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Are Internet users in Slovenia willing to pay for fast broadband and what drives them to migrate?

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ABSTRACT

The European Union (EU) member states are faced with a significant gap between availability of high-speed broadband and the share of households subscribed to such Internet access. This paper investigates the determinants of Internet users' willingness to pay (WTP) for next-generation access (NGA) in Slovenia. Following the EU Digital Agenda target whereby all households should have Internet access of at least 30 Mbps by 2020, the WTP for an Internet speed of 30 Mbps is analysed. The results show that characteristics relating to the current use of Internet services and characteristics of Internet users both play an important role in explaining the WTP for NGA In particular, the presence of a student or pupil in the household, household income, subscription to mobile broadband and the quality of Internet services positively influence the WTP decision, while respondents that are employed or are already subscribed to fibre have lower WTP The results of our analysis may help Internet service providers and policymakers identify remedies which can reduce the demand gap for NGA networks.

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1. Introduction

The central focus of current broadband development in the European Union (EU) is how to encourage investments in next-generation access (NGA) technologies, which include VDSL, fibre to the home (FTTH), fibre to the building (FTTB), Cable Docsis 3.0 and any other technology capable of at least a 30 Mbps download speed (EC, 2014). According to the EU's Digital Agenda, all EU households should have access to high-speed broadband of at least 30 Mbps by 2020. While NGA networks capable of delivering such speeds are available to 75.9% of EU households, only 27% of households actually subscribe to fixed broadband lines of at least 30 Mbps (EC, 2017a; EC, 2017c). This lack of demand for NGA is also observed in Slovenia, where a mere 18% of households subscribe to broadband with speeds of at least 30 Mbps, even though the NGA coverage is higher than the EU average (EC, 2017c). Generally,

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consumers do not migrate to faster broadband as soon as such Internet access is available. Hence, the demand side should not be neglected when designing customers' migration to fast broadband. In order to trigger such migration, it is important to know which factors lie behind consumers' decision to switch to higher Internet speeds and how much they are willing to pay for such switching. Our research thus attempts to identify possible demand-pull forces, which occur as 'a result of the willingness of potential users to use the innovation' (Choudrie & Papazafeiropoulou, 2007, p. 297) and could help in designing the government intervention and operators strategies.

In our paper, we focus on the demand gap for fast broadband and aim to investigate the behaviour of Internet users who have not yet decided to migrate. Slovenia appears to be a particularly interesting case since, despite its high NGA coverage, the established demand gap is even more pronounced than in the EU Our aim is to determine the factors that, first, impact consumers' willingness to migrate and, second, willingness to pay (WTP) for NGA by non-adopters of fast broadband in Slovenia. By augmenting the studies of the WTP for broadband we try to find out if and how much more current Internet users, non-adopters of high-speed broadband, are willing to pay for a subscription to an Internet speed of 30 Mbps (hereinafter: EU fast broadband).

The paper is structured as follows. Section 2 provides a brief literature review. Section 3 provides a review of NGA coverage in the EU and Slovenia and the penetration of fast broadband in terms of speed. We also discuss the causes of the demand gap for fast speeds. Section 4 outlines methods employed, while description of survey and data is provided in Section 5. Section 6 presents the estimation results of the WTP for the EU fast broadband. Finally, findings are summarised in the conclusion.

2. Literature review

Several studies have analysed the migration from narrowband to fast broadband (Ida & Kuroda, 2006), the second migration within broadband services (from ADSL to fibre) (Ida & Sakahira, 2008), the choice of Internet access modes (Srinuan, Srinuan, & Bohlin, 2012; Sunada, Noguchi, Ohashi, & Okada, 2011) and the WTP for broadband Internet services (Carare, McGovern, Noriega, & Schwarz, 2015; Rosston, Savage, & Waldman, 2010; Savage & Waldman, 2005; Savage & Waldman, 2009). Sunada et al. (2011) used a conditional logit model to estimate the household choice of Internet access mode in Japan. The results show that the characteristics of users rather than the characteristics of access modes play a significant role in demand substitution across access modes. Households with a student and heavy Internet users, i.e., those using the Internet 10 hours or more per week, are more likely to switch to fibre. In contrast, Internet download speed does not significantly affect demand substitution between access modes. The simulation results also indicate that, even if fibre had been available to the whole country, only 10% of households would have switched to this type of access. Another study by Ida and Sakahira (2008), also for Japan, examined migration from ADSL to fibre. They found that a higher income, frequent motion-picture viewing and living in an apartment significantly stimulate migration to fibre. The estimated price elasticity reveals that demand for fibre is also highly elastic. These results are consistent with previous findings of Ida and Kuroda (2006) who also analysed the demand for broadband in Japan. Ida and Sato (2006) used conjoint analysis to examine consumers' preference for broadband services in Japan. They found that the WTP for a speed of 1 Mbps is more than double for users without access to fibre than for users with access to fibre.

