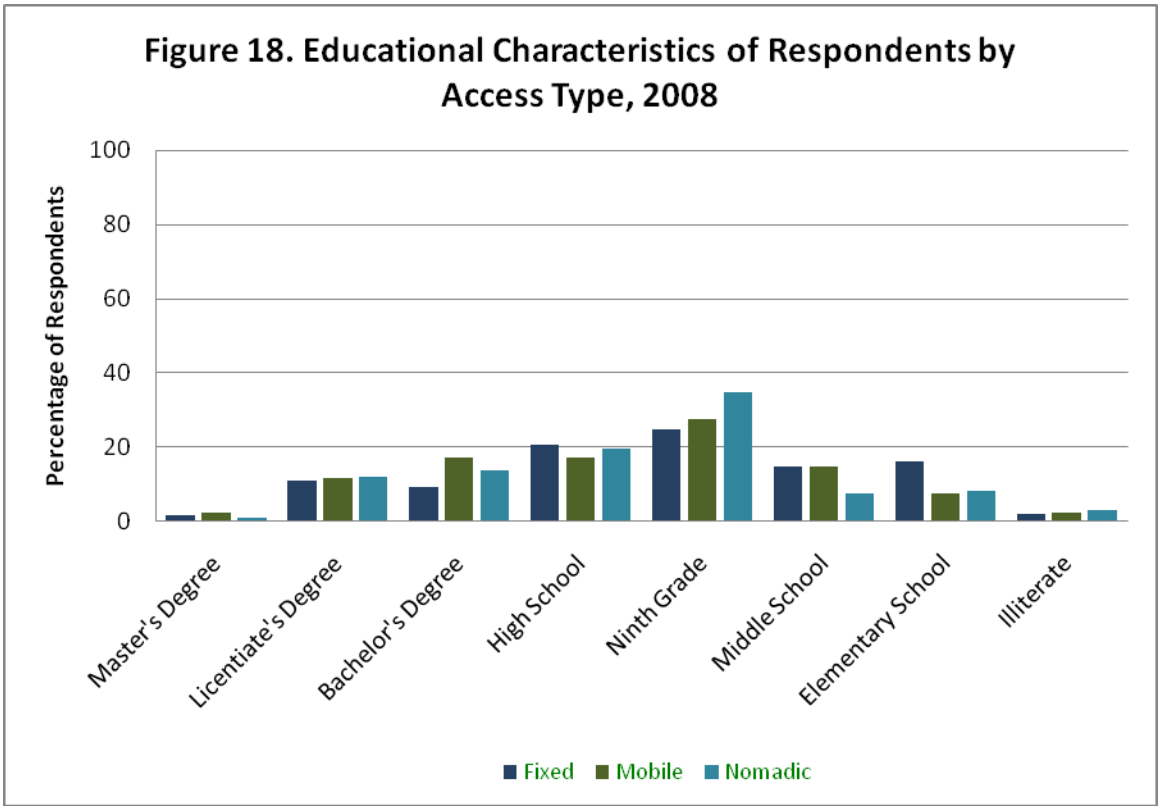
Portions of our analyses considered differences between users of fixed, mobile, and nomadic broadband. We have limited information on nomadic broadband users, but found few differences between fixed, mobile, and nomadic broadband customers in terms of hours of use, implying that at least fixed and mobile broadband are viewed as substitutes by many customers. The differences we found in our above analyses using both 2006 BCS and 2008 ICSCE datasets include the following statistically significant findings:

- Mobile broadband users are slightly less satisfied than fixed and nomadic with their service, but fixed and nomadic broadband customers have about the same degree of satisfaction.
- Customers of the three types of access – fixed, mobile, and nomadic – are similar in their satisfaction with their service speeds.
- Most customers do not switch providers.
- As shown in Figure 15, mobile broadband customers are heavier users in terms of hours of use than are customers of fixed broadband.
- Mobile broadband subscription is higher relative to fixed in older age groups.
- Most regions are similar in their use of fixed and mobile broadband, but Açores and Madeira, both island regions, show relatively more mobile broadband usage than the other regions.
- Most respondents who are accessing the Internet from home multiple times per day are doing so via fixed communications.

D. Identification, Comparison and Explanatory Analysis (in Terms of Socio-Geo-Demographic Variables) of Factors that are Common and Different Between End Users of Fixed, Nomadic, and Mobile Broadband.

It appears from our analyses that mobile and fixed broadband are viewed as reasonable substitutes by customers; however, our available data on nomadic users is limited: data gathering on nomadic users has only recently begun in Portugal and Brazil and the use is relatively new across Europe. As Standard and Poor's (2009) observed, services based on WiFi and WiMAX technologies are just recently emerging in Europe and the services are expected to complement fixed and mobile broadband rather than be a strict substitute for them. Indeed many home subscribers of fixed broadband can be expected to set up WiFi networks within their homes, leading them to use WiFi enabled laptops to access their home fixed broadband services and then using these laptops to be nomadic users away from home. Furthermore some broadband mobile phones, such as the Nokia E71, are WiFi enabled, allowing the user to choose whether to use 3G or a hotspot when a hotspot is available. Thus, a user of such a phone is both a mobile broadband subscriber and a nomadic user. Standard and Poor's also observes that personal computer penetration may soon cap fixed broadband penetration in Europe, implying that mobile broadband may be the future means of expanding broadband penetration, although higher prices for wireless broadband seem to be standing in the way.

With respect to characteristics of fixed, mobile, and nomadic broadband users, we find some variation. Figure 18 indicates that fixed and mobile broadband subscribers differ with respect to education and perhaps income. Mobile broadband users are more likely than their fixed user counterparts to have a university education and to have graduated from high school. They also are more likely to own a dishwasher, perhaps indicating higher incomes. These factors consistently are present in the empirical models as well. For example, in our first model we analyze the differences in characteristics of individuals who have no Internet at home versus those who have broadband. We also compare fixed broadband to mobile broadband.



Source: authors' calculations based on 2008 ICSCE.

To obtain robust empirical results for questions regarding user characteristics, we employ a utility model in which the utility of individuals from alternative modes of Internet access depends on characteristics of the individual / household, and on characteristics of the respective mode of Internet access.[59] Specifically, we utilize a multinomial logit model,[60] which is an extension of the logit regression model used to represent the choice between mutually exclusive options. The multinomial logit requires the distribution of the random error terms to be independent and identical over the alternatives. This can produce biased estimates if the cross-elasticities between all pairs of alternatives are identical. As stated above, the major weakness of the multinomial logit is that the choice between alternatives (i.e., DSL versus cable) depends solely on the characteristics of those alternatives being compared, excluding the characteristics of any other alternatives possible.

The dependent variable for this model is a binary (dummy) variable representing households' broadband choices. Our explanatory variables include the age, education level, and employment status of the main income contributor, the number of people in the household, the number of children in the household, the occupation of the primary respondent, wealth, region, and habitat. Tables 11.1 and 11.2 provide results of the multinomial logit estimations used to compare individuals' characteristics by the manner

[59] Utility in our model also depends on a random disturbance that has extreme value distribution of type I, which gives rise to logit models of choice between alternatives.

[60] A multinomial logit is appropriate for any binary dependent variable y_i and a continuous independent variable x_i, $Pr(y_i=1)=F(x_i' b)$ where, as before, b is a vector of parameters to be estimated and F is the logistic cumulative distribution function.

in which they access the Internet for the years 2006 and 2008 (BCS and ICSCE data, respectively). The base (omitted) alternative is Internet access by fixed broadband. The first column lists those variables that were significant in one or more of the estimations.[61] The following three columns provide results of the comparison of characteristics of those respondents who did not have Internet access at all, who had narrowband access, and who had mobile access. Because only 151 respondents reported having more than one method of Internet access in their home, the classifications are appropriate. We report relative risk ratios (rather than coefficients), which represent the probability that respondents choose an alternative, such as mobile broadband, relative to the omitted (reference) alternative, which in this case is fixed broadband. For example in Table 11.1, households with at least two cars are 1.73 times more likely to get mobile broadband instead of fixed broadband than households with a single car or without a car.

The results indicate that older persons and persons with lower education levels, lower incomes, and smaller households are the least likely people to have Internet access of any form. Madeira is the region where people are least likely to have no Internet access. The relative probability of a wealthier respondent not having Internet access in the home is 0.36, meaning most people of higher income do have Internet access in their home. The choice of narrowband versus fixed broadband follows a similar pattern, with older persons being more likely to have narrowband than fixed broadband. High school graduates were 2.7 times more likely not to have Internet than to have fixed broadband compared to university graduates, but about equally likely to have narrowband or fixed broadband.

In general, having at least one child appears to make it more likely that a household will not have home Internet access. Similarly, larger households are less likely to have Internet access at home, but household size does not affect significantly the choice between different types of Internet access.[62] Initially the probability of not having Internet at home relative to that of having fixed broadband decreases with family size, but that probability increases for families with at least five individuals;[63] the minimum probability of not having home Internet access instead of having fixed broadband Internet access is for a household size between four and five members[64].

The results also indicate that income (proxied by the dummy variable for two or more cars in Table 11.1, and owning a dishwasher in Table 11.2) and education are the primary factors related to the choice between fixed and mobile broadband. Compared to respondents with a university degree, those who graduated from high school were

[61] The exception is that we include all regions and habitats to make it clear that Lisbon is the omitted alternative.

[62] It is unclear from the data why the presence of children and larger household size decreases the probability of having Internet access given the common understanding that Internet access is useful for education and entertainment. We note from Figure 14 that while “study search”, which would appear to be an educational use, is a prominent use of the Internet in Portugal, general information searching and obtaining news are comparable and might not be related to children or household size. This issue would appear to require further study to find an answer in which we could place more confidence.

[63] The actual coefficients are $-0.7594721*dc\_3+0.0799416*dc\_3^2$.

[64] The minimum is 0.7594721/(2*0.0799416)=4.75 household members.

approximately half as likely to get mobile instead of fixed broadband (the relative probability is 0.55).

Customer Characteristics	Odds Ratio for Choosing Designated Access Method Relative to Choosing Fixed Broadband		
	No Internet n = 8,249	Narrowband n = 8,249	Mobile Broadband n = 8,249
Age 26 to 35	2.23*** (0.26)	1.67** (0.42)	
Age 36 to 45	2.30*** (0.29)		
Age 46 to 55	2.27*** (0.27)		
Age 56 to 65	4.31*** (0.56)	2.18** (0.67)	
Age 66 to 75	10.42*** (1.93)	2.45* (1.18)	
Age 76 up	72.14*** (36.62)		8.86e-14*** (5.34e-14)
Completed polytechnic school	2.88*** (0.63)		
Completed 12th grade (high school)	2.66*** (0.29)		0.55** (0.16)
Completed 9th grade	4.63*** (0.51)	1.48* (0.32)	0.49** (0.18)
Completed 6th grade	6.36*** (0.78)		
Completed elementary school	11.52*** (1.21)		
Did not complete elementary school	37.34*** (11.75)		3.09e-14*** (1.31e-14)
Child in the household = 1 if yes	1.66*** (0.15)		
Number in household	0.45*** (0.6)		
Number in household squared	1.09*** (0.02)		
Grande Porto = 1 if respondent in Porto	0.50*** (0.13)		
Two or more cars	0.36*** (0.03)		1.73** (0.39)
Norte Litoral	1.77*** (0.19)	3.18*** (0.79)	2.44** (0.86)
Interior	1.52*** (0.18)	2.37*** (0.64)	2.13** (0.82)

Centro Litoral		1.59* (0.45)	
Alentejo	1.54*** (0.26)	2.54** (0.97)	3.39** (1.82)
Algarve	1.79*** (0.37)		
Madeira	0.64** (0.15)		
Acores	2.31*** (0.51)		
Population < 10,000	0.77* (0.12)		
Population > 100,000		0.25** (0.16)	

Only those variables that were significant are reported; complete results are in the Appendix: A.IV.D.1. Standard errors are in parentheses.
* Significant at the 5% level
** Significant at the 1% level
*** Significant at the .1% level
Omitted age group is age 16 to 25.
Omitted education level is university degree.
Omitted region and population (habitat) is Grande Lisboa.
Source: authors' calculations based on 2006 BCS.

Table 11.1: Characteristics of individuals by Internet access method, BCS, 2006

	Odds Ratio for Choosing Designated Access Method Relative to Choosing Fixed Broadband			
Customer Characteristics	**No Internet n = 3,572**	**Narrowband n = 3,572**	**Mobile Broadband n = 3,572**	**Nomadic Broadband n = 3,572**
Female	1.844*** (3.31)			
Age 25 to44	2.958*** (3.45)			
Age 45 to 64	3.098** (3.00)			
Age 65 up	12.578*** (3.81)	16.886* (2.34)	0.000*** (-25.51)	0.000*** (-31.31)
Completed 12th grade (high school)	0.262*** (-5.37)	4.885* (2.22)		
Completed university	0.106*** (-7.61)			
Head_student				0.000*** (-46.56)
Head_unempl				0.020*** (-3.37)
Head_retired			0.000*** (-41.03)	
Head_other_inactive		38.915*** (3.42)		0.000*** (-42.59)

Dishwasher	0.137*** (-10.26)			
Two people in household				
Three people in household	2.777** (2.80)			
Four people in household	2.775** (2.64)			
Five or more people in household	3.093* (2.56)		0.072* (-2.12)	
Centro				
Lisboa	0.470** (-2.96)	0.115** (-2.60)		
Alentejo		1.31e-15*** (-51.47)		
Algarve			0.000*** (-33.87)	12.975** (2.73)
Acores	0.293*** (-4.66)			0.168** (-3.21)
Madeira	0.230*** (-5.67)	0.215* (-2.30)		0.0142*** (-3.57)
2000-9999 inhabitants		4.329* (2.13)		
10000-49999 inhabitants	0.321*** (-4.29)			
50000-99999 inhabitants	0.327* (-2.39)		0.000*** (-53.82)	
At least 100000 inhabitants	0.395** (-3.25)			
Child 15 – 24 in the household = 1 if yes	0.181*** (-6.35)			

Only those variables that were significant are reported; complete results are in the Appendix: A.IV.D.1.
t-statistics are in parentheses.
Omitted age group is 15 – 24.
Omitted education level is primary.
Omitted household size is one member.
Omitted region is Norte.
Omitted employment group is student.
Source: authors' calculations based on 2008 ICSCE.

Table 11.2: Characteristics of individuals by Internet access method, ICSCE, 2008

Within this section of the study we also are able to incorporate some comparisons with communications services in Brazil. Specifically, we report first the number of subscribers in Brazil, and then present various figures that illustrate the similarities and differences between Portugal and Brazil. We are unable to incorporate the Brazilian data into econometric models given that it is limited and aggregated. Still, the following figures provide a guideline as to the status of broadband subscription relative to subscription in Portugal.

Table 12 shows mobile telecommunications subscriptions in Brazil by technology. As with most countries, Brazil began with first generation (1G) mobile technologies, which were analog. These technologies quickly gave way to second generation (2G), digital technologies. These technologies continue to grow as they are the primary means for providing mobile voice services. In 2008 3G mobile services began showing up in Brazil's statistics. These technologies make mobile broadband possible over traditional mobile networks. However, other mobile technologies are also feasible, namely those of WiFi and WiMax, which make nomadic mobile services possible. Nomadic mobile also is showing up in Brazil's 2008 statistics, but as with 3G, these services are still in their infancy.[65]

		Numbers of Subscriptions in Brazil (November of each year)						
		2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Technology	**1G**	872,935	619,727	372,262	138,490	65,402	22,965	11,933
	2G	32,398,968	42,390,904	60,816,472	82,213,154	97,266,377	116,290,862	144,819,357
	3G	0	0	0	0	0	0	1,622,183
	Nomadic	0	0	0	0	0	0	598,924
Total Subscriptions		**33,271,903**	**43,010,631**	**61,188,734**	**82,351,644**	**97,331,779**	**116,313,827**	**147,052,397**

Source: data provided by ANATEL.

Table 12. Telecommunications subscriptions in Brazil, 2002-2008

The next several figures compare Brazil and Portugal. Figure 19 shows personal computers per 100 population for the two countries from 1998 through 2007. In the early part of this period, Portugal led Brazil in this category but by 2004, Brazil appears to have caught up. The lack of change in Portugal from 2002-2004 raises the question of whether there was a change in how these data were gathered or measured for Portugal, but assuming the data are reasonably accurate, the penetration of personal computers should not lead to differences in broadband adoption between the two countries.

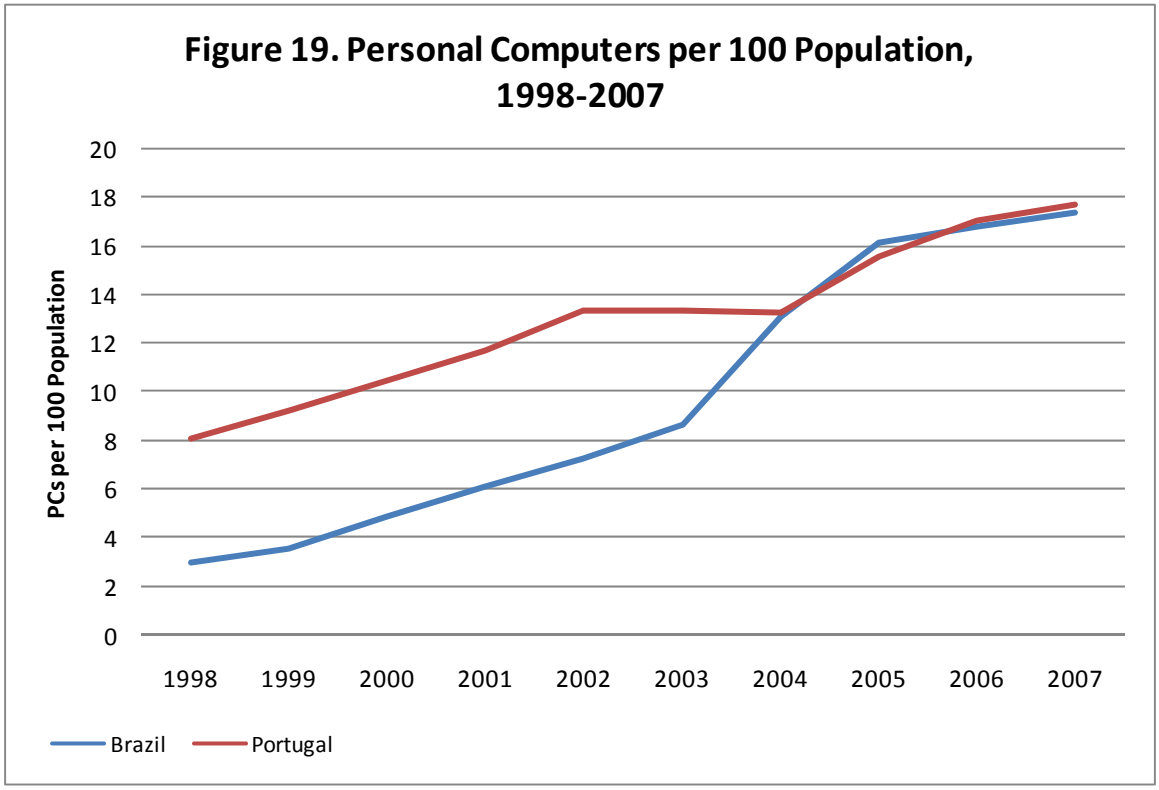
As Figures 19 and 20 show, there are significant differences between the two countries in terms of fixed broadband penetration. Figure 20 shows fixed broadband subscriptions per 100 population for the two countries from 1999 through 2007. Figure 21 shows a comparable series, but uses households as the base because a household, not a person, is the typical consumer of fixed broadband. Both countries start low in 1999 and 2000, as would be expected, but Portugal quickly out paces Brazil, ending 2007 with

[65] A country's technology and radio spectrum management choices affect the evolution of mobile communications, including broadband. For instance some countries choose technology standards for mobile communications, while others allow industry participants to make those choices. Uniform technology standards promote system wide compatibility, but sometimes at the loss of systems competition and alternative paths for technology evolution. For an examination of the importance of technologies and radio spectrum management in mobile telecommunications, see Wakefield et al. (2007).

approximately 15 fixed broadband connections per 100 persons and 44 fixed broadband connections per 100 households, compared with 4 and 14 for Brazil.[66]

The orders of magnitude differences between Brazil and Portugal are similar to the differences between the two countries in terms of overall teledensity: according to the ITU in 2006 Portugal had about 156 fixed and mobile phones per 100 population while Brazil had 73. However, the differences between the two countries are smaller in terms of overall Internet penetration. Figure 22 presents ITU data for Internet users per 100 population for the two countries. As this figure shows, while Portugal has led Brazil in terms of Internet penetration, the South American country has gained on its European counterpart in recent years: while Portugal had almost three times the number of Internet users as Brazil as recently as 2002, in 2007 Portugal led Brazil by less than 30 percent.

Often differences in telecommunications penetration between countries can be explained by differences in per capita GDP; this does not appear to be the case for Portugal and Brazil. As Figure 23 shows, the gap between Portugal and Brazil in terms of per capita GDP grew during the time that differences in Internet and broadband penetration were shrinking.