On the other hand, the results of a study by Srinuan et al. (2012) for Swedish broadband users show that price, housing mode and age are important determinants of the broadband access mode. Evens (2011) focuses solely on the demand side for fibre networks in Flanders (Belgium). He finds low market potential for fibre, which implies that massive adoption is unlikely to occur in the next few years. Customers are also very price-sensitive regarding fibre technology. In addition, innovators and early adopters have a significantly higher WTP for high-capacity broadband than other adopter segments.

Some studies also aimed at revealing households' WTP for broadband Internet services and speeds. Using conjoint analysis, Savage and Waldman (2005) found that the reliability of services, speed and being always connected are important Internet access attributes for U.S. consumers. The WTP for speed increases with income and education, while age has a negative effect. In another study, Savage and Waldman (2009) also examined U.S. households' demand for Internet bandwidth. The study employing a repeated discrete choice experiment focused on the variation of the WTP for bandwidth by location and technical ability. The results show the much higher WTP for bandwidth of urban consumers with high technical ability compared with rural consumers. Using a choice experiment, Rosston et al. (2010) confirmed that reliability and speed are important characteristics of broadband Internet service in the USA. Further, they found that in addition to education and income online experience also increases the WTP for speed. A very fast Internet service is not valued much more than a fast Internet service by households. Most recently, Carare et al. (2015) using Tobit, logit and linear probability models examined the stated WTP for broadband of non-adopters in the USA. They found that a price reduction of about 15% would initiate a 10% subscription rate increase.

3. NGA coverage, broadband speeds and demand gap

The EU Digital Agenda sets several objectives related to the information society. Two of them relate to migration to higher Internet speeds. By 2020, fast broadband of at least 30 Mbps should be available to all Europeans and at least 50% of households should subscribe to ultrafast broadband of at least 100 Mbps (EC, 2014).

The fixed broadband markets in the EU are relatively fragmented in terms of NGA coverage. On one hand, there are leading countries with more than 90% NGA coverage (Malta, Belgium, Netherlands, Luxemburg, Denmark, Portugal, Latvia and the United Kingdom), where Malta is leading the group with complete NGA network coverage of the whole territory. The opposite group of countries with NGA coverage below the EU average (75.9%) includes 10 countries (Slovakia, the Czech Republic,

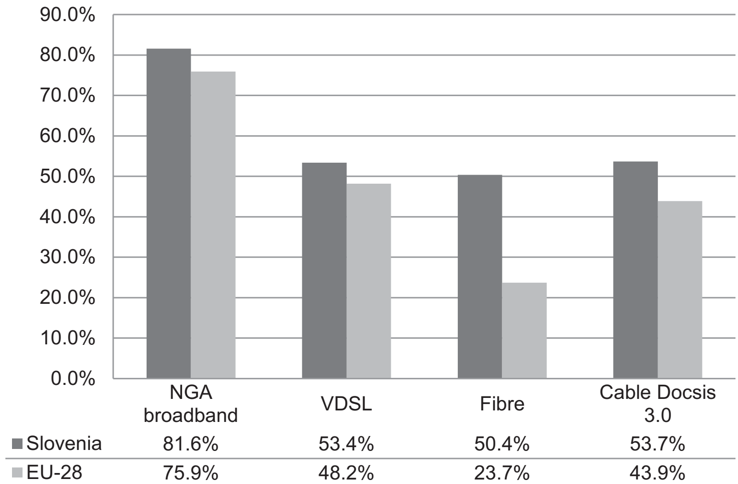

Figure 1. Total coverage by N.G.A. broadband technology in 2016. Source: EC, 2017a.

Finland, Bulgaria, Romania, Poland, Croatia, France, Italy and Greece), where Greece trails behind with only 44.2% of NGA coverage. All other countries belong to the third group exceeding the average EU NGA coverage (EC, 2017a).

In Slovenia, the country of our study, the NGA coverage is more than 5 percentage points above the EU average. The higher NGA coverage in Slovenia is mostly driven by the much higher coverage of fibre technologies (Figure 1).