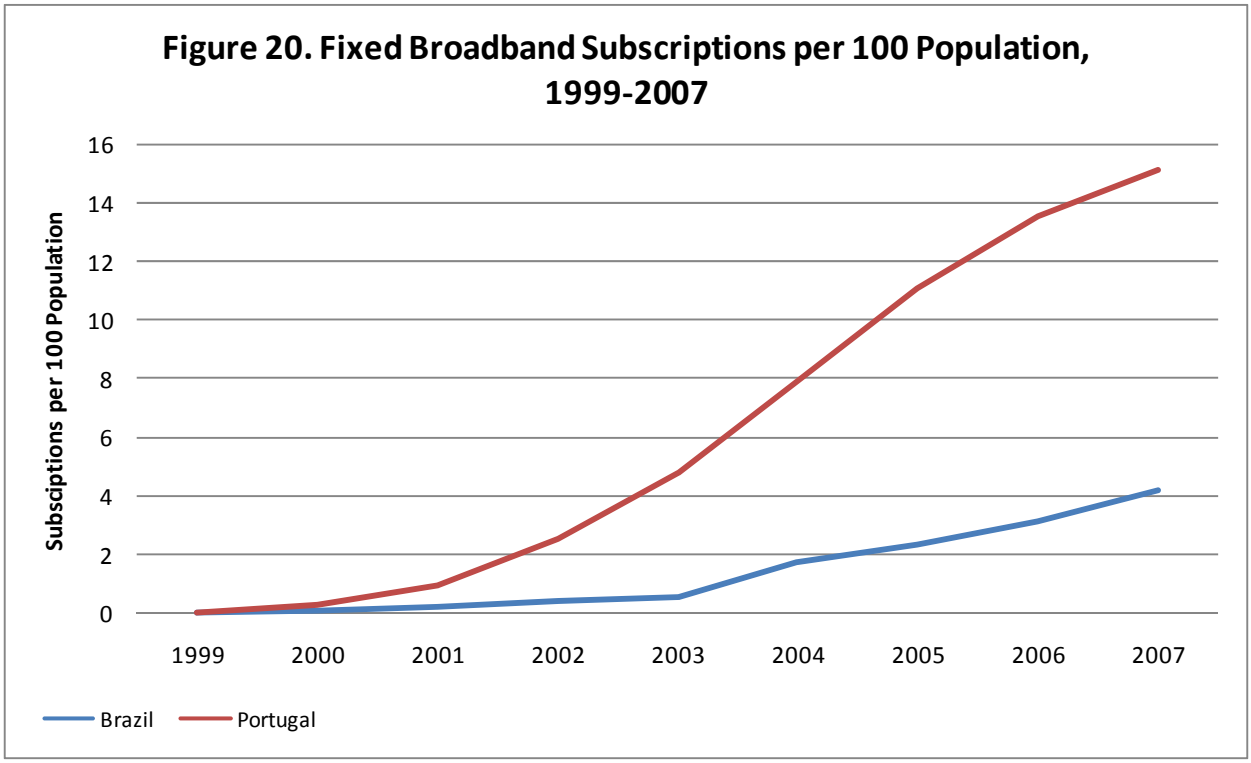


Source: authors' calculations based on ITU and Computer Industry Almanac data.

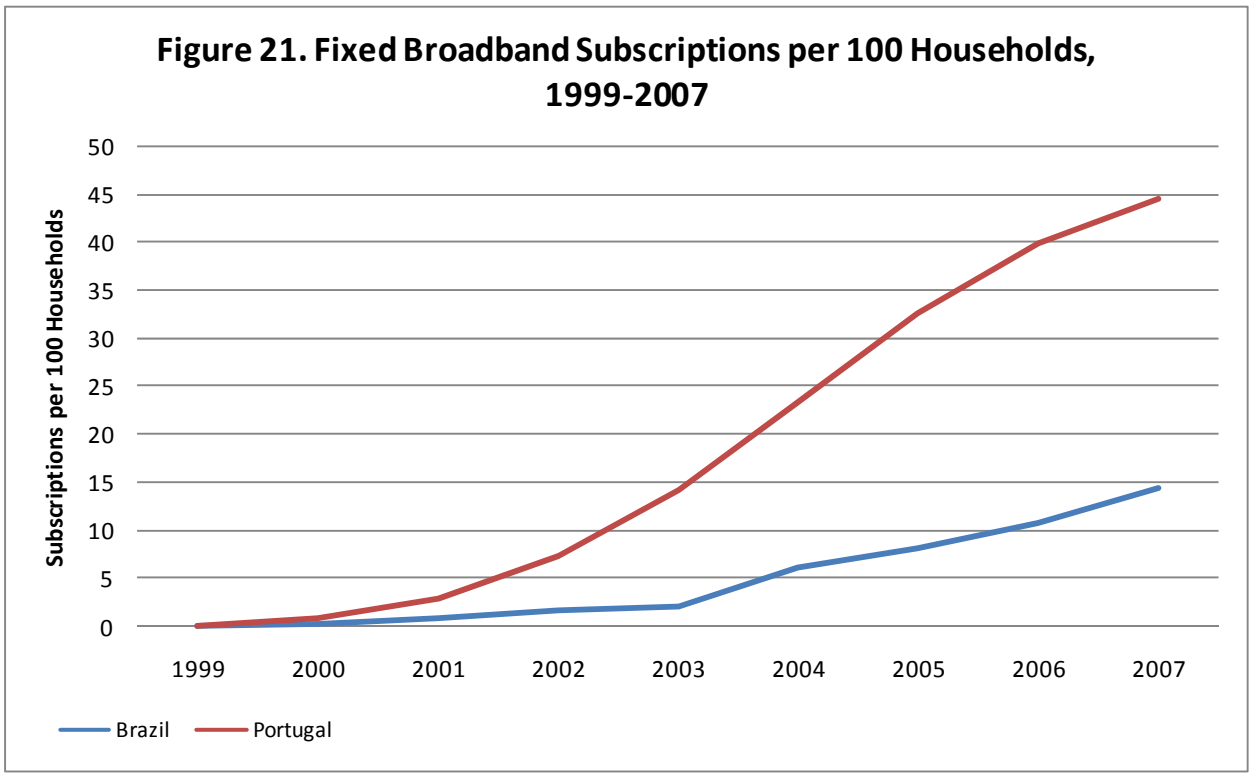
The figures comparing Portugal and Brazil illustrate that Brazil clearly has lagged behind Portugal in subscriptions; however, there was a significant increase in personal

[66] Ofcom (2008), citing IDATE, shows that Brazil's broadband penetration per household is comparable to two other large emerging markets, namely Russia and China, while being ahead of a third, namely India.

computer ownership in Brazil in 2003 and 2004, perhaps prompted by a reduction in taxes applied to low-end personal computers in Brazil after 2003. The uptick in personal computers in Brazil made ownership there equivalent to ownership in Portugal. This increase in the ability of households to connect to the Internet from their homes is likely to be a necessary precursor to a similar dramatic increase in broadband subscription, as indicated by the relatively rapid increase in Internet users. This possibility should be explored in greater detail as improved data become available.



Source: authors' calculations based on ITU data.



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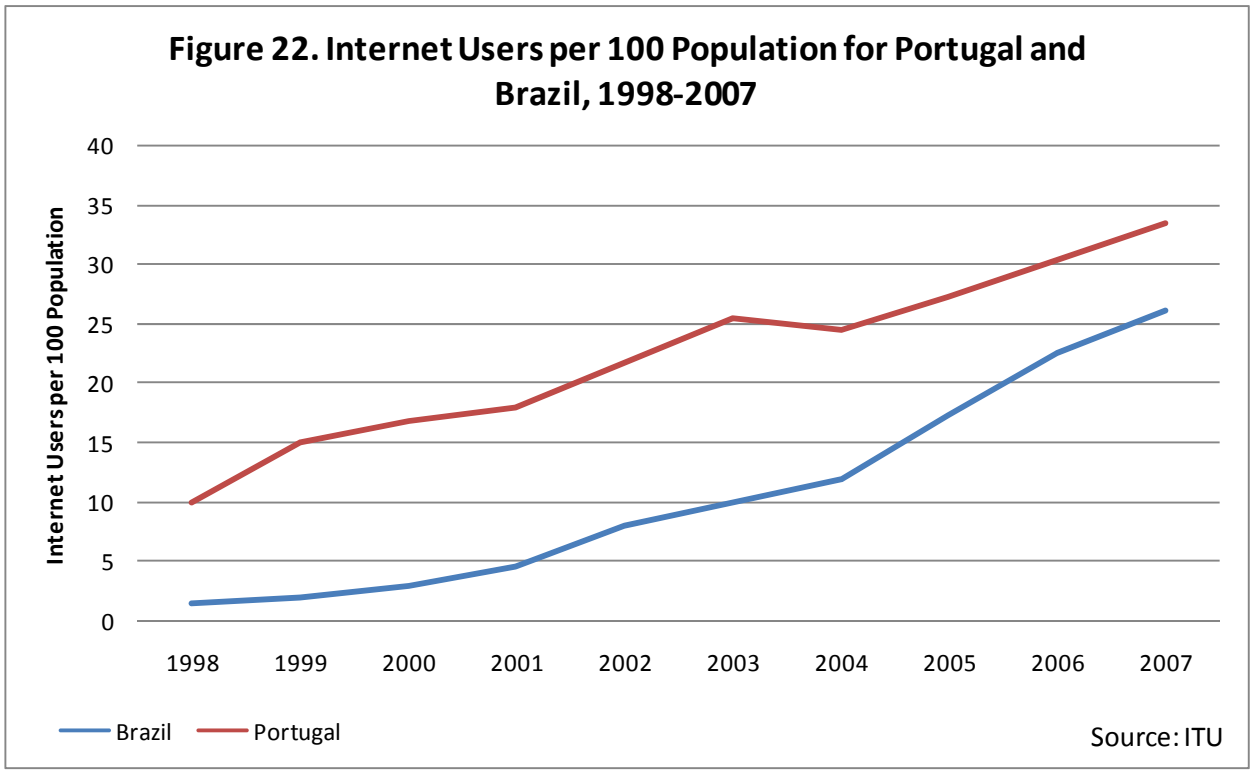

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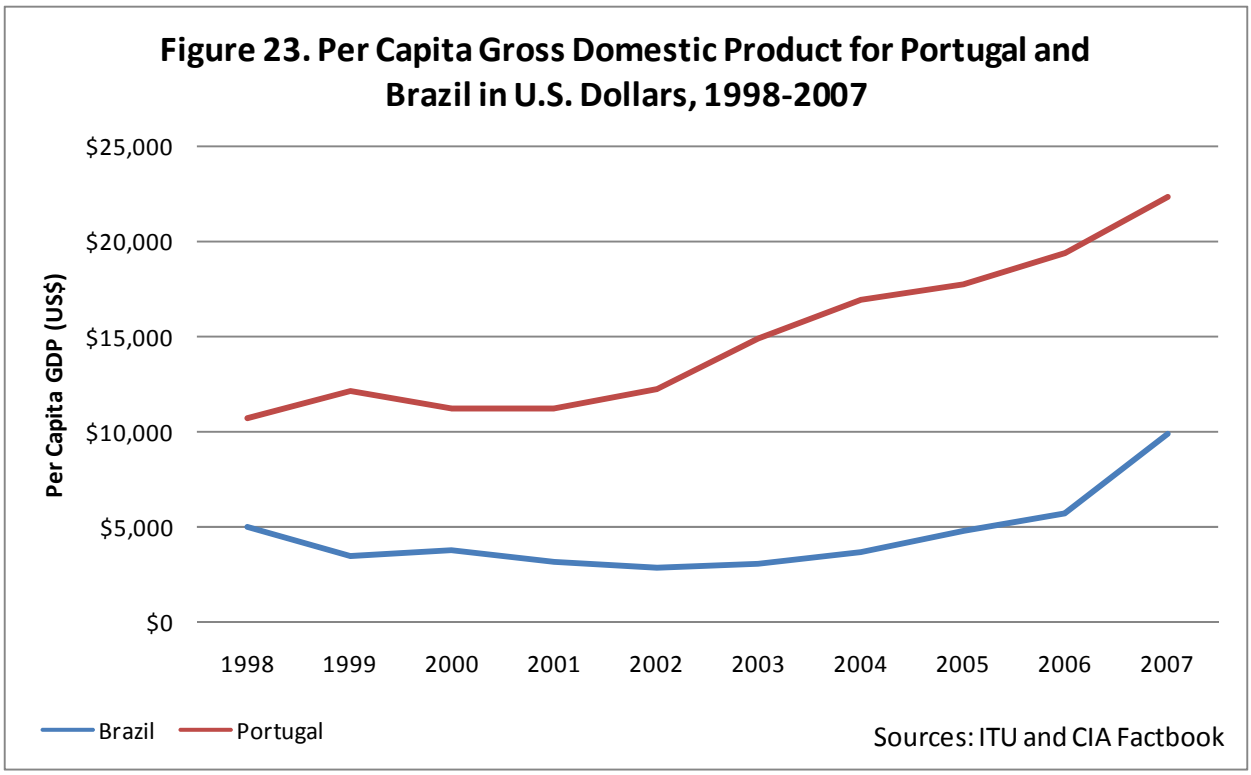


Source: authors' calculations based on ITU data.

E. Identification, Comparison, and Explanatory Analysis (in Terms of Socio-Geo-Demographic Variables) that are Common and Different Between End Users Who Are Simultaneously Clients of Fixed, Nomadic, and Mobile Broadband.

Finding differences across end-users who choose multiple types of access is a valuable goal to help determine the degree to which such access types are substitutes. In this respect we have some limited support for the notion that multiple access types are indeed substitutes: of approximately 8,600 respondents in the 2006 BCS survey, we found only 151 (1.76 percent) who report having more than one type of home Internet access. Still, we hope to ascertain reasons for multiple modes of access to better understand substitutability across such modes, as these respondents indicate that various access types are not perfect substitutes. We suggest that fixed broadband might be deemed more valuable for those with a fixed location who want higher bandwidth, while mobile may be more useful for those who also are more mobile.

As we indicated above, nomadic users often are also fixed broadband subscribers or mobile broadband subscribers. This results from the growth of home WiFi networks and the converged device market, which in Europe has grown from about 11 million units sold in 2005 to more than 15 million in 2006. Furthermore, the converged device customer profile has been changing in Europe. As recently as 2005, most high-end smartphones were used primarily for business. Now consumers are using these convergence devices, such as the BlackBerry Pearl or Palm Treo 750, for web browsing, checking personal e-mail, managing family schedules, and the like. This has

happened in part because of a decrease in prices: T-Mobile UK has given the BlackBerry Pearl away for free with some wireless calling plans and, in 2008, T-Mobile Germany launched the iPhone in packages priced for the residential user.[67]

Table 13 provides information on the number of types of Internet access within a house in Portugal in 2006. As reported above, the vast majority has only one form of access, and such access is not through 3G mobile phone. Nevertheless, we examine those 151 respondents with more than one type of access to find usage patterns or trends.

In Figure 24 we compare the education and income level (by proxy) of those respondents reporting two or more types of Internet access in their homes in 2006. Those reporting multiple access types generally have a higher level of education, and also greater income. While income is expected to be a significant predictor of multiple modes of access, the link between multiple modes of access and education is not as predictable. It remains to be determined why individuals need more than one access type; in other words, for a small subset of our sample database it is clear that types of access are not perfect substitutes; there must be value in different forms of access.

		Mobile phone operator for respondents with Internet access through 3G mobile phone			
Number of types of Internet access used in respondent's house	**Total**	**Optimus**	**TMN**	**Vodaphone**	**No Answer**
One	3094	9	9	16	3060
Two	121	1	0	2	118
Three	13	0	0	0	13
More than three	17	0	0	0	17
No answer	338	0	0	0	338
Total	3583	10	9	18	3546

Source: authors' calculations based on 2006 BCS.

Table 13: Internet access and 3G mobile phone operators, BCS, 2006

There are evident regional variations as well, as shown in Figure 25. Noticeably, Madeira having about the same number of homes with two, three, or more types of access and Algarve having only one type. Being island regions we might expect Açores and Madeira to be similar; however, they do not appear to have the same options available.

Finally, we find that average age falls steadily with an increase in the number of types of access (from an average age of 36.23 years to 31.29).[68]

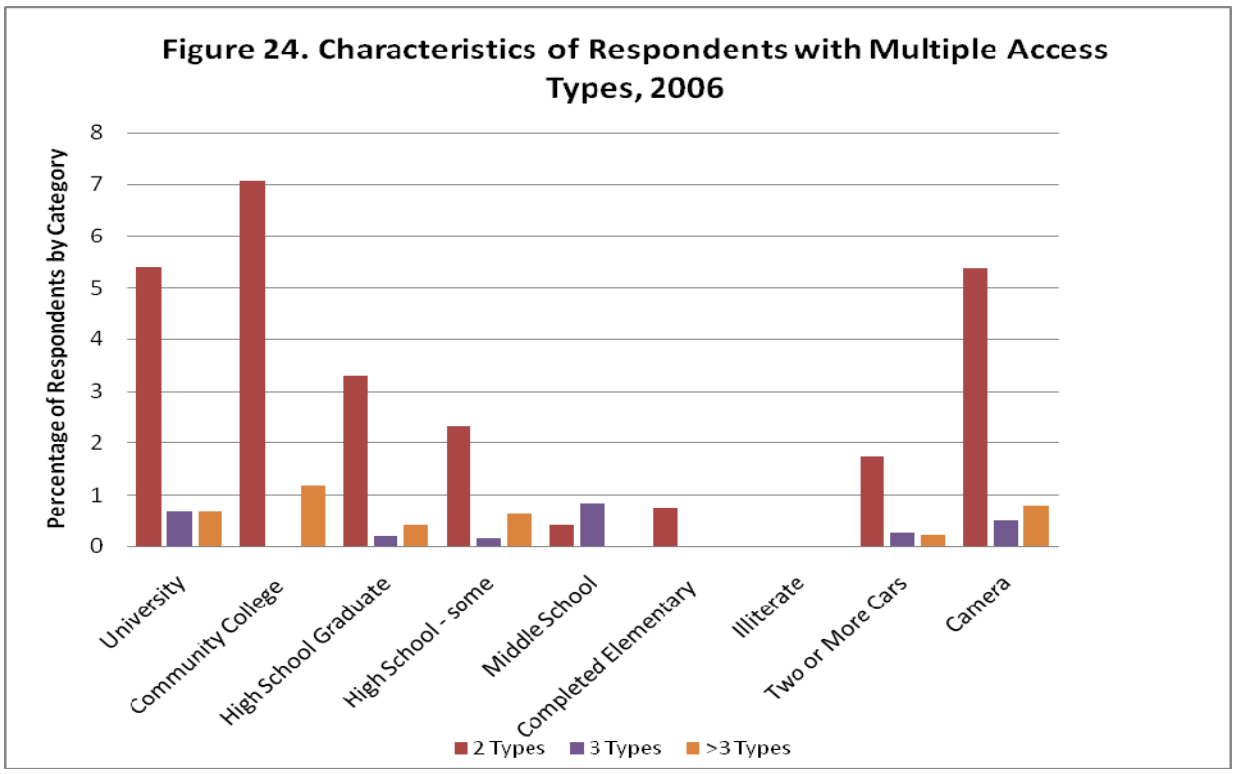
F. Evaluation of the Degree of Substitutability Between Fixed, Nomadic, and Mobile Broadband.

[67] IDC, as cited by Standard and Poor's (2009).
[68] Result is not shown in a figure.

According to OECD studies (2007), most countries saw a decrease in fixed access lines as mobile access subscriptions increased. This may be interpreted as consumers dropping their fixed lines that now are viewed as redundant, i.e., the technologies are substitutable.[69] Still this is not as clear for all countries. This is because some operators require customers to continue to pay for a fixed line in order to get DSL access. This blurs the line between fixed and mobile as consumers end up reportedly in both categories. VOIP also may be categorized as broadband. To begin to account for this difficulty, some studies differentiate between the number of paths data can travel and the number of channels; this allows a better understanding of an individual consumer's Internet access mode. In countries with strong fixed line infrastructure generally these lines are kept. In countries with less advanced fixed line infrastructure the move towards mobile communications can be seen more readily.

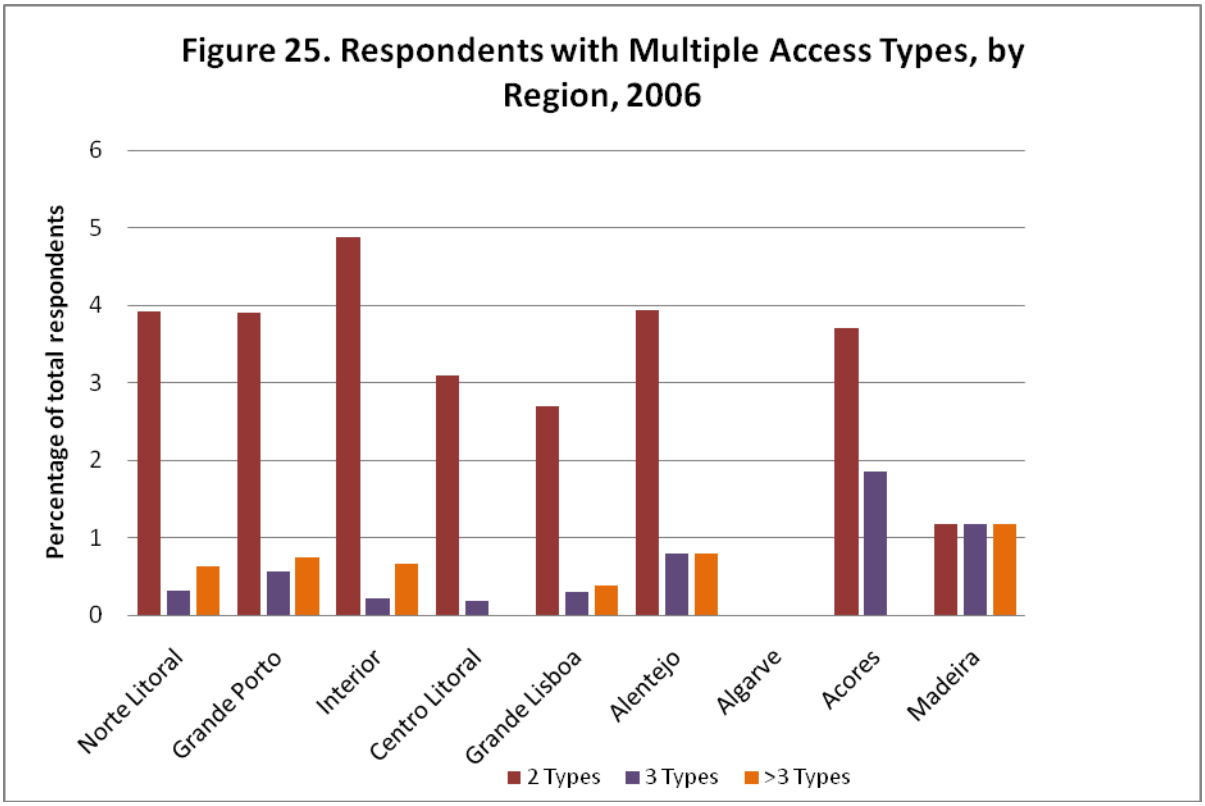
Generally we measure substitutability using cross-price elasticity as explained in Section IV.B. Because the pricing data needed to carry out cross-price elasticity calculations are not available, we consider demand factors. If demand drivers differ, the goods might not be perfect substitutes.

As we discuss above, purchasers of mobile and fixed broadband share similar characteristics, implying that the products could be substitutes. This does not rule out that the products also could be complements in some situations. For example some customers of fixed broadband might find the service so useful that they begin using broadband for many applications, making it valuable to subscribe to mobile broadband also. We cannot test this possibility with the current data.



Source: authors' calculations based on 2006 BCS.

[69] See OECD (2007), page 97.



Source: authors' calculations based on 2006 BCS.

V. Future Directions for Study

In this section we briefly summarize possible future directions for studies of broadband, primarily related to Portugal and Brazil. We begin with future directions that could be made possible with the important data collection that ANACOM is conducting and that could be conducted in Brazil.

A. Data Enhancements and Research Extensions

The surveys in Portugal are gathering important information on customers and usage. Additional data on prices for narrowband and broadband (both fixed and mobile), as well as nomadic, would allow us to determine the elasticity between technologies. Speed information and volume of traffic both would improve the strength of the models employed. Actual expenses per month for service bundles including broadband, television, fixed telephony, mobile telephony, as well as actual usage of each service for fixed and mobile (number of hours, not just number of occurrences) are needed. It is difficult to analyze bundles without detailed knowledge about the package, but since this is how customers are purchasing the services, these details would be important to gather.

Furthermore, it would be important to design existing survey questions so that they lend themselves to more rigorous analysis. For example, it is difficult to determine whether

customers understood some of the survey questions, or at least understood them the same way that we interpret them for quantitative analysis.

In the future, we would hope to incorporate models using the e.iniciativas survey data. This would allow additional analyses of the relationship between fixed and mobile broadband and the manner in which mobile broadband access affects the amount and patterns of Internet use, especially if we have limited additional data about plan characteristics for the plans in the current broadband surveys. The variables and models in the e.iniciativas survey are similar to the data from the broadband surveys, but the former has certain advantages (as well as disadvantages).

Strengths of the e.iniciativas data include a larger number of mobile subscribers, so it is more likely we will be able to analyze substitution between fixed and mobile broadband. Also, prices for similar plans (in terms of nominal speed, volume levels, and length of contract) are the same, while the nominal speeds for plans offered by different operators also are identical. This then resembles a controlled experiment to estimate the importance of other characteristics such as operator reputation and existing market share. Finally, we may be able to utilize information about changes in usage in terms of changes in the amount of use, as well as pre and post usage patterns as a result of subscription to mobile broadband.

The data is limited as discussed above in that the e.iniciativas survey is not nationally representative (the program is targeted towards students and professors). In e.iniciativas, the three UMTS operators had different levels of responsibility given the licensing procedure of UMTS and the different levels of fulfillment of their commitments. This means that the three UMTS entered the e.iniciativas program with more offers than others. Also, we do not have information about the chosen laptop (the other product in the bundle), which is needed to distinguish the role played by laptop characteristics in determining the choice of providers or plans from the role of factors such as provider reputation, length of contract, and plan characteristics. Potential sources of additional data include ANACOM and operator websites.

B. Other Important Research Questions

There are several important research questions that could drive future directions, including those relating to nomadic use, market competition, and resolving cause and effect questions.

Regarding nomadic usage, our analyses indicate that nomadic subscriptions in Portugal follow a different pattern than does the development of hotspots. This implies that hotspots are a broader market than nomadic Portuguese customers. The location choices and technology impacts of hotspots should be explored, as should the types of customers who find nomadic use to be a substitute for fixed or mobile broadband descriptions. Such analyses could inform important public policy questions about regulatory oversight (if any) that might be appropriate for nomadic subscriptions and hotspots. This could be particularly important in countries like Brazil that are growing rapidly and have large geographic space.

Market performance is an important question. Further work on price elasticities and cross elasticities would be valuable for ANACOM and for ANATEL in the study of its own markets and development of appropriate regulatory policies.

As a matter of important developments for research techniques, the choice of broadband plan and usage are endogenous, and the hours of use of different services are probably correlated. Future work should examine carefully the cause and effect relationships, paying particular attention to the interdependencies.

Also important are the methods by which broadband data finds its way into broad indices, such as the OECD index. The simplifying assumptions of such indices can be quite misleading. A more sophisticated approach that considers different weights is needed for different technologies and different uses, and technologies should not be omitted; these changes to the index would be valuable for many countries.

Finally, it is understood that broadband has economic impacts. Less well understood are the societal impacts, more specifically, the impacts of citizen participation in government, educational achievement, and other societal engagements. For example, in Brazil children in low-income areas are given computer training, after which the training facility sets them up with their first job. As another example, in some African countries, mobile communications are used to monitor elections.[70]

VI. Conclusion

In the literature to date there remains a great deal that is unknown with respect to how various technologies of broadband delivery differ in their commercial viability, effectiveness, and value. Our analyses have enabled us to provide a wealth of information not previously available on the characteristics of customers and their associated usage patterns, the degree to which they are tied to their current provider and / or technology choice, and the degree to which customers view different types of Internet access to be substitutes.

We found that with respect to adhesion, speed and reliability (i.e., the characteristics of the service to which customers subscribe) most greatly affect customers' desire to switch or to remain with their current provider. We also provide some of the first estimates that we are aware of for price elasticities for bandwidth and for WiFi. With respect to elasticity, our findings are consistent with other studies that show price elasticities are elastic, although the price elasticities for WiFi we found cover only a small range of prices and do not tell us how prices affect the decision to use WiFi, only the amount a given customer might purchase. Additional analysis of both WiFi and nomadic usage patterns and provider offerings would greatly add to the general understanding of customers' technology choices.

[70] For more on these and other examples of societal impacts, see Jamison (2007).

Our analysis of usage objectives and patterns of use determined that fixed and mobile customers are remarkably similar. Our results also are in agreement with other studies that have found that more educated, wealthier, and younger customers tend to have greater usage hours. There also exists evidence that customers use the Internet (whether it is via fixed, mobile, or nomadic access) in similar ways. Slight differences were found in usage patterns by customer characteristics and also across geographical regions; however, these differences are as expected. For example, in the autonomous regions of Açores and Madeira, we would expect mobile Internet access to be more prevalent relative to other regions due simply to the terrain and cost of providing fixed versus mobile broadband.

Finally, we use the available price and survey data across years to consider the degree to which different types of access are substitutes. Our elasticity estimates as well as our consideration of customers' desire to switch providers and intensity of desire to switch providers lead us to conclude that the different types of Internet access generally are viewed as substitutes.

If fixed and mobile Internet connectivity are viewed as substitutes, they may be expected to have similar economic effects for society, but research is needed to determine if that presumption is indeed correct. It is possible that customers would value two products the same even though they have different impacts on the customers' economic and social lives. However the implication remains that efforts to increase mobile Internet adoption can be expected to generate positive social and economic benefits, just as fixed Internet adoption has been shown to do in prior research.

While our analysis is specific to Portugal, there is no reason to assume that our findings for Portugal are not illustrative of a general trend across other similarly developed countries. This makes the conclusions of our analyses of the deployment, adoption and use of fixed and mobile broadband access useful in a much broader context. We trust that this study will serve as an initial step in consideration of the benefits of mobile and nomadic broadband, and will be valuable for informing government Internet policy in Portugal as well as in other countries around the world.

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Appendix

The majority of results were obtained using ICP-ANACOM's 2006 BCS and 2008 ICSCE, and 2008 ECSI survey data.

Note that in 2006 there are only three mobile broadband users who also access the Internet in some other way. As a result, one cannot address fixed and mobile broadband as complements; the technologies appear to be substitutes in many ways. In addition, the "Fixed and Mobile" group in the nested and multinomial logit models does not have sufficient observations to warrant inclusion in the estimations. The three mobile broadband observations are not included in the estimations. The variables used in the 2006 estimations are described in Table A.1.1 below; those used in the 2008 estimations are described in Table A.1.2. Also included is the omitted variable (reference group) where applicable.

Variable, 2006 BCS	Description
Intention to switch	
wantswitch	Dummy = 1 if respondent has considered switching Internet provider
wantswitchint	Intensity with which respondent wishes to switch provider in the next 12 months 1 = very certain, 2 = wants very much to switch, 3 = has some desire to switch, 4 = has little desire to switch
Internet use	
hoursuse	Number of hours of Internet use per week
filetax	Dummy = 1 if respondent filed taxes online
bank	Dummy = 1 if respondent manages bank accounts online
payserv	Dummy = 1 if respondent uses the Internet to pay for services (such as electricity, gas, etc.)
studysearch	Dummy = 1 if respondent searches for study related material
downlmgv	Dummy = 1 if respondent downloads music, games, or videos
entert	Dummy = 1 if respondent uses the Internet for entertainment (to play music, videos, or games)
shop	Dummy = 1 if respondent shops online
voip	Dummy = 1 if respondent uses VOIP to make telephone calls
messenger	Dummy = 1 if respondent uses programs such as Yahoo Messenger to talk online
voipmessg	Dummy = 1 if respondent uses either VOIP or software such as yahoo Messenger
Type of Internet access	Reference group (omitted dummy) is DSL
Narrow	Dummy = 1 if narrowband Internet access, 0 otherwise
Cable	Dummy = 1 if cable modem broadband, 0 otherwise
Mobile	Dummy = 1 if mobile broadband, 0 otherwise
Int_access	1 = No Internet, 2 = Narrowband, 3 = Fixed Broadband, 4 = Mobile Broadband
Years	Number of years the household has had Internet access
Satisfaction with service	1 = very unsatisfied, 2 = unsatisfied, 3 = satisfied, 4 = very satisfied
speed	Satisfaction with speed of Internet service = 1, 2, 3, or 4
reliability	Satisfaction with the reliability of Internet service = 1, 2, 3, or 4
billing	Satisfaction with billing transparency = 1, 2, 3, or 4
Complaint	Dummy = 1 if respondent / household ever filed a complaint to the Internet provider
Age	Reference group (omitted dummy) is 16-25 years old
age26_35	Dummy = 1 if respondent is between 26 and 35 years old
age36_45	Dummy = 1 if respondent is between 36 and 45 years old
age46_55	Dummy = 1 if respondent is between 46 and 55 years old
age56_65	Dummy = 1 if respondent is between 56 and 65 years old
age66_75	Dummy = 1 if respondent is between 66 and 75 years old
age76_	Dummy = 1 if respondent is older than 75
Education	Education level achieved by the head of household (reference group is university graduate)
head_poli	Dummy = 1 if the head of the household is a polytechnic institute graduate
head_highsc	Dummy = 1 if the head of the household is a high school graduate
head_ano9	Dummy = 1 if the head of the household completed only 9 years of study

head_ano6	Dummy = 1 if the head of the household completed only 6 years of study
head_elem	Dummy = 1 if the head of the household graduated only elementary school
head_noed	Dummy = 1 if the head of the household is uneducated
Employment Status	Reference individuals undertake an activity that is not remunerated (students, etc.)
Empl	Dummy = 1 if respondent is employed
Unempl	Dummy = 1 if respondent is unemployed
Household size	
hh_number	Number of individuals in household
hh_numbersq	Square of the number of individuals in household
Habitat	Reference (omitted dummy) is the city of Lisbon
hab2k	Dummy = 1 if there are up to 1999 inhabitants
hab10k	Dummy = 1 if there are 2000-9999 inhabitants
hab100k	Dummy = 1 if there are 10000-99999 inhabitants
hab100kplus	Dummy = 1 if there are over 100000 inhabitants
habPorto	Dummy = 1 if household is in the city of Porto
Income proxy	
two_cars	Dummy = 1 if household owns at least two cars
Region	Reference (omitted dummy) is for the greater Lisbon area
norte_lito~l	Dummy = 1 if household is in North-Litoral Region
grande_porto	Dummy = 1 if household is in the greater Porto area (not just the city of Porto)
Interior	Dummy = 1 if household is in Interior Region
centro_lit~l	Dummy = 1 if household is in Center-Litoral Region
Alentejo	Dummy = 1 if household is in Alentejo Region
Algarve	Dummy = 1 if household is in Algarve Region
Madeira	Dummy = 1 if household is in the Island of Madeira
Acores	Dummy = 1 if household is in the Azores Islands

Table A.1.1 2006 BCS Survey Data Variable Names and Descriptions

Variable 2008 ICSCE	**Description**
Intention to switch	
wantswitch	Dummy = 1 if respondent has considered switching Internet provider
wantswitchint	Intensity with which respondent wishes to switch provider in the next 12 months 1 = very certain, 2 = wants very much to switch, 3 = has some desire to switch, 4 = has little desire to switch
Internet use	
Frequency of Use	Frequency of home Internet use; reference group (omitted dummy) is several times per day
several_daily	Dummy = 1 if respondent uses Internet in home several times per day
once_daily	Dummy = 1 if respondent uses Internet in home once per day
several_week	Dummy = 1 if respondent uses Internet in home several times per week
once_weekly	Dummy = 1 if respondent uses Internet in home less than once per week
filetax	Dummy = 1 if respondent filed taxes online
bank	Dummy = 1 if respondent manages bank accounts online
payserv	Dummy = 1 if respondent uses the Internet to pay for services (such as electricity, gas, etc.)
studysearch	Dummy = 1 if respondent searches for study related material
downlmgv	Dummy = 1 if respondent downloads music, games, or videos
entert	Dummy = 1 if respondent uses the Internet for entertainment (to play music, videos, or games)
shop	Dummy = 1 if respondent shops online
voip	Dummy = 1 if respondent uses VOIP to make telephone calls
messenger	Dummy = 1 if respondent uses programs such as Yahoo Messenger to talk online
voipmessg	Dummy = 1 if respondent uses either VOIP or software such as yahoo Messenger
Type of Internet access	Types of home Internet access; reference group (omitted dummy) is no home Internet access
Int_none	Dummy = 1 if no home Internet access
Int_narrow	Dummy = 1 if narrowband Internet access
Int_fixed	Dummy = 1 if fixed broadband Internet access

Int_mobile	Dummy = 1 if mobile broadband Internet access
Int_fx_mob	Dummy = 1 if fixed and mobile broadband Internet access
Int_nomadic	Dummy = 1 if nomadic Internet access
Primary Internet access	Main type of home Internet access; reference group (omitted dummy) is no home Internet access
Intm_none	Dummy = 1 if no home Internet access
Intm_narrow	Dummy = 1 if narrowband Internet access
Intm_fixed	Dummy = 1 if fixed broadband Internet access
Intm_mobile	Dummy = 1 if mobile broadband Internet access
Intm_nomadic	Dummy = 1 if nomadic Internet access
Intm_access_type	1 = No Internet, 2 = Narrowband, 3 = Fixed Broadband, 4 = Mobile Broadband, 6 = Nomadic
Years	Number of years the household has had Internet access
Satisfaction with service	1 = very unsatisfied, 2 = unsatisfied, 3 = satisfied, 4 = very satisfied
speed	Satisfaction with speed of Internet service = 1, 2, 3, or 4 with 1 being highly satisfied
complaint	Dummy = 1 if respondent / household ever filed a complaint to the Internet provider
Age	Reference group (omitted dummy) is 15-24 years old
head_age15_24	Dummy = 1 if head of household is between 15 and 24 years old
head_age25_44	Dummy = 1 if head of household is between 25 and 44 years old
head_age45_64	Dummy = 1 if head of household is between 45 and 64 years old
head_age65_up	Dummy = 1 if head of household is older than 64
age15_24	Dummy = 1 if respondent is between 15 and 24 years old
age25_44	Dummy = 1 if respondent is between 25 and 44 years old
age45_64	Dummy = 1 if respondent is between 45 and 64 years old
age65_up	Dummy = 1 if respondent is older than 64
Education	Education level achieved by the head of household and respondent (reference group primary education)
head_univ	Dummy = 1 if the head of the household is a university graduate
head_highsc	Dummy = 1 if the head of the household is a high school graduate
head_primary	Dummy = 1 if the head of the household completed primary school only
univ	Dummy = 1 if the respondent is a university graduate
highsc	Dummy = 1 if the respondent is a high school graduate
primary	Dummy = 1 if the respondent completed primary school only
Employment Status	Employed or not; reference group (omitted dummy) is individuals who are employed except in Table 11.2, in which the reference group is student.
head_empl	Dummy = 1 if head of household is employed
head_unempl	Dummy = 1 if head of household is unemployed
head_student	Dummy = 1 if head of household is a student
head_retired	Dummy = 1 if head of household is retired
head_other_inactive	Dummy = 1 if head of household is other type of inactive person
empl	Dummy = 1 if respondent is employed
unempl	Dummy = 1 if respondent is unemployed
student	Dummy = 1 if respondent is a student
retired	Dummy = 1 if respondent is retired
other_inactive	Dummy = 1 if respondent is other type of inactive person
Household size	Number of persons in household; reference group (omitted dummy) is 1 member
hh_1	Dummy = 1 if one person in the household
hh_2	Dummy = 1 if two people in the household
hh_3	Dummy = 1 if three people in the household
hh_4	Dummy = 1 if four people in the household
hh_5	Dummy y= 1 if five or more people in the household
Habitat	Number of inhabitants; reference (omitted dummy) is less than 2,000 inhabitants
hab2k	Dummy = 1 if there are up to 1999 inhabitants
hab10k	Dummy = 1 if there are 2000-9999 inhabitants
hab50k	Dummy = 1 if there are 10000-49999 inhabitants
hab50-99999	Dummy = 1 if there are 50000-99999 inhabitants
hab100kplus	Dummy = 1 if there are more than 100000 inhabitants
Income proxy	
dishwasher	Dummy = 1 if household owns a dishwasher
Region	Reference (omitted dummy) is Norte Region
Norte	Dummy = 1 if household is in Norte Region

Centro	Dummy = 1 if household is in Centro Region
Lisboa	Dummy = 1 if household is in Lisboa Region
Alentejo	Dummy = 1 if household is in Alentejo Region
Algarve	Dummy = 1 if household is in Algarve Region
Madeira	Dummy = 1 if household is in the Islands of Madeira
Acores	Dummy = 1 if household is in the Azores Islands
Operator	Length of time household has used its particular Internet operator; reference group (omitted dummy) is less than six months
oper_6_months	Dummy = 1 if household has used Internet operator for less than six months
oper_1_year	Dummy = 1 if household has used Internet operator for six months to one year
oper_2_year	Dummy = 1 if household has used Internet operator for one to two years
oper_3_year	Dummy = 1 if household has used Internet operator for two to three years
oper_3_yr_plus	Dummy = 1 if household has used Internet operator for three or more years
Tariff	Type of Internet tariff; reference group (omitted dummy) is pre-paid
tariff_prepay	Dummy = 1 if Internet tariff is pre-paid
tariff_timed	Dummy = 1 if Internet tariff is timed provision (e.g., billing for 10 minute periods)
tariff_fx_limit	Dummy = 1 if Internet tariff is fixed fee with traffic limits
tariff_fx_no_limit	Dummy = 1 if Internet tariff is fixed fee without traffic limits
Download Capacity	Download capacity of Internet service in home; reference group (omitted dummy) is up to 2 MB
dwnld_2mb	Dummy = 1 if download capacity is up to 2Mb
dwnld_3_4mb	Dummy = 1 if download capacity is 3 to 4 Mb
dwnld_5_6mb	Dummy = 1 if download capacity is 5 to 6 Mb
dwnld_7_8mb	Dummy = 1 if download capacity is 7 to 8 Mb
dwnld_9_16mb	Dummy = 1 if download capacity is 9 to 16 Mb
dwnld_17_18mb	Dummy = 1 if download capacity is 17 to 18 Mb
dwnld_19_24mb	Dummy = 1 if download capacity is 19 to 24 Mb
dwnld_25_29mb	Dummy = 1 if download capacity is 25 to 29 Mb
dwnld_30_49mb	Dummy = 1 if download capacity is 30 to 49 Mb
dwnld_50upmb	Dummy = 1 if download capacity is 50 Mb or more
Children	Presence of children of certain age in the household; reference group (omitted dummy) is child 0 to 6.
child0_6	Dummy = 1 if there is at least one child between 0 and 6 years of age in the household
child7_14	Dummy = 1 if there is at least one child between 7 and 14 years of age in the household
child15_24	Dummy = 1 if there is at least one youth between 15 and 24 years of age in the household (and not head of hh)
child0_6X7_14	Dummy = 1 if both a child between 0 and 6 years old, and one between 7 and 14 years old in household
child0_6X15_24	Dummy = 1 if both a child between 0 and 6 years old, and a 15 to 24 years old youth in household
Child7_14X15_24	Dummy = 1 if both a child between 7 and 14 years old, and a 7 to 14 years old youth in household

Table A.1.2. 2008 ICSCE Survey Data Variable Names and Descriptions

NUTS II	Frequency	Percent	Cum.
Norte	2,979	34.34	34.34
Centro	1,997	23.02	57.35
Lisboa	2,244	25.86	83.22
Alentejo	745	8.59	91.80
Algarve	325	3.75	95.55
Acores	189	2.18	97.79
Madeira	197	2.27	100.00

Table A.2.1 Tabulation of NUTS II categories, represented in BCS 2006 survey

Region	Frequency	Percent	Cum.
Norte Litoral	1,598	18.42	18.42
Grande Porto	1,106	12.75	31.17
Interior	1,241	14.30	45.47
Centro Litoral	1,355	15.62	61.09
Grande Lisboa	2,244	25.86	86.95
Alentejo	421	4.85	91.80
Algarve	325	3.75	95.55
Acores	189	2.18	97.73
Madeira	197	2.27	100.00

Table A.2.2 Tabulation of regional categories represented in the BCS 2006 survey

Internet Access Method (2008 Survey)	Frequency	Percent	Cumulative
Modem (analogue phone line) or ISDN	2,304	64.00	64.00
ADSL or other XDSL accesses	82	2.28	66.28
Cable connection	885	24.58	90.86
Mobile phone or PDA with broadband Internet connection	84	2.33	93.19
Phone connected to Internet through narrowband	7	0.19	93.39
Broadband wireless connections other than (4)	133	3.67	97.06
Data transmission cards	106	2.94	100.00
Total	3,600	100.00	

Table A.3.1 Tabulation of ICSCE 2008 survey responses for methods of accessing Internet.