In spite of the high average NGA coverage in the EU, a huge demand gap exists as the difference between the levels of fast broadband adoption and the availability of NGA, as shown in Table 1. The average EU fast broadband penetration corresponds to a 27% household penetration rate, which is more than 48% percentage points lower than the average NGA coverage in the EU Again, there are significant variations in this gap across countries. The Netherlands, the leading EU country with a fast broadband household penetration rate of 66%, has penetration of more than two times higher than the EU average (27%). Slovenia appears to be an interesting country for this study as it witnesses a huge discrepancy between the availability of technologies (penetration, coverage) and fast broadband adoption. In 2016, only 24% of fixed broadband subscriptions in Slovenia were of at least 30 Mbps, which corresponds to a relatively low (7.1) estimated subscriptions per 100 inhabitants. Only Cyprus (1.3%), Greece (2.3%), Croatia (2.5%), Italy (3.0%) and Austria (6.9%) had lower fast broadband penetration in the EU (Table 1; EC, 2016; EC, 2017c).

The insufficient demand for fast Internet speed in Slovenia is also seen in the fact that the majority of subscribers to NGA have a download speed of less than 30 Mbps. In 2016, 62% of all fixed broadband subscriptions were to NGA, but only 24% of fixed lines had a speed of at least 30 Mbps. This allows us to conclude that just 39% of NGA subscribers are connected to more than a 30 Mbps download Internet speed in Slovenia, contrary to the EU where there are around 88% of such NGA subscriptions. Ultrafast broadband of at least 100 Mbps is still very rare in

Table 1. Share of fixed broadband subscriptions by speed (in %).

Internet download speed	Slovenia 2010	2011	2012	2013	2014	2015	2016	EU-28 2016	Slovenia rank among EU-28 countries 2016
≥ 2 Mbps	44	83	83	89	93	94	95	99	27
≥ 10 Mbps	26	32	36	45	51	63	71	82	20
≥ 30 Mbps	1	2	4	6	10	18	24	37	22
≥ 100 Mbps	0	2	3	4	6	10	12	15	16

Source: EC, 2017b.

both Slovenia and the EU, with only 3.6% and 4.9% penetration rates, respectively (EC, 2016).

The Eurobarometer survey from December 2011 (EC, 2012a) provides some insights into the insufficient demand for higher broadband speeds in the EU One finding is that when EU consumers subscribe to the Internet the price is relatively more important for their choice of subscriptions than a higher download connection speed. Another reason for the lack of demand lies in the lack of interest and/or awareness of subscription terms regarding Internet speeds. Surprisingly, the majority of EU customers (58%) were not aware of their maximum download speed. Only 14% of subscribers would be prepared to pay more for an Internet connection with a higher speed or a greater downloading capacity, whereas 79% of them would be willing to pay only up to a 15% higher price. The most important reported motives to pay more for a higher speed are to upload or share content, to watch videos, live events and television. On the other hand, a lack of awareness of potential benefits, a lack of services and the expected (higher) price were the principal reasons they were not prepared to pay more for a faster Internet connection (EC, 2012a; 2012b).

The Eurobarometer survey from March 2013 (EC, 2013a) also found that only 40% of EU customers were prepared to change their Internet provider if they were offered a higher speed or a greater downloading capacity for the same price. These findings indicate that most EU consumers are reluctant to either pay for or switch to obtain a faster Internet connection. Similar behaviour was observed in Slovenia, where just 18% of customers were ready to pay a higher price for a faster Internet connection with their current provider and only half were prepared to change their provider for a faster connection at the same price (EC, 2013a). Surveys (EC, 2012a; 2013a) also reported that EU customers who were not aware of their maximum download speed were less likely to pay more for a faster Internet connection. In contrast, those who had often experienced difficulties accessing online content due to insufficient Internet capacity were willing to pay more for an Internet connection with a higher speed.

The demand gap for faster speeds seems to have started shrinking recently as broadband subscriptions in the EU have been becoming faster. In 2016, 82% of fixed broadband subscriptions were of at least 10 Mbps as opposed to 26% in 2010 (Table 1). At the same time, low-speed subscriptions (below 2 Mbps) have become marginal in the EU, except in Estonia (EC, 2016).

In order to trigger migration to fast broadband, it is useful to know whether the characteristics of customers and their Internet use habits and experiences impact their readiness to switch over to higher Internet speeds and, if they do, what is their willingness to pay for such migration. Our research attempts to answer these questions.