Internet Access Method – Main (2008 Survey)	Frequency	Percent	Cumulative
Modem (analogue phone line) or ISDN	2,304	64.00	64.00
ADSL or other XDSL accesses	87	2.42	66.42
Cable connection	897	24.92	91.33
Mobile phone or PDA with broadband Internet connection	87	2.42	93.75
Phone connected to Internet through narrowband			
Broadband wireless connections other than (4)	122	3.39	97.14
Data transmission cards	103	2.86	100.00
Total	3,600	100.00	

Table A.3.2 Tabulation of ICSCE 2008 survey responses for main method of accessing Internet.

A-IV.A Results for Identification, Comparison, and Analysis of the Adhesion Factors of Fixed, Nomadic, and Mobile Broadband.

1. Logit Model for the Intention to Switch (using the survey design), 2006

```
*svy: logistic wantswitch narrow cable mobile years complaint p_35* age* head_* empl
unempl dc_5 dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior centro_litoral
alentejo algarve madeira acores if dc_5<9 & p_4==1
svy: logistic wantswitch $Jswitchvars if hh_size < 9 & p_4==1 (running logistic on
estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2258
Number of PSUs     =      2258                  Population size    = 2143.6631
                                                 Design df          =      2249
                                                 F(  38,   2212)    =      6.94
                                                 Prob > F           =    0.0000
```

wantswitch	Odds Ratio	Std. Err.	t	P>|t|	[95% Conf.	Interval]
narrow	.7096768	.4291647	-0.57	0.571	.2167874	2.323203
cable	.9443228	.1186107	-0.46	0.648	.7381567	1.208071
mobile	.7364805	.2617064	-0.86	0.389	.3668817	1.478415
years	1.018412	.0251118	0.74	0.459	.9703391	1.068867
complaint	3.143048	.4112095	8.75	0.000	2.431796	4.062327
speed	.4887849	.055909	-6.26	0.000	.3905727	.6116932
reliability	.7529505	.0830419	-2.57	0.010	.6065101	.9347487
billing	.8494983	.0950037	-1.46	0.145	.6822084	1.057811
age26_35	1.005469	.1922219	0.03	0.977	.691117	1.462804
age36_45	1.067837	.197948	0.35	0.723	.7423872	1.535959
age46_55	.8992781	.1852065	-0.52	0.606	.6004743	1.34677
age56_65	.9254919	.2765795	-0.26	0.796	.5150597	1.662983
age66_75	1.404283	.8067647	0.59	0.555	.4551702	4.332471
age76_	4.757591	5.092363	1.46	0.145	.5831759	38.81277
head_poli	1.977554	.6490572	2.08	0.038	1.03897	3.764033
head_highsc	.9285141	.1460812	-0.47	0.637	.6820224	1.264091
head_ano9	.8730689	.1582366	-0.75	0.454	.6119165	1.245675
head_ano6	.9671916	.2441678	-0.13	0.895	.5895365	1.586771
head_elem	.9827809	.1876496	-0.09	0.928	.6758386	1.429126
head_noed	1.302574	1.383872	0.25	0.804	.1621764	10.46206
empl	1.202085	.2026278	1.09	0.275	.8637266	1.672993
unempl	1.176155	.3000375	0.64	0.525	.7131913	1.93965
hh_size	.7000165	.1633982	-1.53	0.127	.4429078	1.106377
hh_sizesq	1.042079	.0335424	1.28	0.200	.9783347	1.109977
hab2k	1.036827	.2847479	0.13	0.895	.6050783	1.776646
hab10k	1.196682	.3250176	0.66	0.509	.7025366	2.038397
hab100k	.8654314	.2265486	-0.55	0.581	.5179514	1.446026
hab100kplus	1.834794	.6204513	1.79	0.073	.9453471	3.561094
habPorto	.9105112	.3544036	-0.24	0.810	.4244131	1.953358
two_cars	1.20422	.149806	1.49	0.135	.9435359	1.536926
norte_lito~l	1.760631	.3454701	2.88	0.004	1.198274	2.586906
grande_porto	1.503953	.310494	1.98	0.048	1.003246	2.254557
interior	1.41888	.2925153	1.70	0.090	.9470399	2.125805
centro_lit~l	.5801076	.1200909	-2.63	0.009	.3865469	.8705924
alentejo	.333492	.1540971	-2.38	0.018	.134759	.8253025
algarve	.5579435	.2653806	-1.23	0.220	.2195362	1.417994
madeira	.0964446	.098832	-2.28	0.023	.0129282	.7194813
acores	.3337874	.2080695	-1.76	0.079	.0983059	1.13334

1a. Logit Model for the Intention to Switch (using the survey design), 2008

```
Survey: Logistic regression

Number of strata   =         7                  Number of obs      =      1187
Number of PSUs     =      1187                  Population size    = 1518.8463
                                                Subpop. no. of obs =       562
                                                Subpop. size       = 691.69483
                                                Design df          =      1180
                                                F(  42,   1139)    =      3.09
                                                Prob > F           =    0.0000

------------------------------------------------------------------------------
             |             Linearized
  wantswitch | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      female |   .3084143   .2979282    -1.22   0.224     .0463479    2.052293
   age_25_44 |   44.38066   63.44272     2.65   0.008     2.686215    733.2409
   age_45_64 |    9.88059   15.07258     1.50   0.133     .4954089    197.0616
      highsc |   372.3766   1278.311     1.72   0.085     .4425262    313347.3
        univ |   36.03831   119.0315     1.09   0.278     .0552626    23501.58
     student |   1.003869   1.665949     0.00   0.998     .0386931    26.04477
      unempl |   1.834622    6.97104     0.16   0.873     .0010615    3170.961
     retired |    .365508   1.068742    -0.34   0.731     .0011788    113.3331
other_inac~e |    38.5973   75.16289     1.88   0.061     .8457814    1761.391
  dishwasher |    2.20523   1.917258     0.91   0.363     .4005417    12.14116
        hh_2 |   .1437963   .1651481    -1.69   0.092      .015106    1.368816
        hh_3 |   .0494675   .0575111    -2.59   0.010     .0050547    .4841118
        hh_4 |   .0073959   .0120035    -3.02   0.003     .0003062    .1786133
        hh_5 |   .0926559   .1484786    -1.48   0.138     .0039943     2.14932
      centro |   .0165595   .0557416    -1.22   0.223     .0000224    12.22489
      lisboa |   .4269859    .451923    -0.80   0.422     .0535272    3.406062
    alentejo |   2.454246   5.788565     0.38   0.704     .0240004    250.9671
     algarve |    .119605   .2000331    -1.27   0.204     .0044947    3.182743
      acores |   .1217883   .2070257    -1.24   0.216     .0043369     3.42006
     madeira |   1.474615   2.251182     0.25   0.799     .0737699    29.47662
    hab10kmm |   .0701262   .1174023    -1.59   0.113     .0026265    1.872357
    hab50kmm |   .0942065   .1133826    -1.96   0.050     .0088831    .9990786
hab50_9999~m |   .1417775   .1920557    -1.44   0.150     .0099394    2.022332
hab100kplu~m |   .0015972   .0040689    -2.53   0.012     .0000108    .2366453
       years |   1.448032   .3297571     1.63   0.104     .9262687    2.263703
tariff_timed |   .0010696   .0038855    -1.88   0.060     8.59e-07    1.332378
tari~x_limit |    .109851   .2347197    -1.03   0.302     .0016602    7.268452
tari~o_limit |   .1464053   .2803664    -1.00   0.316     .0034185    6.270219
 dwnld_3_4mb |    5.67767   9.551309     1.03   0.302      .209295    154.0215
 dwnld_5_6mb |   .3042568   .6802842    -0.53   0.595     .0037852    24.45604
 dwnld_7_8mb |   1.984773   3.099188     0.44   0.661     .0927278    42.48266
dwnld_9_16mb |   1.039713   1.636802     0.02   0.980     .0473704    22.82025
dwnld_17_1~b |   14.87925   28.43408     1.41   0.158     .3501658    632.2491
dwnld_19_2~b |   .7487758    2.61346    -0.08   0.934      .000795    705.2774
dwnld_25_2~b |   .8061544   1.741037    -0.10   0.921     .0116468    55.79956
dwnld_30_4~b |   22.34581   52.49142     1.32   0.186      .222653    2242.661
dwnld_50upmb |    25.0333    54.7241     1.47   0.141     .3434286    1824.735
   complaint |   1.014287   1.854787     0.01   0.994     .0280546    36.67062
  narrowmain |   28.62265   71.35448     1.35   0.179     .2150497    3809.613
      cablec |   .6162433   .7915061    -0.38   0.706      .049584    7.658831
     mobilec |   .0039211   .0140513    -1.55   0.122     3.47e-06    4.434706
    nomadicc |   4.158848   5.086668     1.17   0.244     .3774012    45.82925
------------------------------------------------------------------------------
```

2. Ordered Logit of the Intensity with which Individuals Want to Switch, 2006

```
*ologit wantswitchint narrow cable mobile years complaint p_35* age* head_* empl
unempl dc_5 dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior centro_litoral
alentejo algarve madeira acores if dc_5<9 & p_4==1, or
ologit wantswitchint $Jswitchvars if hh_size<9 & p_4==1, or

Iteration 0:   log likelihood = -588.58769
Iteration 1:   log likelihood = -544.73306
Iteration 2:   log likelihood = -543.65916
Iteration 3:   log likelihood = -543.65509
Iteration 4:   log likelihood = -543.65509

Ordered logistic regression                       Number of obs   =        470
                                                  LR chi2(38)     =      89.87
                                                  Prob > chi2     =     0.0000
Log likelihood = -543.65509                       Pseudo R2       =     0.0763

------------------------------------------------------------------------------
wantswitch~t | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   4.035981   4.297655     1.31   0.190     .5006792    32.53409
       cable |   .3822776   .0829291    -4.43   0.000     .2498757    .5848352
      mobile |   1.652214   .9586465     0.87   0.387     .5298866    5.151692
       years |   .9846746   .0362774    -0.42   0.675     .9160786    1.058407
   complaint |   1.584163   .3097862     2.35   0.019     1.079806    2.324095
       speed |   .7297577   .1016286    -2.26   0.024     .5554403    .9587824
 reliability |   .9725901   .1248228    -0.22   0.829     .7562862    1.250759
     billing |   .7553999   .0965746    -2.19   0.028     .5879691    .9705084
    age26_35 |   1.255714   .3636143     0.79   0.432     .7118857    2.214987
    age36_45 |    1.18916   .3577071     0.58   0.565      .659467    2.144308
    age46_55 |   .7699455   .2515845    -0.80   0.424     .4058118    1.460816
    age56_65 |    1.76058    .909072     1.10   0.273     .6399401    4.843642
    age66_75 |   7.342638   5.863718     2.50   0.013     1.534955    35.12437
      age76_ |   .1073137   .1616224    -1.48   0.138     .0056064    2.054127
   head_poli |    1.11544   .5298295     0.23   0.818     .4396717    2.829851
 head_highsc |   1.099094   .2736798     0.38   0.704     .6746541    1.790557
   head_ano9 |   1.464942   .4318866     1.30   0.195      .822003    2.610762
   head_ano6 |   .7467181    .287677    -0.76   0.448     .3509352    1.588863
   head_elem |   1.083602   .3367515     0.26   0.796     .5893069    1.992499
   head_noed |   .2491483   .4285129    -0.81   0.419     .0085599    7.251848
        empl |   1.480427   .4017549     1.45   0.148     .8697409    2.519905
      unempl |   1.713473    .666731     1.38   0.166     .7992187    3.673576
     hh_size |   .9451732   .3291435    -0.16   0.871     .4776307    1.870383
   hh_sizesq |   1.024662   .0449421     0.56   0.579     .9402571    1.116644
       hab2k |   .8283531   .3732869    -0.42   0.676     .3424776    2.003544
      hab10k |   .9969779   .4432698    -0.01   0.995     .4170901    2.383094
     hab100k |   .7347272   .3144465    -0.72   0.471      .317564     1.69989
 hab100kplus |   1.139668   .6317169     0.24   0.814     .3845547    3.377525
    habPorto |   .3517071   .2147835    -1.71   0.087     .1062581    1.164127
    two_cars |   .8642574   .1714235    -0.74   0.462     .5858807    1.274903
norte_lito~l |   1.908554    .587728     2.10   0.036     1.043715    3.490012
grande_porto |   2.474075   .7982637     2.81   0.005     1.314533    4.656442
    interior |   1.357204   .4583256     0.90   0.366     .7001572     2.63084
centro_lit~l |   1.383527   .4981178     0.90   0.367     .6831647    2.801882
    alentejo |   1.214627   .9253209     0.26   0.799     .2728882     5.40631
     algarve |   1.285572   .8616895     0.37   0.708     .3455854    4.782306
     madeira |    .247097   .4382597    -0.79   0.431      .007641     7.99075
      acores |   .6140775   .7431002    -0.40   0.687      .057303    6.580656
-------------+----------------------------------------------------------------
       /cut1 |  -3.383103   .9413812                     -5.228176    -1.53803
       /cut2 |  -.7993029   .9298712                     -2.621817    1.023211
       /cut3 |   .7489081   .9316186                     -1.077031    2.574847
```

2.a. Ordered Logit of Satisfaction with Current Provider, 2008

```
Survey: Ordered logistic regression
Number of strata   =         7                  Number of obs      =      1239
Number of PSUs     =      1239                  Population size    = 1576.4701
                                                Subpop. no. of obs =       617
                                                Subpop. size       = 761.44818
                                                Design df          =      1232
                                                F(  47,   1186)    =      6.29
                                                Prob > F           =    0.0000
------------------------------------------------------------------------------
             |             Linearized
 i_satisfied | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      female |   2.572852   .5660037     4.30   0.000     1.670991    3.961461
   age_25_44 |   1.002486   .3997899     0.01   0.995     .4584443    2.192149
   age_45_64 |    3.15622   1.751581     2.07   0.039     1.062474    9.375964
   age_65_up |   4.494587    4.94162     1.37   0.172     .5198848    38.85728
      highsc |   .5739133   .3430106    -0.93   0.353     .1776677     1.85389
        univ |   .5518481   .3382912    -0.97   0.332     .1657704    1.837097
     student |   1.096549   .4646094     0.22   0.828     .4775488    2.517897
      unempl |   1.421864   1.008923     0.50   0.620     .3534032    5.720656
     retired |   .0676627   .0413452    -4.41   0.000     .0204038    .2243815
other_inac~e |   1.096728   .8712239     0.12   0.907     .2308087    5.211292
  dishwasher |   .6713425   .1826234    -1.46   0.143      .393701    1.144779
        hh_2 |   .3981328   .1626559    -2.25   0.024     .1786201    .8874127
        hh_3 |   .3400465   .1341143    -2.73   0.006     .1568536    .7371946
        hh_4 |   .3039715   .1388323    -2.61   0.009     .1240746    .7447024
        hh_5 |   .4517686   .2602797    -1.38   0.168     .1458904     1.39896
      centro |   1.162708    .541184     0.32   0.746     .4665396    2.897699
      lisboa |   .7168651   .3081071    -0.77   0.439     .3084843    1.665873
    alentejo |   2.758302   2.015831     1.39   0.165     .6575855    11.56995
     algarve |   1.940711   2.217736     0.58   0.562     .2062049    18.26513
      acores |     .73232   .3852122    -0.59   0.554     .2609245    2.055356
     madeira |   1.555916   .6960909     0.99   0.323     .6468423    3.742605
    hab10kmm |   1.897834   .7545093     1.61   0.107     .8699995    4.139974
    hab50kmm |   1.088468   .3915393     0.24   0.814     .5374324    2.204487
hab50_9999~m |   1.216348   .7031286     0.34   0.735     .3913125    3.780871
hab100kplu~m |   .8246638   .2902236    -0.55   0.584     .4134465    1.644881
 oper_1_year |   1.493667    1.07093     0.56   0.576     .3658969    6.097458
 oper_2_year |   .4373576   .2236119    -1.62   0.106     .1604009    1.192522
 oper_3_year |   .6650497    .323986    -0.84   0.403     .2557257    1.729552
oper_3_yr_~s |   1.645648   .9233736     0.89   0.375     .5473405    4.947845
tariff_timed |   .1090009   .0935255    -2.58   0.010      .020247    .5868138
tari~x_limit |   .9596459   .5365617    -0.07   0.941     .3204167    2.874133
tari~o_limit |   1.268283   .6726123     0.45   0.654     .4480766    3.589883
 dwnld_3_4mb |   .5436149   .3558214    -0.93   0.352     .1505193    1.963317
 dwnld_5_6mb |   .6811561   .4180088    -0.63   0.532     .2043485    2.270502
 dwnld_7_8mb |    .978628   .6033092    -0.04   0.972     .2919771    3.280095
dwnld_9_16mb |   1.463749    .933248     0.60   0.550     .4190145    5.113333
dwnld_17_1~b |   1.487745   1.323553     0.45   0.655     .2597308    8.521845
dwnld_19_2~b |   1.488041   .9839706     0.60   0.548      .406633     5.44537
dwnld_25_2~b |   3.979192   3.410185     1.61   0.107     .7406175    21.37941
dwnld_30_4~b |   .1880139   .1956147    -1.61   0.108     .0244178    1.447685
dwnld_50upmb |   1.393446   1.642806     0.28   0.778     .1379041    14.08001
   complaint |   .2188214   .1462069    -2.27   0.023     .0589923    .8116798
       years |   .7868305   .0722564    -2.61   0.009     .6571077    .9421624
  narrowmain |   .0731545   .4534745    -0.42   0.673     3.82e-07    13992.96
      cablec |   1.419692   .3587333     1.39   0.166     .8647644    2.330722
     mobilec |   .5227488   .3728744    -0.91   0.363     .1289846    2.118597
    nomadicc |   .4951923   .2098862    -1.66   0.098     .2155952    1.137388
-------------+----------------------------------------------------------------
       /cut1 |   -7.65112   1.241847    -6.16   0.000    -10.08749    -5.21475
       /cut2 |  -7.562175   1.225155    -6.17   0.000    -9.965796   -5.158554
       /cut3 |  -6.921598   1.150014    -6.02   0.000    -9.177801   -4.665395
```

```
       /cut4 |  -5.685716   1.151479    -4.94   0.000    -7.944794   -3.426639
       /cut5 |   -4.26693   1.133583    -3.76   0.000    -6.490897   -2.042962
       /cut6 |  -3.245217    1.08964    -2.98   0.003    -5.382972   -1.107461
       /cut7 |  -1.635814   1.072004    -1.53   0.127    -3.738969    .4673404
       /cut8 |    .932277   1.063729     0.88   0.381    -1.154644    3.019198
       /cut9 |    2.28729   1.041461     2.20   0.028     .2440563    4.330523
------------------------------------------------------------------------------
```

3.a. Bivariate Tobit of Switching Costs of Fixed Internet Users, ECSI 2008

```
summarize overall satisfaction if respondent did not answer “don’t know”

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
Overall      |      1242    7.279388    1.617803          1         10
Satisfaction

summarize perceived quality if respondent did not answer “don’t know”

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
Perceived quality   1242    7.345411    1.603988          1         10

summarize fulfillment of expectations if respondent did not answer “don’t know”

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
Fulfillment of      1239    6.819209    1.804568          1         10
Expectations

. estout BT1_11 BT1_12 BT1_13 BT1_14, cells(b(star fmt(%9.3f)) se(par)) stats(chi2 p
N,fmt(%9.3f %9.0g)) legend collabels(, none) varlabels(_cons C
> onstant) posthead("") prefoot("") postfoot("") varwidth(18) modelwidth(12)
delimiter("")
```

	Model 1	Model 2	Model 3	Model 4
Fixed to Fixed				
Clix_ADSL	-13.522**	-12.756**	-13.173**	-14.186**
	(4.457)	(4.470)	(4.468)	(4.491)
SAPO_ADSL	-10.460*	-9.249	-11.080*	-11.051*
	(4.725)	(4.737)	(4.735)	(4.750)
Netvisao	-7.219	-6.664	-7.479	-7.417
	(4.338)	(4.361)	(4.359)	(4.372)
MEO	-10.324	-9.504	-9.354	-11.041
	(7.258)	(7.284)	(7.278)	(7.315)
Number of Years	0.235	0.255	0.428	0.296
with operator	(0.605)	(0.608)	(0.605)	(0.609)
Overall satisfaction	2.777*	5.343***		
	(1.287)	(0.971)		
Perceived quality	2.442		5.457***	
	(1.456)		(0.974)	
Fulfillment of	1.585			4.367***
expectations	(1.170)			(0.851)
female	5.446	6.015	5.703	5.571
	(3.193)	(3.206)	(3.207)	(3.219)
age25_44	5.858	5.070	4.415	6.489
	(5.346)	(5.343)	(5.334)	(5.381)
age45_64	16.520**	16.540**	15.256*	16.022**
	(6.031)	(6.063)	(6.047)	(6.072)
age65_up	33.242**	34.327**	33.725**	31.393**
	(10.563)	(10.608)	(10.600)	(10.640)
nohighsc	9.930*	10.131*	10.387**	10.668**
	(3.972)	(3.996)	(3.990)	(4.000)
highsc	10.580**	10.751**	11.054**	10.820**

	(3.702)	(3.724)	(3.719)	(3.732)
empl	0.546	0.997	1.576	-0.411
	(5.469)	(5.478)	(5.474)	(5.504)
unempl	10.760	11.808	11.130	9.550
	(8.399)	(8.435)	(8.429)	(8.462)
stayhome	1.003	0.105	2.821	0.392
	(12.173)	(12.230)	(12.222)	(12.259)
retired	-16.432	-15.976	-15.928	-17.346*
	(8.656)	(8.701)	(8.695)	(8.725)
Constant	-13.576	-4.650	-5.590	6.169
	(9.390)	(8.866)	(8.899)	(7.701)
Fixed to Mobile				
Clix_ADSL	-17.531*	-16.636*	-17.250*	-18.578*
	(7.535)	(7.548)	(7.532)	(7.584)
SAPO_ADSL	-8.748	-6.926	-9.585	-9.421
	(7.981)	(7.991)	(7.976)	(8.014)
Netvisao	1.319	2.195	0.960	1.121
	(7.347)	(7.377)	(7.361)	(7.395)
MEO	-15.501	-14.661	-14.550	-16.764
	(12.260)	(12.291)	(12.258)	(12.341)
Number of Years	-0.092	-0.104	0.126	-0.037
With operator	(1.026)	(1.029)	(1.022)	(1.030)
Overall satisfaction	3.503	7.455***		
	(2.174)	(1.641)		
Perceived quality	4.764		8.131***	
	(2.462)		(1.646)	
Fulfillment of	1.433			5.931***
expectations	(1.976)			(1.437)
female	10.286	11.116*	10.530	10.510
	(5.405)	(5.422)	(5.413)	(5.443)
age25_44	1.979	1.278	0.485	3.156
	(9.014)	(9.001)	(8.969)	(9.064)
age45_64	11.198	11.511	9.735	10.655
	(10.196)	(10.242)	(10.193)	(10.251)
age65_up	12.903	14.095	13.210	10.017
	(17.875)	(17.933)	(17.885)	(17.981)
nohighsc	8.913	9.241	9.456	9.980
	(6.718)	(6.752)	(6.730)	(6.759)
highsc	7.242	7.391	7.784	7.524
	(6.257)	(6.286)	(6.266)	(6.299)
empl	11.291	11.521	12.340	9.639
	(9.213)	(9.219)	(9.194)	(9.260)
unempl	20.227	21.473	20.450	18.315
	(14.282)	(14.328)	(14.289)	(14.365)
stayhome	6.522	4.698	8.589	5.274
	(20.718)	(20.804)	(20.746)	(20.850)
retired	7.922	8.267	8.396	6.487
	(14.598)	(14.663)	(14.625)	(14.700)
Constant	-22.990	-8.343	-13.301	7.793
	(15.898)	(14.981)	(15.024)	(12.983)
sigma1				
Constant	41.572***	41.828***	41.800***	41.926***
	(1.101)	(1.108)	(1.107)	(1.111)
sigma2				
Constant	69.761***	70.127***	69.948***	70.275***
	(2.099)	(2.111)	(2.105)	(2.117)
atan_rho				
Constant	1.163***	1.182***	1.175***	1.189***
	(0.103)	(0.104)	(0.104)	(0.105)
chi2	88.185	78.070	79.260	73.925
p	3.05e-11	3.70e-10	2.26e-10	2.03e-09
N	772	772	772	772

* p<0.05, ** p<0.01, *** p<0.001

3.b. Bivariate Tobit of Switching Costs of Mobile Internet Users, ECSI 2008

```
. estout BT2_11 BT2_12 BT2_13 BT2_14, cells(b(star fmt(%9.3f)) se(par)) stats(chi2 p
N,fmt(%9.3f %9.0g)) legend collabels(, none) varlabels(_cons C
> onstant) posthead("") prefoot("") postfoot("") varwidth(18) modelwidth(12)
delimiter("")
```

	Model 1	Model	Model 3	Model 4
Mobile to Mobile				
Optimus	-16.223	-13.843	-16.981	-15.790
	(13.477)	(13.563)	(13.395)	(13.409)
TMN	-19.674	-17.777	-22.191*	-18.080
	(11.625)	(11.499)	(11.260)	(11.346)
Number of years	-0.808	-0.847	-0.819	-0.903
with operator	(1.692)	(1.712)	(1.696)	(1.697)
Overall satisfaction	0.477	6.352*		
	(4.068)	(2.900)		
Perceived quality	4.982		8.531**	
	(4.783)		(3.022)	
Fulfillment of	4.225			7.524**
expectations	(3.764)			(2.718)
female	7.971	8.945	7.725	9.149
	(10.295)	(10.396)	(10.326)	(10.293)
age25_44	18.471	25.634	18.846	19.923
	(17.116)	(16.960)	(16.979)	(16.951)
age45_64	35.869	45.094*	35.965	39.003*
	(19.876)	(19.556)	(19.763)	(19.604)
age65_up	52.844	52.958	51.716	57.271
	(46.712)	(47.221)	(46.788)	(46.749)
nohighsc	-3.944	-2.506	-5.042	-2.687
	(12.690)	(12.772)	(12.672)	(12.665)
highsc	-0.178	-2.680	-1.647	0.099
	(11.608)	(11.664)	(11.575)	(11.653)
empl	-13.629	-20.611	-14.995	-14.996
	(17.423)	(17.320)	(17.368)	(17.391)
unempl	-14.275	-22.172	-16.558	-13.315
	(24.234)	(24.216)	(24.030)	(24.156)
stayhome	-6.065	-6.641	-7.433	-5.785
	(48.773)	(49.355)	(48.913)	(48.970)
retired	-16.616	-20.543	-16.393	-20.484
	(35.225)	(35.538)	(35.316)	(35.250)
Constant	-3.731	18.306	5.987	11.503
	(29.468)	(27.915)	(27.226)	(25.978)
Mobile to Fixed				
Optimus	-7.509	-3.936	-8.545	-7.409
	(20.040)	(20.191)	(19.913)	(20.413)
TMN	-4.981	2.121	-4.378	-1.066
	(17.292)	(17.140)	(16.776)	(17.295)
Number of years	-4.307	-4.387	-4.339	-4.655
with operator	(2.492)	(2.525)	(2.496)	(2.559)
Overall satisfaction	3.438	9.517*		
	(6.199)	(4.347)		
Perceived quality	14.726*		12.665**	
	(7.131)		(4.470)	
Fulfillment of	-6.289			4.916
expectations	(5.671)			(4.174)
female	11.545	14.643	13.017	16.475
	(15.317)	(15.465)	(15.313)	(15.646)
age25_44	-25.106	-17.741	-27.804	-21.749
	(25.302)	(25.108)	(25.075)	(25.644)
age45_64	-2.957	8.760	-5.029	6.724
	(29.631)	(29.244)	(29.454)	(29.929)

age65_up	-9.929	-6.093	-8.311	3.835
	(70.434)	(71.421)	(70.682)	(72.331)
nohighsc	-16.410	-11.433	-14.967	-12.204
	(18.901)	(19.031)	(18.841)	(19.318)
highsc	9.009	10.740	12.283	10.840
	(17.434)	(17.509)	(17.343)	(17.920)
empl	19.104	14.689	23.122	15.743
	(25.832)	(25.657)	(25.684)	(26.381)
unempl	40.167	38.303	46.726	45.405
	(36.191)	(36.187)	(35.862)	(36.937)
stayhome	-11.785	-9.650	-10.978	-11.994
	(71.609)	(72.533)	(71.747)	(73.619)
retired	61.103	56.903	63.583	50.812
	(53.329)	(54.078)	(53.706)	(54.876)
Constant	-3.172	7.636	-10.370	45.992
	(43.909)	(41.594)	(40.347)	(40.050)
sigma1				
Constant	62.508***	63.266***	62.711***	62.770***
	(3.508)	(3.549)	(3.519)	(3.518)
sigma2				
Constant	91.581***	92.792***	91.804***	94.177***
	(6.332)	(6.399)	(6.323)	(6.546)
atan_rho				
Constant	2.201***	2.155***	2.105***	2.239***
	(0.365)	(0.358)	(0.350)	(0.372)
chi2	22.836	17.944	21.318	20.979
p	.1181953	.2093587	.093768	.10216
N	194	194	194	194

* p<0.05, ** p<0.01, *** p<0.001

A-IV.C. Identification of the Usage Objectives and Usage Patterns of Fixed, Nomadic, and Mobile Broadband; Analysis of Differences Among Each One of the Usage Patterns; and Explanation of the Main Differences.

1a. Negative Binomial Regression of the Hours of Use (using survey design), BCS 2006

In this model the coefficients are semi-elasticities.

```
svy, subpop(indhrsuse): nbreg hoursuse $Jexplvars
(running nbreg on estimation sample)

Survey: Negative binomial regression

Number of strata   =         9                  Number of obs      =      2329
Number of PSUs     =      2329                  Population size    = 2215.6236
                                                Subpop. no. of obs =      2302
                                                Subpop. size       = 2189.7523
                                                Design df          =      2320
                                                F(  35,   2286)    =      5.01
                                                Prob > F           =    0.0000


    hoursuse |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    age26_35 |  -.0787221   .0885011    -0.89   0.374    -.2522717    .0948275
    age36_45 |  -.1764678   .0935156    -1.89   0.059    -.3598506     .006915
    age46_55 |   -.127631   .0992175    -1.29   0.198    -.3221952    .0669332
    age56_65 |  -.3870283   .1108487    -3.49   0.000    -.6044012   -.1696553
    age66_75 |  -.2886655   .1656777    -1.74   0.082    -.6135572    .0362263
      age76_ |   -.526419   .3564046    -1.48   0.140    -1.225324    .1724857
   head_poli |  -.0278202   .1444304    -0.19   0.847    -.3110464     .255406
 head_highsc |   .0114739   .0655884     0.17   0.861    -.1171442    .1400919
   head_ano9 |   .0041118   .0754319     0.05   0.957    -.1438091    .1520327
   head_ano6 |   .1012791   .0955818     1.06   0.289    -.0861555    .2887137
   head_elem |   .0183722   .0723644     0.25   0.800    -.1235334    .1602779
   head_noed |  -.2291142   .2473181    -0.93   0.354    -.7141018    .2558734
        empl |  -.0928988   .0651355    -1.43   0.154    -.2206286     .034831
      unempl |  -.1088505   .0911349    -1.19   0.232    -.2875648    .0698638
       child |    .041711   .0658211     0.63   0.526    -.0873633    .1707854
     hh_size |  -.0176564   .0259798    -0.68   0.497    -.0686024    .0332897
   hh_sizesq |   .0001015   .0002558     0.40   0.691    -.0004002    .0006032
       hab2k |   .4263643   .1166864     3.65   0.000     .1975439    .6551848
      hab10k |   .5268999   .1197048     4.40   0.000     .2921604    .7616394
     hab100k |    .478625   .1106743     4.32   0.000     .2615941    .6956558
 hab100kplus |   .5568207   .1571666     3.54   0.000     .2486189    .8650224
    habPorto |   .7869517   .1651584     4.76   0.000     .4630782    1.110825
    two_cars |   .2507794   .0505376     4.96   0.000     .1516759     .349883
norte_lito~l |  -.0286585    .087528    -0.33   0.743    -.2002999    .1429828
grande_porto |  -.1248393   .0935736    -1.33   0.182    -.3083359    .0586573
    interior |  -.0323465   .0885838    -0.37   0.715    -.2060582    .1413651
centro_lit~l |   -.050806    .071447    -0.71   0.477    -.1909126    .0893005
    alentejo |  -.4858815   .1129467    -4.30   0.000    -.7073684   -.2643945
     algarve |  -.4859077   .2644271    -1.84   0.066    -1.004446    .0326305
     madeira |    .378864   .4678173     0.81   0.418    -.5385197    1.296248
      acores |   .2034099   .1419879     1.43   0.152    -.0750265    .4818463
       speed |  -.1104213   .0542642    -2.03   0.042    -.2168328   -.0040098
 reliability |   .0377975   .0502478     0.75   0.452    -.0607378    .1363328
     billing |   .1322062     .05411     2.44   0.015     .0260972    .2383151
   complaint |   .0782025   .0600508     1.30   0.193    -.0395563    .1959613
       _cons |   2.306088   .2950403     7.82   0.000     1.727518    2.884658
-------------+----------------------------------------------------------------
    /lnalpha |  -.2573079   .0336113                     -.3232193   -.1913965
-------------+----------------------------------------------------------------
       alpha |   .7731301   .0259859                      .7238151    .8258051
------------------------------------------------------------------------------
```

1b. Ordered Logistic Regression of the Hours of Use (using survey design), ICSCE 2008

```
usage
Renamed
svy, subpop(sbp_usage): ologit i_use $Jixvarsuse1, or
(running ologit on estimation sample)

Survey: Ordered logistic regression
Number of strata   =         7                  Number of obs      =      1166
Number of PSUs     =      1166                  Population size    = 1524.0718
                                                Subpop. no. of obs =       553
                                                Subpop. size       = 715.38711
                                                Design df          =      1159
                                                F(  38,   1122)    =      5.98
                                                Prob > F           =    0.0000
------------------------------------------------------------------------------
             |             Linearized
       i_use | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      female |   1.670347   .4713629     1.82   0.069     .9601769    2.905777
   age_25_44 |   2.746695   1.243796     2.23   0.026     1.129679    6.678301
   age_45_64 |   2.677041   1.716537     1.54   0.125     .7608309    9.419369
   age_65_up |   22.99439   49.53193     1.46   0.146     .3358476    1574.351
      highsc |   .2476681   .1879873    -1.84   0.066     .0558609    1.098076
        univ |   .1234337   .0996812    -2.59   0.010     .0253111    .6019436
     student |   .1667642   .0880776    -3.39   0.001      .059165    .4700461
      unempl |   .1956996    .201048    -1.59   0.113     .0260742     1.46882
     retired |   .1713311   .1525105    -1.98   0.048     .0298777    .9824845
other_inac~e |   2.108909   1.479864     1.06   0.288     .5322652     8.35579
  dishwasher |   .8663181   .3073225    -0.40   0.686     .4319184    1.737613
        hh_2 |   1.725274   .9272682     1.01   0.310      .601024    4.952498
        hh_3 |   1.937781   1.019299     1.26   0.209     .6903874    5.438967
        hh_4 |    1.24268   .7284049     0.37   0.711     .3934601    3.924805
        hh_5 |   3.014379   1.824285     1.82   0.069     .9194262    9.882771
      centro |   .8255392   .4271879    -0.37   0.711     .2990955    2.278586
      lisboa |   .2400628   .1238987    -2.76   0.006     .0872072    .6608417
    alentejo |   .2035915   .1197384    -2.71   0.007     .0642123    .6455068
     algarve |   .0739921   .0675028    -2.85   0.004     .0123545     .443145
      acores |   .1709032   .0899007    -3.36   0.001     .0608867    .4797095
     madeira |   .2404352    .109632    -3.13   0.002     .0982804    .5882052
    hab10kmm |   .8811119   .4198642    -0.27   0.791     .3459358    2.244226
    hab50kmm |   1.668381   .8135806     1.05   0.294     .6408784     4.34325
hab50_9999~m |   .8605108   .5321598    -0.24   0.808     .2557427    2.895405
hab100kplu~m |   .8639396   .4225998    -0.30   0.765     .3308866    2.255732
       years |   .9859847   .0735466    -0.19   0.850     .8517477    1.141378
tariff_timed |   2.098723   1.082831     1.44   0.151     .7626419    5.775499
tari~x_limit |   .5878784   .3246583    -0.96   0.336     .1989374    1.737235
tari~o_limit |   .5549991   .2681345    -1.22   0.223     .2150922    1.432055
 dwnld_3_4mb |   .3985436   .3035603    -1.21   0.227     .0894252    1.776199
 dwnld_5_6mb |   .7359036    .527298    -0.43   0.669     .1804142    3.001726
 dwnld_7_8mb |   .5451699   .3386915    -0.98   0.329     .1611249    1.844595
dwnld_9_16mb |   .4402732   .2786626    -1.30   0.195     .1271766    1.524184
dwnld_17_1~b |   .7082896   .5439137    -0.45   0.653     .1569886    3.195609
dwnld_19_2~b |   .8256462   .5657324    -0.28   0.780     .2152491    3.166989
dwnld_25_2~b |    .502445   .4225545    -0.82   0.413     .0964901    2.616341
dwnld_30_4~b |   .5156048   .6718739    -0.51   0.611     .0399921    6.647519
dwnld_50upmb |   .7201347    .806684    -0.29   0.770     .0799676    6.485054
-------------+----------------------------------------------------------------
       /cut1 |  -2.694107   1.244441    -2.16   0.031    -5.135716   -.2524973
       /cut2 |  -.6923888   1.237271    -0.56   0.576    -3.119931    1.735153
       /cut3 |   1.458811   1.349993     1.08   0.280    -1.189892    4.107514
------------------------------------------------------------------------------
```

2. Ways of Using the Internet, 2006

a. Filing Taxes (using survey design)

```
*svy: logistic  filetax narrow cable mobile years p_35* age* head_* empl unempl dc_5
dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior centro_litoral alentejo
algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3 & dc_2>25
svy: logistic  filetax $Jusetaxvars if hh_size<9 & p_4==1 & p_13~=3 & dc_2>25
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      1678
Number of PSUs     =      1678                  Population size    = 1562.4104
                                                Design df          =      1669
                                                F(  35,   1635)    =      5.26
                                                Prob > F           =    0.0000
```

filetax	Odds Ratio	Linearized Std. Err.	t	P>|t|	[95% Conf.	Interval]
narrow	1.105954	.5688897	0.20	0.845	.4032471	3.033213
cable	1.035341	.1208079	0.30	0.766	.8235489	1.301599
mobile	1.280385	.4941855	0.64	0.522	.600575	2.729695
years	1.119402	.0272432	4.63	0.000	1.067223	1.174132
speed	.9145871	.0994015	-0.82	0.411	.7390018	1.131891
reliability	1.318327	.1480359	2.46	0.014	1.057723	1.64314
billing	.9431716	.1041316	-0.53	0.596	.75953	1.171215
age26_35	1.232385	.5306799	0.49	0.628	.5295934	2.867808
age36_45	.9378008	.4014988	-0.15	0.881	.40497	2.171692
age46_55	.9154391	.3923757	-0.21	0.837	.3949321	2.121956
age56_65	1.087598	.4810397	0.19	0.849	.456786	2.58955
age76_	1.978505	2.516113	0.54	0.592	.163327	23.96715
head_poli	.9445156	.3471613	-0.16	0.877	.4593236	1.942225
head_highsc	.7361449	.107139	-2.10	0.035	.553336	.9793493
head_ano9	.5140779	.0841535	-4.06	0.000	.3728961	.7087125
head_ano6	.3825686	.0852445	-4.31	0.000	.2471188	.5922607
head_elem	.288034	.0539685	-6.64	0.000	.1994526	.4159565
empl	1.046873	.2142337	0.22	0.823	.7007713	1.563909
unempl	.9021914	.2418558	-0.38	0.701	.5332691	1.526339
hh_size	.8622001	.1932999	-0.66	0.508	.5554379	1.338384
hh_sizesq	1.013886	.0311619	0.45	0.654	.9545717	1.076887
hab2k	.956616	.2412603	-0.18	0.860	.5833205	1.568801
hab10k	1.052565	.2671822	0.20	0.840	.6397697	1.731705
hab100k	1.211714	.2907709	0.80	0.424	.7568189	1.94003
hab100kplus	.8935444	.2838017	-0.35	0.723	.4792552	1.665963
habPorto	1.292781	.4977915	0.67	0.505	.6074741	2.751199
two_cars	1.663857	.1941352	4.36	0.000	1.323511	2.091724
norte_lito~l	.6748739	.1360509	-1.95	0.051	.4544651	1.002178
grande_porto	.475448	.0971173	-3.64	0.000	.3184977	.7097406
interior	.5248896	.1098701	-3.08	0.002	.3481487	.7913547
centro_lit~l	.6464857	.1175469	-2.40	0.017	.4525612	.9235076
alentejo	.5246778	.1739505	-1.95	0.052	.2738309	1.005317
algarve	1.048958	.3886582	0.13	0.897	.5071582	2.169565
madeira	.5310052	.2237946	-1.50	0.133	.2323248	1.213674
acores	1.697916	.863226	1.04	0.298	.6263956	4.602395