Drawing on microeconomic theory and the empirical studies presented in Section 2, we postulate the following hypotheses:

Hypothesis 1. *Characteristics of the current use of Internet services impact the WTP for NGA*

Hypothesis 2. *The WTP for NGA depends on socio-economic characteristics of households.*

Hypothesis 3. *The decisions on whether to subscribe to and how much to pay for NGA are not necessarily influenced by the same factors.*

In principle, the two decisions in the third hypothesis could be influenced by similar factors. However, the impact of these factors may not prove to be statistically significant and identical in both cases. For example, the willingness to pay is expected to be influenced to a larger extent by factors such as income and employment status, while the willingness to subscribe or migrate may much more depend on factors such as heavy use and IT literacy. This, however, remains to be tested in the paper.

Due to the high number of explanatory variables considered in the model and the different models employed, the explanatory variables' expected influence on the WTP for NGA is explained in more detail in Section 6.

4. Methods

Following the related empirical studies presented in Section 2, limited dependent variable models are used to analyse Internet users' preferences with respect to subscribing to high-speed Internet. We formulate an econometric model that is consistent with microeconomic theory of utility maximisation (Hanemann & Kanninen, 2001).

4.1. Model of utility maximisation

Let us assume an individual consumer with a utility function defined over market goods, denoted by q, and an item that is to be valued (i.e., high-speed Internet), denoted by I. Other market good attributes and individual characteristics that determine his preferences for goods are denoted by s. The corresponding indirect utility function

$$v(p,\ I,\ m,\ s,\ \varepsilon) \tag{1}$$

depends on the prices of the market goods (p), the individual's income (m), his characteristics (s), the item to be evaluated *(I)*, and the random error *(ε)*. The latter represents unobservable characteristics of the individual and/or attributes of the item and can stand for both variation in preferences among respondents and measurement error.

A consumer is confronted with the decision to purchase good I (subscribe to a fast broadband), so that state of I changes from $I0$ to $I1$. Assuming this to be an improvement, then $v(p,\ I1,\ m,\ s,\ \varepsilon) \geq v(p, I0,\ m,\ s,\ \varepsilon)$. This change in the state of good I is associated with a cost of c (in EUR) and according to utility maximisation theory, the probability that consumer decides to purchase good I is:

$$\Pr\ (\text{decision is "yes"}) = \Pr\left\{v(p, I1,\ m-c,\ s,\ \varepsilon) \geq v(p,\ I0,\ m,\ s,\ \varepsilon)\right\}. \quad (2)$$

The latter can be expressed equivalently by using compensating variation measure, C, that satisfies:

$$v(p,\ I1,\ m-C,\ s,\ \varepsilon) = v(p,\ I0,\ m, s,\ \varepsilon). \quad (3)$$

Therefore,

$$C = C(p,\ I0,\ I1,\ m,\ s,\ \varepsilon) \quad (4)$$

is the consumer's maximum WTP for the change of I from $I0$ to $I1$, that is a maximum WTP for subscribing to the EU fast broadband. The consumer will subscribe to the fast broadband only if the cost of subscription (c) is less or equals his WTP Equivalently to condition (2) this can be expressed as:

$$\Pr\ (\text{decision is "yes"}) = \Pr\left\{C(p,\ I0,\ I1,\ m,\ s,\ \varepsilon) \geq c\right\}. \quad (5)$$

In accordance with a random utility model, $C(p,\ I0, I1,\ m,\ s,\ \varepsilon)$ is a random variable. Although the respondent knows his own WTP for the change in I, it is unknown to the investigator and thus treated as a random variable (Hanemann & Kanninen, 2001).

4.2. Econometric models

The consumer's decisions whether to subscribe or not and how much to pay for the EU fast broadband (an Internet speed of 30 Mbps), are modelled with two econometric models, namely a probit and a Tobit model. In both models the maximum likelihood estimation method is used.

Decision of household i ($i = 1 \ldots .n$) whether to subscribe or not to the EU fast broadband is determined by the following linear equation:

$$z_i = \mathbf{x}_i'\gamma + u_i \quad (6)$$

where $\mathbf{x}_i$ is a vector of explanatory variables, γ is a vector of parameters, u_i is a random error, and z_i ($DWTPS$) is a dichotomous dependent variable taking values:

$$z_i = \begin{cases} 1 & \textit{if household is willing to subscribe} \\ 0 & \textit{otherwise} \end{cases} \quad (7)$$

Applying a binary probit model, the probability that household i is willing to pay for/subscribe to an Internet speed of 30 Mbps is (Greene, 2000; Wooldridge, 2003):

$$\Pr(z_i = 1|\mathbf{x}_i) = \Phi\left(\mathbf{x}'_i\gamma\right), \quad (8)$$

where the $\Phi(\cdot)$ is the cumulative density function of the standard normal distribution.