b. Internet Banking (using survey design)

```
*svy: logistic  bank narrow cable mobile years p_35* age* head_* empl unempl dc_5
dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior centro_litoral alentejo
algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3 & dc_2>25
svy: logistic  bank $Jusetaxvars if hh_size<9 & p_4==1 & p_13~=3 & dc_2>25
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      1678
Number of PSUs     =      1678                  Population size    = 1562.4104
                                                 Design df          =      1669
                                                 F(  35,   1635)    =      4.72
                                                 Prob > F           =    0.0000

             |             Linearized
        bank | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   1.407472   .7651266     0.63   0.530     .4845916    4.087933
       cable |   1.117149    .129729     0.95   0.340     .8895974    1.402906
      mobile |    1.80415   .6634767     1.60   0.109     .8770326    3.711329
       years |   1.100922   .0262306     4.04   0.000     1.050657    1.153591
       speed |   .8443753   .0925819    -1.54   0.123     .6809848    1.046969
 reliability |   1.059625   .1207219     0.51   0.611      .847433    1.324948
     billing |   .9634264   .1078025    -0.33   0.739     .7735784    1.199866
    age26_35 |   4.748181    2.08487     3.55   0.000     2.006798    11.23443
    age36_45 |   2.777942   1.221303     2.32   0.020     1.172807    6.579905
    age46_55 |   2.148563   .9488395     1.73   0.083     .9035896    5.108872
    age56_65 |   2.593748   1.162931     2.13   0.034     1.076482    6.249551
      age76_ |   2.274153   3.171546     0.59   0.556     .1475258    35.05672
   head_poli |   .8224122   .2779953    -0.58   0.563     .4237932    1.595971
 head_highsc |     .74776   .1039466    -2.09   0.037     .5693119    .9821418
   head_ano9 |   .6620318   .1081275    -2.53   0.012     .4805671    .9120186
   head_ano6 |   .3656334   .0846415    -4.35   0.000     .2321966    .5757526
   head_elem |   .3703996   .0711206    -5.17   0.000      .254163    .5397949
        empl |   .8851043   .1740128    -0.62   0.535     .6019017    1.301557
      unempl |   .8366538   .2193438    -0.68   0.496     .5002948    1.399154
     hh_size |   .7882563   .1757084    -1.07   0.286      .509085    1.220519
   hh_sizesq |   1.021736   .0317372     0.69   0.489     .9613453     1.08592
        hab2k |   .9277465   .2289448    -0.30   0.761     .5717701    1.505349
       hab10k |   1.031442   .2501539     0.13   0.898     .6409949    1.659721
      hab100k |    1.14926   .2643886     0.60   0.545     .7319076    1.804597
 hab100kplus |   .5284743   .1644333    -2.05   0.041     .2870666     .972893
    habPorto |   .8660335   .3332776    -0.37   0.709     .4071244    1.842223
    two_cars |   1.487204   .1703044     3.47   0.001     1.188026    1.861723
norte_lito~l |   .7683846   .1547536    -1.31   0.191     .5176321    1.140607
grande_porto |   .7247737   .1470102    -1.59   0.113     .4868809    1.078902
    interior |   .5034331   .1035033    -3.34   0.001      .336366    .7534797
centro_lit~l |   .7825601   .1407283    -1.36   0.173     .5499643    1.113527
    alentejo |   .5182541   .1832725    -1.86   0.063     .2590062    1.036992
     algarve |   .4469556   .1513021    -2.38   0.017      .230096    .8681999
     madeira |   1.492481   .6467484     0.92   0.356     .6379453    3.491679
      acores |   2.077845   1.025719     1.48   0.139     .7890714    5.471547
------------------------------------------------------------------------------
```

c. Paying for Services (using survey design)

```
*svy: logistic  payserv narrow cable mobile years p_35* age* head_* empl unempl dc_5
dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior centro_litoral alentejo
algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3 & dc_2>25
svy: logistic  payserv $Jusetaxvars if hh_size<9 & p_4==1 & p_13~=3 & dc_2>25
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      1678
Number of PSUs     =      1678                  Population size    = 1562.4104
                                                Design df          =      1669
                                                F(  35,   1635)    =      5.15
                                                Prob > F           =    0.0000
```

payserv	Odds Ratio	Linearized Std. Err.	t	P>|t|	[95% Conf.	Interval]
narrow	1.149067	.6439368	0.25	0.804	.3828122	3.449091
cable	1.190639	.1387219	1.50	0.134	.9474022	1.496325
mobile	1.617381	.5545635	1.40	0.161	.8255488	3.168706
years	1.139602	.0273684	5.44	0.000	1.087166	1.194566
speed	.8871515	.0995166	-1.07	0.286	.7119421	1.10548
reliability	1.013509	.1108512	0.12	0.902	.8178266	1.256013
billing	1.061136	.1195287	0.53	0.598	.8507858	1.323494
age26_35	2.469125	1.097071	2.03	0.042	1.032919	5.902278
age36_45	1.477102	.6574551	0.88	0.381	.6169749	3.536336
age46_55	1.069635	.4768882	0.15	0.880	.446127	2.564557
age56_65	1.252101	.570748	0.49	0.622	.5120976	3.061442
age76_	1.617183	2.158474	0.36	0.719	.1179847	22.16627
head_poli	1.176855	.4080201	0.47	0.639	.5962031	2.323015
head_highsc	.894122	.1264004	-0.79	0.429	.6776051	1.179823
head_ano9	.5887215	.0962903	-3.24	0.001	.4271572	.8113945
head_ano6	.5050257	.1156915	-2.98	0.003	.3222392	.7914958
head_elem	.4999732	.0947808	-3.66	0.000	.3447195	.7251495
empl	.995647	.1956423	-0.02	0.982	.6772125	1.463814
unempl	1.029655	.2764063	0.11	0.913	.6081692	1.743246
hh_size	.6236346	.1439209	-2.05	0.041	.3965969	.9806433
hh_sizesq	1.044527	.0338042	1.35	0.178	.9802843	1.11298
hab2k	.7417376	.1842432	-1.20	0.229	.4556837	1.207361
hab10k	.8869657	.2181135	-0.49	0.626	.5475657	1.436738
hab100k	1.06963	.2505202	0.29	0.774	.6756584	1.693323
hab100kplus	.3540668	.1140589	-3.22	0.001	.1882264	.6660238
habPorto	.8743909	.3428959	-0.34	0.732	.4051924	1.886905
two_cars	1.455614	.1676556	3.26	0.001	1.161274	1.824557
norte_lito~l	.7774114	.1548212	-1.26	0.206	.5260311	1.148922
grande_porto	.6487143	.132283	-2.12	0.034	.4348646	.9677269
interior	.5301281	.1049725	-3.21	0.001	.3595086	.7817223
centro_lit~l	.963303	.1721879	-0.21	0.834	.678426	1.367802
alentejo	1.082474	.3525458	0.24	0.808	.5714689	2.050418
algarve	.4681184	.1594405	-2.23	0.026	.2400088	.9130283
madeira	.900969	.4395104	-0.21	0.831	.3460793	2.345547
acores	1.474813	.6786493	0.84	0.399	.5980871	3.636719

d. Searching for Study Related Material (using survey design)

```
*svy: logistic  studysearch narrow cable mobile years p_35* age* poli highsc ano9 ano6
elem noed empl unempl dc_5 dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior
centro_litoral alentejo algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3
svy: logistic  studysearch $Jvoipvars  if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2324
Number of PSUs     =      2324                  Population size    = 2206.9771
                                                Design df          =      2315
                                                F(  37,   2279)    =      3.98
                                                Prob > F           =    0.0000

             |             Linearized
 studysearch | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   .2921307   .1571673    -2.29   0.022     .1017158    .8390077
       cable |    .941798   .1520194    -0.37   0.710     .6862621    1.292485
      mobile |   .5842237   .2436636    -1.29   0.198     .2578581    1.323664
       years |   1.037045    .036114     1.04   0.296     .9685898    1.110338
       speed |   .7952228   .1328825    -1.37   0.170     .5730306     1.10357
 reliability |   1.100718   .1669666     0.63   0.527      .817506    1.482045
     billing |   1.019493    .161112     0.12   0.903     .7478207    1.389861
    age26_35 |   .3674929   .1105328    -3.33   0.001     .2037485    .6628318
    age36_45 |   .4756787   .1519021    -2.33   0.020     .2543026    .8897676
    age46_55 |   .4035405   .1351295    -2.71   0.007     .2092689    .7781611
    age56_65 |   .3363477   .1251131    -2.93   0.003     .1621798    .6975578
    age66_75 |   .1435467   .0749783    -3.72   0.000     .0515413    .3997892
      age76_ |   .2417385   .3072514    -1.12   0.264     .0199939    2.922773
        poli |   .9546552   .5386773    -0.08   0.934     .3157135    2.886689
      highsc |   .5044102   .1018749    -3.39   0.001     .3394519    .7495308
        ano9 |   .4060006   .0904171    -4.05   0.000     .2623392    .6283333
        ano6 |   .3616568   .1094827    -3.36   0.001     .1997476    .6548045
        elem |   .3891993    .122276    -3.00   0.003     .2101877    .7206706
        noed |    .049017   .0452426    -3.27   0.001     .0080219    .2995131
        empl |   .5322445   .1441648    -2.33   0.020     .3129193    .9052947
      unempl |   .8772924   .3231019    -0.36   0.722     .4260765    1.806347
     hh_size |   2.114081   .5402711     2.93   0.003     1.280785    3.489532
   hh_sizesq |   .9174442   .0317578    -2.49   0.013     .8572342    .9818833
       hab2k |   .8582717    .310401    -0.42   0.673     .4222987    1.744335
      hab10k |   .8985695   .3198246    -0.30   0.764     .4471241    1.805823
     hab100k |   .9758746   .3151448    -0.08   0.940     .5180443     1.83832
 hab100kplus |   .6124914   .2662043    -1.13   0.259     .2611877    1.436307
    habPorto |   3.245959   1.870206     2.04   0.041     1.048707    10.04689
    two_cars |   1.178197   .1797076     1.08   0.282     .8736111    1.588977
norte_lito~l |    .637913   .1725056    -1.66   0.097     .3753683     1.08409
grande_porto |    .417834    .102893    -3.54   0.000        .2578     .677212
    interior |   .6653638   .1832224    -1.48   0.139     .3877392     1.14177
centro_lit~l |   1.599458   .4584559     1.64   0.101     .9117242    2.805964
    alentejo |     1.3347   .6176529     0.62   0.533     .5386055    3.307473
     algarve |   .9544431   .4851971    -0.09   0.927     .3522168    2.586366
     madeira |   6.590464   7.243299     1.72   0.086     .7636724    56.87545
      acores |   .8724958   .5835884    -0.20   0.838     .2350284    3.238966
```

e. Downloading Music, Games, and Videos (using survey design)

```
svy: logistic  downlmgv narrow cable mobile years p_35* age* poli highsc ano9 ano6
elem noed empl unempl dc_5 dc_5sq hab dc_12_s4 norte_litoral grande_porto interior
centro_litoral alentejo algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3
svy: logistic  downlmgv $Jvoipvars  if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2324
Number of PSUs     =      2324                  Population size    = 2206.9771
                                                Design df          =      2315
                                                F(  37,   2279)    =      3.91
                                                Prob > F           =    0.0000

             |             Linearized
    downlmgv | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   .5306989   .2503873    -1.34   0.179      .210395    1.338631
       cable |   1.157342   .1137577     1.49   0.137      .954446    1.403369
      mobile |   .6325158   .1709226    -1.70   0.090     .3723349    1.074507
       years |   1.019089   .0198557     0.97   0.332     .9808864    1.058779
       speed |   1.141639   .1010437     1.50   0.135      .959736     1.35802
 reliability |   .8409507   .0713018    -2.04   0.041     .7121342    .9930686
     billing |   1.025917   .0915637     0.29   0.774      .861197    1.222144
    age26_35 |   .6839988   .1014408    -2.56   0.011      .511389    .9148698
    age36_45 |   .6061596   .0914216    -3.32   0.001     .4509628    .8147667
    age46_55 |    .467878    .077581    -4.58   0.000     .3380003    .6476615
    age56_65 |   .3162277    .071348    -5.10   0.000     .2031653    .4922099
    age66_75 |   .1922204   .0806308    -3.93   0.000     .0844421    .4375625
      age76_ |   .0898934   .1015022    -2.13   0.033     .0098197    .8229159
        poli |   1.417371   .4111038     1.20   0.229     .8025392    2.503231
      highsc |   1.253751   .1427223     1.99   0.047     1.002913    1.567327
        ano9 |   1.124892   .1528719     0.87   0.387     .8617333    1.468416
        ano6 |    .908792   .1855915    -0.47   0.640     .6088959    1.356394
        elem |   .9255933   .1787762    -0.40   0.689     .6337625    1.351804
        noed |   2.180729   1.928588     0.88   0.378     .3849677    12.35319
        empl |   .7327643   .0979348    -2.33   0.020     .5638203    .9523309
      unempl |   .7349194   .1445473    -1.57   0.118     .4997283      1.0808
     hh_size |   1.105895   .2074408     0.54   0.592     .7655341    1.597584
   hh_sizesq |   .9987337   .0252253    -0.05   0.960     .9504722    1.049446
       hab2k |   .8077747   .1733727    -0.99   0.320     .5302751    1.230493
      hab10k |   .9109559   .1943755    -0.44   0.662     .5994831     1.38426
     hab100k |   1.103762   .2222667     0.49   0.624     .7436653    1.638223
 hab100kplus |   .7737064   .2088195    -0.95   0.342      .455744    1.313504
    habPorto |   1.160283   .3723404     0.46   0.643     .6183953    2.177015
    two_cars |   1.206984   .1155214     1.97   0.049     1.000437    1.456174
norte_lito~l |   .7265133   .1167402    -1.99   0.047     .5301468    .9956139
grande_porto |   .7092955   .1170426    -2.08   0.037     .5132097    .9803012
    interior |    .662177   .1119467    -2.44   0.015     .4753307    .9224701
centro_lit~l |   .9699235   .1479466    -0.20   0.841      .719171    1.308106
    alentejo |   .3473631   .1019224    -3.60   0.000     .1953869    .6175496
     algarve |   .7240912   .2141117    -1.09   0.275     .4054747    1.293072
     madeira |   2.128419   .9159558     1.76   0.079     .9152814     4.94948
      acores |   1.268691   .5171417     0.58   0.559     .5704387    2.821647
------------------------------------------------------------------------------
```

f. Entertainment (using survey design)

```
*svy: logistic  entert narrow cable mobile years p_35* age* poli highsc ano9 ano6 elem
noed empl unempl dc_5 dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior
centro_litoral alentejo algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3
svy: logistic  entert $Jvoipvars if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2319
Number of PSUs     =      2319                  Population size    = 2202.0228
                                                 Design df          =      2310
                                                 F(  36,   2275)    =      4.20
                                                 Prob > F           =    0.0000

             |             Linearized
      entert | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   .4428681    .196674    -1.83   0.067     .1853808    1.057996
       cable |   1.265263   .1242982     2.39   0.017     1.043556    1.534072
      mobile |   .3936728   .1159425    -3.17   0.002     .2209594     .701388
       years |   1.019627   .0198718     1.00   0.319     .9813942     1.05935
       speed |   1.228883   .1097938     2.31   0.021     1.031385      1.4642
 reliability |     .93552   .0785944    -0.79   0.428     .7934231    1.103065
     billing |   .9486811   .0835243    -0.60   0.550     .7982503    1.127461
    age26_35 |   .7989268   .1189651    -1.51   0.132     .5966112    1.069849
    age36_45 |   .7559098   .1146724    -1.84   0.065      .561402    1.017808
    age46_55 |    .645535   .1079981    -2.62   0.009      .464985    .8961911
    age56_65 |   .4893876   .1103605    -3.17   0.002     .3144851     .761563
    age66_75 |   .2737116   .1125407    -3.15   0.002     .1222152    .6130008
        poli |   .9366333   .2854731    -0.21   0.830     .5152274    1.702708
      highsc |   1.384244   .1567851     2.87   0.004      1.10854    1.728517
        ano9 |   .9561891   .1291358    -0.33   0.740     .7337136    1.246123
        ano6 |   .9020526     .18429    -0.50   0.614      .604282    1.346555
        elem |    1.14914   .2191207     0.73   0.466       .79064    1.670195
        noed |   .6462555   .5767012    -0.49   0.625     .1123095    3.718708
        empl |   .5635717   .0756467    -4.27   0.000     .4331465    .7332693
      unempl |   .7238461   .1426398    -1.64   0.101      .491838    1.065296
     hh_size |   1.307314   .2664872     1.31   0.189     .8765515    1.949767
   hh_sizesq |   .9848312   .0274691    -0.55   0.584     .9324112    1.040198
       hab2k |   1.088177    .230788     0.40   0.690     .7179201    1.649388
      hab10k |   1.262641   .2658551     1.11   0.268     .8355283    1.908087
     hab100k |   1.259168   .2492015     1.16   0.244       .85415    1.856235
 hab100kplus |   .8346531   .2251634    -0.67   0.503     .4917654    1.416622
    habPorto |   1.300076   .4116258     0.83   0.407     .6987515    2.418882
    two_cars |   1.076694   .1023239     0.78   0.437     .8936253    1.297265
norte_lito~l |   .8206369   .1330021    -1.22   0.223     .5972043    1.127663
grande_porto |   .6471293   .1073753    -2.62   0.009     .4673917     .895986
    interior |    .601378   .1027773    -2.98   0.003     .4301286    .8408079
centro_lit~l |     1.0131   .1560124     0.08   0.933      .749036    1.370256
    alentejo |   .7643859   .1987904    -1.03   0.302     .4590167    1.272907
     algarve |   .7844241   .2343623    -0.81   0.416     .4366206    1.409281
     madeira |   3.841953   1.887278     2.74   0.006     1.466217    10.06714
      acores |    1.69969    .735642     1.23   0.220     .7273916     3.97165
------------------------------------------------------------------------------
```

g. Getting the News Online (using survey design)

```
*svy: logistic  news narrow cable mobile years p_35* age* poli highsc ano9 ano6 elem
noed empl unempl dc_5 dc_5sq hab* dc_12_s4 norte_litoral grande_porto interior
centro_litoral alentejo algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3
svy: logistic  news $Jvoipvars if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2319
Number of PSUs     =      2319                  Population size    = 2202.0228
                                                Design df          =      2310
                                                F(  36,   2275)    =      4.16
                                                Prob > F           =    0.0000

             |             Linearized
        news | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   1.207508   .8481842     0.27   0.788     .3045584    4.787503
       cable |   1.055162   .1375507     0.41   0.680     .8171441     1.36251
      mobile |   .5766657   .1839848    -1.73   0.085     .3084655    1.078057
       years |    1.05347   .0283292     1.94   0.053     .9993558    1.110514
       speed |   1.029142   .1173169     0.25   0.801     .8229845    1.286941
 reliability |   .9780474    .102793    -0.21   0.833     .7958872      1.2019
     billing |    1.05394   .1210321     0.46   0.647     .8414235    1.320132
    age26_35 |   1.542849   .3053004     2.19   0.029     1.046643    2.274303
    age36_45 |   1.220247   .2378482     1.02   0.307     .8326188    1.788337
    age46_55 |   1.473109    .329927     1.73   0.084     .9494989     2.28547
    age56_65 |   1.403652   .4408543     1.08   0.280      .758188    2.598616
    age66_75 |   .2833726   .1193169    -2.99   0.003     .1240975    .6470721
        poli |   .4801749   .1887246    -1.87   0.062      .222164    1.037828
      highsc |   .5226201    .084422    -4.02   0.000     .3807275    .7173944
        ano9 |   .4258367   .0770853    -4.72   0.000     .2985914     .607308
        ano6 |    .266072   .0673567    -5.23   0.000      .161958     .437115
        elem |   .2594147   .0606062    -5.78   0.000     .1640691    .4101685
        noed |    .704938    .616458    -0.40   0.689     .1268812    3.916557
        empl |   .7524312   .1284403    -1.67   0.096     .5383816    1.051583
      unempl |   .7242475   .1808489    -1.29   0.196      .443839    1.181812
     hh_size |   1.035698   .2326561     0.16   0.876     .6666866    1.608959
   hh_sizesq |   .9905462   .0293814    -0.32   0.749     .9345732    1.049871
       hab2k |   .5132079   .1469937    -2.33   0.020     .2926599    .8999604
      hab10k |   .9012665   .2578827    -0.36   0.716     .5142428    1.579568
     hab100k |   1.127059   .3142459     0.43   0.668     .6523653    1.947164
 hab100kplus |    .840493   .3181256    -0.46   0.646     .4001165    1.765557
    habPorto |   1.516362   .7346258     0.86   0.390     .5864198    3.921004
    two_cars |   1.199974   .1491419     1.47   0.143      .940422    1.531162
norte_lito~l |   1.281475   .2800156     1.14   0.256     .8348651    1.966999
grande_porto |   .9478745   .2191058    -0.23   0.817     .6024047    1.491466
    interior |    .913572    .201252    -0.41   0.682     .5931057    1.407192
centro_lit~l |   .7471445   .1425113    -1.53   0.127     .5139966    1.086048
    alentejo |   1.368365   .4833517     0.89   0.375     .6844974    2.735471
     algarve |   1.928709    .894767     1.42   0.157     .7765512    4.790306
     madeira |   13.97015   14.90984     2.47   0.014      1.72293    113.2751
      acores |    1.63913   .8995323     0.90   0.368     .5587798     4.80824
------------------------------------------------------------------------------
```

h. Online Shopping (using survey design)

```
*svy: logistic  shop narrow cable mobile years p_35* age* poli highsc ano9 ano6 elem
noed empl unempl dc_5 dc_5sq hab* dc 12_s4 norte_litoral grande_porto interior
centro_litoral alentejo algarve madeira acores if dc_5<9 & p_4==1 & p_13~=3
svy: logistic  shop $Jvoipvars if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2314
Number of PSUs     =      2314                  Population size    = 2197.3569
                                                Design df          =      2305
                                                F(  35,   2271)    =      5.49
                                                Prob > F           =    0.0000

             |             Linearized
        shop | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   1.233385   .5324909     0.49   0.627     .5289511    2.875955
       cable |   1.027461     .10583     0.26   0.793     .8395453    1.257437
      mobile |   1.126935   .3013953     0.45   0.655     .6670032    1.904012
       years |   1.209433   .0258811     8.89   0.000      1.15973    1.261265
       speed |   .9370861   .0927758    -0.66   0.512     .7717247     1.13788
 reliability |   .8886742   .0809116    -1.30   0.195      .743365    1.062388
     billing |   1.022156   .0921343     0.24   0.808     .8565485    1.219783
    age26_35 |   1.339218    .212408     1.84   0.066     .9812388    1.827797
    age36_45 |   .9660949   .1603823    -0.21   0.835     .6976487    1.337836
    age46_55 |    .860442   .1566701    -0.83   0.409     .6020777    1.229676
    age56_65 |   1.005797   .2721844     0.02   0.983     .5916175    1.709936
    age66_75 |   1.222559   .4608101     0.53   0.594     .5838003     2.56021
        poli |   1.348854   .3977009     1.01   0.310     .7565924     2.40474
      highsc |   .7869603   .0921177    -2.05   0.041     .6255513    .9900171
        ano9 |   .7340585    .106061    -2.14   0.032     .5529419    .9744999
        ano6 |   .6155463   .1492356    -2.00   0.045      .382634    .9902343
        elem |   .4247257    .100909    -3.60   0.000     .2665438    .6767816
        empl |   1.106395   .1610004     0.69   0.487     .8317254    1.471772
      unempl |   1.068076   .2418513     0.29   0.771     .6851062    1.665123
     hh_size |   .7204395   .1500258    -1.57   0.115     .4789039    1.083794
   hh_sizesq |   1.031238    .029422     1.08   0.281     .9751262    1.090579
       hab2k |   .9737257   .2110568    -0.12   0.902     .6365612    1.489474
      hab10k |   1.226537   .2642734     0.95   0.343     .8038624    1.871455
     hab100k |   1.286068   .2601582     1.24   0.214     .8649366    1.912245
 hab100kplus |   .6904727   .2028748    -1.26   0.208     .3880743    1.228508
    habPorto |   2.381429   .7980786     2.59   0.010     1.234321    4.594594
    two_cars |   1.305783   .1353583     2.57   0.010     1.065586    1.600124
norte_lito~l |   .8485105   .1447882    -0.96   0.336     .6072025    1.185717
grande_porto |   .4128326   .0779972    -4.68   0.000     .2850168    .5979672
    interior |   .7864568   .1376665    -1.37   0.170     .5579519    1.108544
centro_lit~l |   1.039908   .1641914     0.25   0.804     .7630055      1.4173
    alentejo |   1.281775   .3818845     0.83   0.405     .7146221    2.299042
     algarve |    .618525   .2144987    -1.39   0.166     .3133383    1.220959
     madeira |    .840082   .3909891    -0.37   0.708     .3372478    2.092638
      acores |   1.568095   .6338598     1.11   0.266     .7097683    3.464402
------------------------------------------------------------------------------
```

i.a VOIP (using survey design)

```
*Telephone vs. VOIP & Messenger substitution (social networks also perhaps,  those
that use messenger etc.)
Probability of using VOIP
svy: logistic  voip $Jvoipvars if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2281
Number of PSUs     =      2281                  Population size    = 2165.8588
                                                Design df          =      2272
                                                F(  36,   2237)    =      2.81
                                                Prob > F           =    0.0000

             |             Linearized
        voip | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   .9430072   .5138064    -0.11   0.914     .3239535    2.745032
       cable |   1.088123    .141169     0.65   0.515      .843699    1.403359
      mobile |   1.360906   .4302666     0.97   0.330     .7320946    2.529816
       years |   1.124384   .0283225     4.65   0.000     1.070192    1.181319
       speed |   1.055755   .1329547     0.43   0.667     .8247292    1.351496
 reliability |    .970644   .1118975    -0.26   0.796     .7742473    1.216859
     billing |   1.254301   .1672401     1.70   0.089     .9657122     1.62913
    age26_35 |   .9285501   .1739426    -0.40   0.692     .6430833    1.340737
    age36_45 |   .7146573    .146618    -1.64   0.102     .4779402    1.068617
    age46_55 |   1.038122   .2215428     0.18   0.861     .6831226    1.577603
    age56_65 |   .9029799   .2813593    -0.33   0.743     .4901298    1.663585
    age66_75 |   1.295066   .6404172     0.52   0.601     .4910705    3.415388
      age76_ |   19.44744   32.72538     1.76   0.078     .7173488    527.2231
        poli |   .6024485    .274055    -1.11   0.265     .2468882    1.470075
      highsc |   .8053041   .1152648    -1.51   0.130     .6082201     1.06625
        ano9 |   .7562195   .1380631    -1.53   0.126     .5286412     1.08177
        ano6 |    .290603   .1292182    -2.78   0.005     .1215085    .6950136
        elem |   .4332937   .1388388    -2.61   0.009     .2311476     .812223
        empl |   .9020073   .1553013    -0.60   0.549     .6435436    1.264277
      unempl |   .8698267   .2481848    -0.49   0.625     .4970874    1.522063
     hh_size |   .8607634   .2007111    -0.64   0.520     .5448746    1.359788
   hh_sizesq |   1.014434   .0308269     0.47   0.637     .9557485    1.076724
       hab2k |   .6777327    .176752    -1.49   0.136     .4063943    1.130236
      hab10k |    .641902   .1651664    -1.72   0.085     .3875531    1.063179
     hab100k |   .7121986   .1717701    -1.41   0.159     .4438093    1.142894
 hab100kplus |     .64081   .2219788    -1.28   0.199     .3248725    1.263996
    habPorto |   .8098877   .3328602    -0.51   0.608     .3617415    1.813223
    two_cars |   1.635943   .2132914     3.78   0.000     1.266866    2.112543
norte_lito~l |   .8438955   .1890666    -0.76   0.449     .5438555    1.309465
grande_porto |   .6564187   .1559973    -1.77   0.077     .4118944    1.046107
    interior |   .6687135   .1585726    -1.70   0.090     .4200359    1.064618
centro_lit~l |   1.304383   .2501579     1.39   0.166     .8955145    1.899931
    alentejo |   .6887574   .2985508    -0.86   0.390      .294378    1.611489
     algarve |   1.074793   .4218846     0.18   0.854     .4977686    2.320716
     madeira |   .2566776   .2740491    -1.27   0.203     .0316296    2.082964
      acores |   .4661464   .3896969    -0.91   0.361     .0904777    2.401615
------------------------------------------------------------------------------
```

i.b VOIP, 2008 (using survey design)

```
xi: svy, subpop(sbp_VOIP): logistic VOIP $JixvarsNoOperYears6 years narrowmain cableC
mobileC nomadic  (running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         6                  Number of obs      =      1199
Number of PSUs     =      1199                  Population size    = 1490.8811
                                                Subpop. no. of obs =       586
                                                Subpop. size       = 710.74979
                                                Design df          =      1193
                                                F(  38,   1156)    =      1.48
                                                Prob > F           =    0.0325
------------------------------------------------------------------------------
             |             Linearized
        voip | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      female |   1.049896   .3924282     0.13   0.896      .504269    2.185898
   age_25_44 |   .7274764   .3680195    -0.63   0.530     .2696319    1.962757
   age_45_64 |   .7673262   .5489157    -0.37   0.711     .1885579    3.122593
   age_65_up |   .0055028   .0097047    -2.95   0.003     .0001729    .1750977
      highsc |   1.506428   1.225755     0.50   0.615     .3052364    7.434644
        univ |   2.859491   2.381376     1.26   0.207     .5580728    14.65166
     student |   2.796851   1.532777     1.88   0.061     .9543461    8.196581
     retired |   5.329769   5.532721     1.61   0.107     .6953389    40.85264
other_inac~e |   2.393678   2.253172     0.93   0.354     .3775849    15.17458
  dishwasher |   1.483749   .6185507     0.95   0.344     .6548594    3.361807
        hh_2 |   2.764823   1.846252     1.52   0.128     .7459114    10.24819
        hh_3 |   1.423802   .8791687     0.57   0.567     .4239513    4.781708
        hh_4 |   1.567632   1.060167     0.66   0.506     .4159142    5.908596
        hh_5 |   3.758283   2.569192     1.94   0.053     .9829022    14.37039
      centro |   .6687717   .4184338    -0.64   0.520     .1959573    2.282414
      lisboa |   .9263412   .4643732    -0.15   0.879      .346443     2.47691
    alentejo |   .6406745   .6608172    -0.43   0.666     .0846804    4.847214
      acores |   1.519423   .7855189     0.81   0.419     .5510277    4.189711
     madeira |   1.660645   1.020304     0.83   0.409     .4974681    5.543552
      hab10k |   3.043815   1.541424     2.20   0.028     1.126995    8.220807
    hab50kmm |   .8774631   .4035332    -0.28   0.776     .3559389    2.163128
hab50_9999~m |   .8038686    .819713    -0.21   0.831     .1087238    5.943544
 hab100kplus |   1.471139   .9096214     0.62   0.533     .4373327     4.94875
tari~x_limit |   .7180616   .5200162    -0.46   0.648     .1734204    2.973193
tari~o_limit |   .8319022   .6247685    -0.25   0.806     .1906165    3.630647
 dwnld_3_4mb |   1.167669   .8056115     0.22   0.822      .301615    4.520504
 dwnld_5_6mb |   1.840656   1.327879     0.85   0.398     .4469699    7.579961
 dwnld_7_8mb |   .5057839   .3469581    -0.99   0.321     .1316631    1.942969
dwnld_9_16mb |   1.117288   .7761983     0.16   0.873     .2859046    4.366257
dwnld_17_1~b |   2.311444   2.079053     0.93   0.352      .395807    13.49843
dwnld_19_2~b |   .6575288   .6289014    -0.44   0.661     .1006806    4.294214
dwnld_25_2~b |   1.203107   1.153211     0.19   0.847     .1834745    7.889201
dwnld_30_4~b |   1.966146   2.300263     0.58   0.563     .1980404    19.51991
dwnld_50upmb |   5.306006    8.34356     1.06   0.289     .2426138    116.0433
       years |   1.023425   .0944004     0.25   0.802     .8540072    1.226451
      cablec |   1.112182   .4529565     0.26   0.794     .5002148    2.472836
     mobilec |   1.621617   1.166163     0.67   0.502      .395546    6.648127
    nomadicc |   1.102231   .6057902     0.18   0.859     .3749507    3.240196
------------------------------------------------------------------------------
Note: 1 stratum omitted because it contains no subpopulation members.
```

j. Messenger (using survey design)

```
Probability of using programs like Messenger
svy: logistic  messenger $Jvoipvars if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2317
Number of PSUs     =      2317                  Population size    = 2200.3353
                                                 Design df          =      2308
                                                 F(  36,   2273)    =      4.04
                                                 Prob > F           =    0.0000


             |             Linearized
   messenger | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   .6023447   .2776295    -1.10   0.272      .243954    1.487244
       cable |    .948184   .0986981    -0.51   0.609     .7731133    1.162899
      mobile |   .6143169   .1687211    -1.77   0.076     .3584997    1.052679
       years |   1.037843   .0213853     1.80   0.072     .9967423    1.080638
       speed |   1.161342   .1059837     1.64   0.101     .9710442    1.388933
 reliability |   .9411727   .0830517    -0.69   0.492     .7916214    1.118977
     billing |   .9428641    .084682    -0.66   0.512     .7906049    1.124446
    age26_35 |   .7870752   .1247229    -1.51   0.131     .5768473    1.073919
    age36_45 |   .5930481    .094973    -3.26   0.001     .4332152    .8118508
    age46_55 |   .5192653   .0920912    -3.70   0.000     .3667332    .7352386
    age56_65 |   .2518712   .0571298    -6.08   0.000     .1614382    .3929621
    age66_75 |   .2161343   .0848696    -3.90   0.000     .1000705     .466811
      age76_ |   .7315258   .9059151    -0.25   0.801     .0644994     8.29666
        poli |   .7439428    .225079    -0.98   0.328     .4110308    1.346495
      highsc |   .9671009   .1153224    -0.28   0.779     .7654497    1.221875
        ano9 |   .8433855   .1178043    -1.22   0.223     .6413095    1.109136
        ano6 |   .7735232   .1629402    -1.22   0.223     .5117718     1.16915
        elem |   .7252893   .1379942    -1.69   0.092     .4994315    1.053287
        empl |   .6867486   .0984357    -2.62   0.009     .5184729    .9096399
      unempl |   .6565209   .1372242    -2.01   0.044     .4357521    .9891398
     hh_size |   1.007747   .2041552     0.04   0.970     .6773602    1.499282
   hh_sizesq |   1.008773   .0279364     0.32   0.752     .9554504     1.06507
       hab2k |   .7011025   .1624236    -1.53   0.125     .4451242    1.104287
      hab10k |   .8228901   .1871262    -0.86   0.391     .5268367    1.285309
     hab100k |   .9130527   .2002317    -0.41   0.678     .5939229    1.403659
 hab100kplus |   .5940843   .1661593    -1.86   0.063     .3432818    1.028123
    habPorto |   1.008141   .3422071     0.02   0.981     .5181248    1.961588
    two_cars |   .9932343   .0993853    -0.07   0.946       .81627    1.208564
norte_lito~l |   .6489432   .1085483    -2.59   0.010     .4674682    .9008684
grande_porto |    .585301   .1020766    -3.07   0.002     .4157685    .8239615
    interior |   .6197321   .1081437    -2.74   0.006       .44014    .8726039
centro_lit~l |   .8154026   .1322013    -1.26   0.208     .5933273    1.120598
    alentejo |   .4217335   .1266647    -2.87   0.004     .2340192    .7600195
     algarve |   .9351154   .2905851    -0.22   0.829     .5084139    1.719939
     madeira |   .7487648   .2852282    -0.76   0.448     .3547527    1.580393
      acores |   2.960229   1.722591     1.87   0.062     .9456739    9.266358
------------------------------------------------------------------------------
```

k. VOIP or Messenger (using survey design)

```
*Probability of using VOIP or Messenger
svy: logistic  voipmessg $Jvoipvars if hh_size<9 & p_4==1 & p_13~=3
(running logistic on estimation sample)

Survey: Logistic regression

Number of strata   =         9                  Number of obs      =      2281
Number of PSUs     =      2281                  Population size    = 2165.8588
                                                Design df          =      2272
                                                F(  36,   2237)    =      3.99
                                                Prob > F           =    0.0000

             |             Linearized
   voipmessg | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      narrow |   .7081243   .3253235    -0.75   0.453     .2876376    1.743305
       cable |   .9400386   .1003629    -0.58   0.563     .7624635     1.15897
      mobile |   .7353733   .2034095    -1.11   0.267     .4274979    1.264974
       years |     1.0682   .0226281     3.11   0.002     1.024735    1.113508
       speed |   1.220576   .1145462     2.12   0.034     1.015407    1.467199
 reliability |   .9182984   .0831654    -0.94   0.347     .7688719    1.096765
     billing |   1.010281   .0923278     0.11   0.911     .8445216    1.208574
    age26_35 |   .7802729   .1272379    -1.52   0.128     .5667198    1.074298
    age36_45 |   .6245132   .1023067    -2.87   0.004     .4529235    .8611095
    age46_55 |   .5955219   .1097352    -2.81   0.005     .4149211    .8547318
    age56_65 |   .2782292   .0636652    -5.59   0.000     .1776334    .4357936
    age66_75 |   .2055142   .0829778    -3.92   0.000     .0931065    .4536317
      age76_ |   .7664183    1.01248    -0.20   0.840     .0574623    10.22231
        poli |   .6581055   .1987364    -1.39   0.166     .3640077    1.189818
      highsc |   .9103403   .1121035    -0.76   0.446     .7150345    1.158992
        ano9 |   .7670083   .1095746    -1.86   0.063      .579606    1.015003
        ano6 |   .7691105   .1677374    -1.20   0.229     .5014746    1.179583
        elem |   .6529224   .1288363    -2.16   0.031     .4434155    .9614181
        empl |   .7004623   .1031831    -2.42   0.016     .5247227    .9350605
      unempl |   .7206972   .1572927    -1.50   0.134     .4697626    1.105674
     hh_size |   1.126406    .229709     0.58   0.559     .7551199    1.680249
   hh_sizesq |   .9952727   .0276983    -0.17   0.865     .9424117    1.051099
       hab2k |   .6536706   .1611519    -1.72   0.085     .4030855    1.060036
      hab10k |   .7686758    .186274    -1.09   0.278     .4779261    1.236305
     hab100k |   .8418697   .1965489    -0.74   0.461     .5326126    1.330694
 hab100kplus |   .5905161   .1723066    -1.81   0.071     .3332172    1.046492
    habPorto |   .8168495   .2868008    -0.58   0.565     .4103182    1.626161
    two_cars |   1.024015    .105439     0.23   0.818     .8367865    1.253136
norte_lito~l |   .6220566   .1074475    -2.75   0.006     .4433268    .8728424
grande_porto |   .5741307   .1032871    -3.08   0.002     .4034563    .8170055
    interior |   .5938616   .1065785    -2.90   0.004     .4176778    .8443629
centro_lit~l |   .8103568   .1360688    -1.25   0.211     .5830059    1.126366
    alentejo |   .4044143   .1234071    -2.97   0.003     .2223022    .7357143
     algarve |    .938809   .2957454    -0.20   0.841     .5061593    1.741275
     madeira |   .6276964   .2417343    -1.21   0.227     .2949618    1.335776
      acores |    2.75248   1.625035     1.71   0.086     .8648007    8.760571
------------------------------------------------------------------------------
```

A-IV.D. Identification, Comparison and Explanatory Analysis (in Terms of Socio-Geo-Demographic Variables) of Factors that are Common and Different Between End Users of Fixed, Nomadic, and Mobile Broadband.

1. Weighted Multinomial Logit Estimation of Choice between No Internet, Narrowband, Fixed Broadband, Mobile Broadband (using survey design), 2006

```
*1. Multinomial Logit No Internet / Narrowband / Fixed BB / Mobile BB / (not enough
observations for Fixed and Mobile BB)
*svy: mlogit i5 age* head_* empl unempl child dc_5 dc_5sq hab* dc_12_s4 norte_litoral
grande_porto interior centro_litoral alentejo algarve madeira acores if dc_5<=9 &
~(head_noed==1 & i5==4) & ~(age76_==1 & i5==4), baseoutcome(3) rrr
svy: mlogit Int_access $Jmlogitvars if hh_size<=9 & ~(head_noed==1 & Int_access==4) &
~(age76_==1 & Int_access==4), baseoutcome(3) rrr
(running mlogit on estimation sample)

Survey: Multinomial logistic regression

Number of strata   =         9                  Number of obs      =      8249
Number of PSUs     =      8249                  Population size    = 8183.9339
                                                 Design df          =      8240
                                                 F(  93,   8148)    =    697.53
                                                 Prob > F           =    0.0000
             |             Linearized
  Int_access |        RRR   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
No Internet  |
    age26_35 |   2.276796   .2614998     7.16   0.000     1.817798    2.851692
    age36_45 |    2.39822   .2876454     7.29   0.000     1.895745    3.033878
    age46_55 |   2.271137   .2711405     6.87   0.000     1.797245    2.869982
    age56_65 |   4.311747   .5587448    11.28   0.000     3.344512    5.558708
    age66_75 |   10.41654   1.930711    12.64   0.000     7.243188    14.98019
      age76_ |   72.13831   36.61797     8.43   0.000     26.67018    195.1219
   head_poli |   2.881778   .6283792     4.85   0.000     1.879432      4.4187
 head_highsc |   2.658272   .2859555     9.09   0.000     2.152883      3.2823
   head_ano9 |   4.626742   .5057973    14.01   0.000     3.734289    5.732482
   head_ano6 |   6.357265   .7761132    15.15   0.000     5.004237    8.076119
   head_elem |   11.52351   1.205943    23.36   0.000     9.386268     14.1474
   head_noed |   37.34418   11.75425    11.50   0.000     20.14949    69.21208
        empl |    1.12467   .0913732     1.45   0.148     .9590909    1.318836
      unempl |   1.224548   .1427401     1.74   0.082     .9744073    1.538903
       child |   1.658933   .1470671     5.71   0.000     1.394303    1.973787
     hh_size |    .451767   .0569982    -6.30   0.000     .3527808    .5785275
   hh_sizesq |   1.087192   .0170137     5.34   0.000     1.054347     1.12106
        hab2k |   .8748202   .1379273    -0.85   0.396     .6422373    1.191632
       hab10k |   .7666436   .1227205    -1.66   0.097     .5601668    1.049228
      hab100k |   .8083288   .1222619    -1.41   0.160     .6009282     1.08731
 hab100kplus |   .8512434   .1660374    -0.83   0.409     .5807646    1.247692
    habPorto |   .5006825   .1251413    -2.77   0.006     .3067472    .8172297
    two_cars |   .3584616   .0253312   -14.52   0.000     .3120919    .4117208
norte_lito~l |    1.76954   .1892879     5.34   0.000     1.434808    2.182362
grande_porto |   1.165947   .1365027     1.31   0.190     .9268511     1.46672
    interior |   1.517724   .1765343     3.59   0.000     1.208289    1.906404
centro_lit~l |   1.185662   .1262798     1.60   0.110     .9622545    1.460939
    alentejo |   1.544772   .2557989     2.63   0.009     1.116589    2.137153
     algarve |   1.791936   .3700975     2.82   0.005     1.195346     2.68628
     madeira |   .6412655   .1498721    -1.90   0.057     .4055755    1.013921
      acores |    2.31373   .5097616     3.81   0.000     1.502271    3.563503
-------------+----------------------------------------------------------------
Narrowband   |
```

age26_35	1.668296	.4182425	2.04	0.041	1.020576	2.7271
age36_45	1.263936	.3464686	0.85	0.393	.7385171	2.163166
age46_55	1.43058	.4098455	1.25	0.211	.8158611	2.508464
age56_65	2.17637	.6732292	2.51	0.012	1.186826	3.990971
age66_75	2.445747	1.177094	1.86	0.063	.952102	6.282605
age76_	4.506537	5.141546	1.32	0.187	.4814568	42.18214
head_poli	1.437994	.6356109	0.82	0.411	.604589	3.420218
head_highsc	.8665128	.1946055	-0.64	0.524	.5579305	1.345767
head_ano9	1.476421	.3158655	1.82	0.069	.9706827	2.245655
head_ano6	.7095849	.2123272	-1.15	0.252	.3946973	1.275688
head_elem	1.117201	.248005	0.50	0.618	.7230153	1.726297
head_noed	.6415362	.6946837	-0.41	0.682	.076801	5.358894
empl	.8729095	.1757292	-0.68	0.500	.5882813	1.295249
unempl	1.500013	.384885	1.58	0.114	.9070995	2.480476
child	.9781041	.1945042	-0.11	0.911	.6623563	1.44437
hh_size	1.035118	.3060175	0.12	0.907	.5798391	1.847873
hh_sizesq	1.005259	.0356937	0.15	0.883	.93767	1.07772
hab2k	.7748101	.3058968	-0.65	0.518	.3573465	1.679968
hab10k	.7533977	.2922385	-0.73	0.465	.3522085	1.611569
hab100k	.6125099	.2373163	-1.27	0.206	.2865943	1.309058
hab100kplus	.2466667	.1575143	-2.19	0.028	.0705469	.8624689
habPorto	.6899147	.4632622	-0.55	0.580	.1849902	2.573013
two_cars	.6784069	.106801	-2.46	0.014	.4982722	.9236638
norte_lito~l	3.178014	.7871392	4.67	0.000	1.955676	5.164339
grande_porto	1.075833	.3541982	0.22	0.824	.5642362	2.051296
interior	2.374876	.6369439	3.22	0.001	1.403829	4.017607
centro_lit~l	1.594139	.4468967	1.66	0.096	.9201691	2.761753
alentejo	2.537231	.9675374	2.44	0.015	1.201486	5.357984
algarve	.6586918	.5056497	-0.54	0.587	.1462699	2.966262
madeira	.6258227	.4919138	-0.60	0.551	.1340557	2.921577
acores	.9797729	.7655334	-0.03	0.979	.2118127	4.532094
Mobile Broadband						
age26_35	1.221152	.4779858	0.51	0.610	.5669457	2.630254
age36_45	.9416598	.4132609	-0.14	0.891	.3983614	2.225927
age46_55	.8557034	.3781836	-0.35	0.724	.3598106	2.035038
age56_65	.7921734	.4205487	-0.44	0.661	.2798133	2.242705
age66_75	.5605415	.5848764	-0.55	0.579	.0724974	4.334043
age76_	8.86e-14	5.34e-14	-49.82	0.000	2.71e-14	2.89e-13
head_poli	.273874	.2803843	-1.27	0.206	.0368118	2.037579
head_highsc	.5484793	.163201	-2.02	0.044	.3060881	.9828202
head_ano9	.4945948	.1775137	-1.96	0.050	.2447384	.9995324
head_ano6	.4820657	.1971704	-1.78	0.074	.2162239	1.074753
head_elem	.5997166	.1953884	-1.57	0.117	.3166524	1.135819
head_noed	3.09e-14	1.31e-14	-73.55	0.000	1.35e-14	7.07e-14
empl	.8352835	.2429616	-0.62	0.536	.4722868	1.477277
unempl	.4385235	.2460896	-1.47	0.142	.1459646	1.317463
child	1.372678	.445201	0.98	0.329	.7268712	2.592266
hh_size	1.097591	.5605925	0.18	0.855	.4032992	2.987129
hh_sizesq	.9726726	.065624	-0.41	0.681	.8521767	1.110206
hab2k	.530697	.2698861	-1.25	0.213	.1958413	1.4381
hab10k	.4892478	.2326455	-1.50	0.133	.1926233	1.24265
hab100k	.5495775	.2750543	-1.20	0.232	.2060413	1.465898
hab100kplus	1.008969	.5907784	0.02	0.988	.3201869	3.179453
habPorto	.310696	.2856352	-1.27	0.204	.051248	1.883624
two_cars	1.725292	.3931371	2.39	0.017	1.103756	2.696819
norte_lito~l	2.444671	.8648605	2.53	0.012	1.221922	4.890997
grande_porto	1.237714	.5507293	0.48	0.632	.5173882	2.960901
interior	2.132852	.8247559	1.96	0.050	.9994476	4.551573
centro_lit~l	1.386677	.5284902	0.86	0.391	.6569283	2.927068
alentejo	3.392275	1.822868	2.27	0.023	1.183105	9.726549
algarve	1.924545	1.43668	0.88	0.381	.4454606	8.314704
madeira	.6052039	.638876	-0.48	0.634	.0764204	4.792853
acores	.8365419	.8834166	-0.17	0.866	.1055499	6.63006

(Int_access== 3 (fixed broadband) is the base outcome)

2. Weighted Multinomial Logit Estimation of Choice between No Internet, Narrowband, Fixed Broadband, Mobile Broadband (using survey design), 2008

```
estout MLOGIT2008, drop(_cons) unstack eform cells(b(star fmt(%9.3f)) se(par)) stats(F
p N, fmt(%9.3f %9.0g)) legend collabels(, none) varlabels(
> _cons Constant) posthead("") prefoot("") postfoot("") varwidth(18) modelwidth(12)
delimiter("")

mlogit2008r
```

	No Internet	Narrowband	Mobile	Nomadic
female	1.844***	0.301	1.918	1.937
	(0.342)	(0.192)	(0.885)	(0.728)
head_age_25_44	2.958***	3.168	0.435	0.584
	(0.931)	(2.332)	(0.376)	(0.297)
head_age_45_64	3.098**	1.362	0.255	0.934
	(1.167)	(1.213)	(0.224)	(0.587)
head_age_65_up	12.578***	16.886*	0.000***	0.000***
	(8.352)	(20.392)	(0.000)	(0.000)
head_highsc	0.262***	4.885*	0.572	1.185
	(0.065)	(3.493)	(0.462)	(0.659)
head_univ	0.106***	5.046	0.395	0.898
	(0.031)	(4.487)	(0.335)	(0.549)
head_student	1.418	6.889	3.272	0.000***
	(1.174)	(7.876)	(3.647)	(0.000)
head_unempl	0.802	2.155	0.088	0.020***
	(0.536)	(2.912)	(0.111)	(0.023)
head_retired	0.860	1.923	0.000***	0.448
	(0.340)	(1.635)	(0.000)	(0.377)
head_other_inactive	3.484	38.915***	4.531	0.000***
	(2.880)	(41.709)	(7.363)	(0.000)
dishwasher	0.137***	0.571	0.606	0.555
	(0.027)	(0.301)	(0.302)	(0.218)
hh_2	1.316	0.394	0.186	0.650
	(0.442)	(0.348)	(0.162)	(0.386)
hh_3	2.777**	0.456	0.450	0.468
	(1.014)	(0.348)	(0.476)	(0.325)
hh_4	2.775**	0.568	0.502	0.524
	(1.072)	(0.430)	(0.521)	(0.372)
hh_5	3.093*	0.842	0.072*	0.410
	(1.365)	(0.906)	(0.090)	(0.346)
centro	0.784	0.525	3.059	0.975
	(0.238)	(0.377)	(2.533)	(0.575)
lisboa	0.470**	0.115**	0.987	0.531
	(0.120)	(0.096)	(0.907)	(0.276)
alentejo	1.351	0.000***	1.371	2.298
	(0.589)	(0.000)	(1.597)	(1.713)
algarve	1.669	6.207	0.000***	12.975**
	(1.313)	(9.041)	(0.000)	(12.167)
acores	0.293***	0.521	0.754	0.168**
	(0.077)	(0.299)	(0.588)	(0.093)
madeira	0.230***	0.215*	0.470	0.142***
	(0.060)	(0.143)	(0.372)	(0.077)
hab10kmm	0.566	4.329*	2.636	0.513
	(0.177)	(2.982)	(1.617)	(0.347)
hab50kmm	0.321***	0.508	0.370	0.350
	(0.085)	(0.368)	(0.247)	(0.198)
hab50_99999mm	0.327*	5.755	0.000***	1.107
	(0.153)	(7.195)	(0.000)	(0.969)
hab100kplusmm	0.395**	2.765	0.523	1.393
	(0.113)	(2.040)	(0.374)	(0.808)
child0_6	0.916	0.690	1.944	1.097
	(0.303)	(0.709)	(1.972)	(0.898)

```
child7_14                0.909          0.828          0.405          0.396
                       (0.275)        (0.879)        (0.439)        (0.285)
child15_24               0.181***       1.441          0.507          0.668
                       (0.049)        (0.966)        (0.475)        (0.356)
child0_6x7_14            1.762          1.596          0.325          2.852
                       (0.942)        (1.899)        (0.439)        (3.093)
child0_6x15_24           0.791          0.336          2.825          0.372
                       (0.419)        (0.392)        (3.388)        (0.428)
child7_14x15_24          1.316          0.720          8.757          2.670
                       (0.615)        (0.848)       (10.322)        (2.351)

* p<0.05, ** p<0.01, *** p<0.001
```

Estimates run singly:

```
*1. Choice between *1=no Internet, 2= Narrowband, 3=Fixed BB, 4=Mobile BB,
5=FixBB&Mobile BB; 6=nomadic
*Renamed
svy, subpop(sbp): mlogit Intm_access_type $JiheadxvarsNoSpeed1 child0_6 child7_14
child15_24 child0_6X7_14 child0_6X15_24 child7_14X15_24, rrr baseoutcome(3)
(running mlogit on estimation sample)

Survey: Multinomial logistic regression

Number of strata   =         7                  Number of obs      =      3572
Number of PSUs     =      3572                  Population size    = 3557.1957
                                                 Subpop. no. of obs =      2966
                                                 Subpop. size       = 2751.7801
                                                 Design df          =      3565
                                                 F( 124,   3442)    =    802.18
                                                 Prob > F           =    0.0000

------------------------------------------------------------------------------
             |             Linearized
intm_acces~e |        RRR   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
No Internet  |
      female |   1.844352   .3415295     3.31   0.001     1.282827    2.651669
head_age_~44 |   2.957582    .930702     3.45   0.001     1.595831     5.48134
head_age_~64 |    3.09785   1.167033     3.00   0.003     1.480075    6.483911
head_age_6~p |   12.57847    8.35185     3.81   0.000     3.421808    46.23814
 head_highsc |   .2617869   .0653389    -5.37   0.000      .160482    .4270412
   head_univ |   .1057096   .0312282    -7.61   0.000      .059234    .1886502
head_student |   1.418041   1.173588     0.42   0.673     .2798883    7.184438
 head_unempl |   .8019185   .5359382    -0.33   0.741     .2163028    2.973024
head_retired |   .8602979   .3401402    -0.38   0.704     .3962697    1.867699
head_other~e |   3.484421    2.87994     1.51   0.131     .6892196    17.61585
  dishwasher |   .1368714   .0265382   -10.26   0.000     .0935872    .2001748
        hh_2 |    1.31596   .4419857     0.82   0.414     .6811712    2.542313
        hh_3 |   2.776831   1.014219     2.80   0.005     1.356901    5.682647
        hh_4 |   2.774997   1.071906     2.64   0.008     1.301232    5.917934
        hh_5 |   3.093348   1.364811     2.56   0.011     1.302399     7.34706
      centro |   .7836313   .2381931    -0.80   0.423     .4318095    1.422104
      lisboa |   .4699082   .1200363    -2.96   0.003     .2847758    .7753952
    alentejo |   1.350731   .5887282     0.69   0.490     .5746972    3.174671
     algarve |   1.668984   1.312768     0.65   0.515      .357024    7.802014
      acores |   .2927537    .077169    -4.66   0.000     .1746031    .4908546
     madeira |   .2295799   .0595705    -5.67   0.000     .1380361    .3818347
    hab10kmm |   .5662081   .1768404    -1.82   0.069      .306927    1.044521
    hab50kmm |   .3206664    .085011    -4.29   0.000     .1906853    .5392496
hab50_9999~m |   .3272518   .1526854    -2.39   0.017     .1311002    .8168847
hab100kplu~m |   .3949118   .1128797    -3.25   0.001     .2254831    .6916496
    child0_6 |   .9156692   .3033537    -0.27   0.790      .478241    1.753196
```

child7_14	.9089528	.2747465	-0.32	0.752	.502532	1.644065
child15_24	.1809202	.0487169	-6.35	0.000	.1067096	.3067401
child0_6x~14	1.761666	.9419197	1.06	0.290	.6175222	5.025679
child0_6x~24	.790565	.4187339	-0.44	0.657	.2798553	2.233272
child7_14~24	1.316155	.6151646	0.59	0.557	.5264101	3.290711
Narrowband						
female	.3008507	.1915835	-1.89	0.059	.086321	1.048541
head_age_~44	3.168281	2.33162	1.57	0.117	.7484962	13.41089
head_age_~64	1.361877	1.213338	0.35	0.729	.2374207	7.811909
head_age_6~p	16.88636	20.39183	2.34	0.019	1.58228	180.2142
head_highsc	4.8853	3.493229	2.22	0.027	1.202358	19.84947
head_univ	5.045605	4.487165	1.82	0.069	.8823975	28.85109
head_student	6.889136	7.876009	1.69	0.091	.7323144	64.8085
head_unempl	2.155466	2.912058	0.57	0.570	.1524641	30.47295
head_retired	1.922944	1.634987	0.77	0.442	.3630651	10.18471
head_other~e	38.91528	41.70907	3.42	0.001	4.758826	318.2296
dishwasher	.5713646	.3010609	-1.06	0.288	.2033526	1.605377
hh_2	.3939857	.3475717	-1.06	0.291	.0698716	2.221571
hh_3	.4559906	.3475664	-1.03	0.303	.1023129	2.03227
hh_4	.5678263	.4296772	-0.75	0.455	.1287917	2.503474
hh_5	.8422558	.9063263	-0.16	0.873	.1021364	6.945566
centro	.5245105	.3772371	-0.90	0.370	.1280405	2.148627
lisboa	.1150572	.0958698	-2.60	0.009	.0224606	.589395
alentejo	1.31e-15	8.75e-16	-51.47	0.000	3.56e-16	4.85e-15
algarve	6.20717	9.04107	1.25	0.210	.3569873	107.9281
acores	.5212814	.2993179	-1.13	0.257	.1691023	1.606923
madeira	.2145331	.143425	-2.30	0.021	.0578409	.7957084
hab10kmm	4.329223	2.981891	2.13	0.033	1.121808	16.70712
hab50kmm	.5077822	.3675766	-0.94	0.349	.1228273	2.099229
hab50_9999~m	5.754546	7.195136	1.40	0.162	.4958594	66.78263
hab100kplu~m	2.764566	2.040081	1.38	0.168	.6505473	11.7483
child0_6	.6895987	.7088153	-0.36	0.718	.0919132	5.173864
child7_14	.8283073	.8794803	-0.18	0.859	.1032989	6.641824
child15_24	1.441059	.9663098	0.54	0.586	.3869992	5.366033
child0_6x~14	1.595708	1.89912	0.39	0.695	.1547243	16.45692
child0_6x~24	.3358175	.3923574	-0.93	0.350	.0339822	3.318602
child7_14~24	.7202156	.8479198	-0.28	0.780	.0716128	7.243263
Mobile Broadband						
female	1.918054	.8849546	1.41	0.158	.7762448	4.739394
head_age_~44	.4350009	.3758609	-0.96	0.335	.0799398	2.367104
head_age_~64	.2548873	.2241369	-1.55	0.120	.0454552	1.429263
head_age_6~p	1.30e-14	1.63e-14	-25.51	0.000	1.11e-15	1.51e-13
head_highsc	.5718835	.4624371	-0.69	0.490	.1171586	2.791521
head_univ	.3950893	.3352543	-1.09	0.274	.0748445	2.085597
head_student	3.272252	3.646633	1.06	0.288	.368075	29.0909
head_unempl	.0884562	.1105212	-1.94	0.052	.0076355	1.024753
head_retired	6.62e-15	5.27e-15	-41.03	0.000	1.39e-15	3.15e-14
head_other~e	4.531082	7.363384	0.93	0.353	.187266	109.6339
dishwasher	.6058277	.3019495	-1.01	0.315	.2280128	1.609678
hh_2	.1864405	.161884	-1.93	0.053	.0339783	1.023009
hh_3	.4495825	.4756248	-0.76	0.450	.0564931	3.577858
hh_4	.5021099	.5212265	-0.66	0.507	.0655979	3.843332
hh_5	.0724088	.0897651	-2.12	0.034	.0063709	.8229689
centro	3.058582	2.533478	1.35	0.177	.6028584	15.51761
lisboa	.9873555	.9071609	-0.01	0.989	.162983	5.981426
alentejo	1.370892	1.597485	0.27	0.787	.1395631	13.46591
algarve	1.85e-15	1.85e-15	-33.87	0.000	2.60e-16	1.32e-14
acores	.753837	.5881313	-0.36	0.717	.1632895	3.480139
madeira	.4695255	.3720538	-0.95	0.340	.0992966	2.220157
hab10kmm	2.636134	1.616902	1.58	0.114	.7919474	8.774828
hab50kmm	.3695317	.2474806	-1.49	0.137	.0994023	1.373748
hab50_9999~m	8.25e-16	5.32e-16	-53.82	0.000	2.33e-16	2.92e-15
hab100kplu~m	.5234741	.3736683	-0.91	0.365	.129146	2.121824
child0_6	1.943808	1.971767	0.66	0.512	.2660203	14.20338

child7_14	.4045936	.4385217	-0.83	0.404	.0483197	3.387766
child15_24	.5066424	.4745966	-0.73	0.468	.0807363	3.179321
child0_6x~14	.3248107	.4393621	-0.83	0.406	.0229004	4.606989
child0_6x~24	2.825344	3.387914	0.87	0.386	.2691756	29.65562
child7_14~24	8.75688	10.3221	1.84	0.066	.8682851	88.31541
Nomadic Broadband						
female	1.936929	.7281933	1.76	0.079	.9268165	4.047937
head_age_~44	.5839088	.2966384	-1.06	0.290	.2156598	1.58096
head_age_~64	.9336945	.5865303	-0.11	0.913	.2724668	3.199603
head_age_6~p	7.19e-15	7.47e-15	-31.31	0.000	9.35e-16	5.52e-14
head_highsc	1.185304	.6588394	0.31	0.760	.3985997	3.524701
head_univ	.8982615	.5492579	-0.18	0.861	.2708593	2.978941
head_student	3.30e-18	2.85e-18	-46.56	0.000	6.05e-19	1.79e-17
head_unempl	.0196805	.0229711	-3.37	0.001	.0019961	.1940416
head_retired	.4480891	.3766078	-0.96	0.340	.0862398	2.328204
head_other~e	9.75e-15	7.38e-15	-42.59	0.000	2.21e-15	4.30e-14
dishwasher	.554736	.2184314	-1.50	0.135	.2563337	1.200513
hh_2	.6497069	.3862351	-0.73	0.468	.2025475	2.08405
hh_3	.4678908	.3250036	-1.09	0.274	.1198635	1.826426
hh_4	.5235396	.3716495	-0.91	0.362	.1301652	2.105738
hh_5	.4095172	.3464674	-1.06	0.291	.0779611	2.151128
centro	.9749421	.5754026	-0.04	0.966	.3065041	3.10114
lisboa	.5308309	.2755433	-1.22	0.223	.1918515	1.468748
alentejo	2.297548	1.712809	1.12	0.265	.5327005	9.909368
algarve	12.9746	12.16679	2.73	0.006	2.063564	81.57743
acores	.1677889	.0934318	-3.21	0.001	.0563142	.4999293
madeira	.141502	.0774362	-3.57	0.000	.0483937	.4137482
hab10kmm	.513037	.3471789	-0.99	0.324	.1361237	1.933587
hab50kmm	.3501992	.1980606	-1.86	0.064	.1155424	1.061424
hab50_9999~m	1.107417	.9687957	0.12	0.907	.1992538	6.15483
hab100kplu~m	1.392627	.8083479	0.57	0.568	.4462605	4.345913
child0_6	1.097406	.8984174	0.11	0.910	.2204317	5.463367
child7_14	.3963601	.2847063	-1.29	0.198	.0969309	1.620755
child15_24	.6682808	.3555052	-0.76	0.449	.2355004	1.896384
child0_6x~14	2.852324	3.092534	0.97	0.334	.3404078	23.90002
child0_6x~24	.3724734	.4278799	-0.86	0.390	.0391691	3.541991
child7_14~24	2.669684	2.350703	1.12	0.265	.4750152	15.00418

(intm_access_type==3 is the base outcome)