The second model uses Equation (4) for estimating valuation function that assigns the monetary value of a change in economic welfare that occurs for any change of *I*. Since in the second model, where the decision on 'how much to pay' is modelled, the dependent variable, i.e., additional willingness to pay for the EU fast broadband (*WTPS*), is zero for a significant number of observations, we estimated a Tobit model.[1] Following Maddala (1983), Greene (2000) and Wooldridge (2003), the Tobit model is typically derived in terms of latent variable y_i* which is unobserved and determined by:

$$y_i^* = \mathbf{x}'_i\boldsymbol{\beta} + v_i, \tag{9}$$

where $\mathbf{x}_i$ stands for a vector of explanatory variables (which is the same as in Equation (6)), $\boldsymbol{\beta}$ is a vector of parameters and v_i is the random error. v_i is independently and normally distributed with a mean of zero and variance of σ^2. Further, variable y_i (*WTPS*) is the observed or stated willingness to pay by household *i* taking the values:

$$\begin{array}{lll} y_i = y_i^* & \text{if} & y_i^* > 0, \\ y_i = 0 & & \text{otherwise.} \end{array} \tag{10}$$

The hypothesis tested is that the following two groups of explanatory variables ($\mathbf{x}_i$) influence the WTP for the EU fast broadband: (1) household socio-economic characteristics (such as household income, age, education, gender, employment, a student/pupil in the family (household), location of current residence); and (2) characteristics of the current use of Internet services (intensity of Internet usage, quality of Internet services, type of broadband access, speed of access, monthly charge, movies, music or games downloading, subscription to the incumbent operator, subscription to mobile broadband and a bundled package).

5. Survey and data

In order to explore the WTP for NGA in Slovenia, data were gathered via an Internet survey in June 2013. The research was sponsored by the Slovenian Research Agency. The survey investigated Internet use by Slovenian households. The questionnaire consisted of 44 questions covering: (1) the current use of Internet and other communication services; (2) the type of broadband access; and (3) Internet service providers' subscription details. An additional 12 questions were related to socio-demographic and economic characteristics of households. A pre-test of the questionnaire was undertaken with experts from the field in the telecommunications industry. A pilot study was also conducted on a smaller sample of broadband users. Subsequently, the questionnaire was amended and refined by giving some additional information and explanations to ensure that respondents understood the questions asked.

In line with the models, the respondents were asked whether they would subscribe to an Internet speed of 30 Mbps (*DWTPS*). The follow-up question asked them to specify how much more per month in addition to their current bill for Internet or bundle package services they would be willing to pay (*WTPS*).

To elicit the WTP, an open-ended format was chosen in the survey.[2] In order to obtain more reliable answers the respondents were reminded of their reported average monthly bill for broadband services. Respondents were also informed about the EU's Digital Agenda target. To illustrate the capability of a speed of 30 Mbps for less informed respondents about the impact of speed on the use of services and applications, additional information was provided in the questionnaire, that a download speed of 30 Mbps allows a 2-hour, high-definition movie to be downloaded in just a few minutes.

The survey and sampling were conducted by a professional market research agency in order to ensure the representativeness of the sample. The random sampling procedure was used and observations were chosen from a representative database of the Slovenian population, aged between 18 and 70 years. To ensure reliable answers, only respondents who are responsible for Internet-related decisions in the household were included in the survey. Further, since we were only investigating non-adopters' demand for fast broadband, any respondents with access to broadband with a download speed above 30 Mbps were excluded from the sample. We further omitted those households which did not report their characteristics (e.g., household income). After also excluding those with inconsistencies in the answers, 640 households remained in the final sample. Although this exclusion may create a selection bias, the following comparison of the selected sample characteristics with those of the population shows that the sample represents the population reasonably well.

While the average age in the sample (42.2 years) corresponds well to population numbers (42.1 years), the share of males (51.6%) is slightly higher (by two percentage points) (SORS, 2015a). The reported average household income without transfers (EUR 18,648) is close to the Slovenian average (EUR 18,913 net annually) (SORS, 2015b). With respect to education, the share of respondents who completed secondary school (50.1%) is almost the same as in the population (53.27%), those with a tertiary education are overrepresented and those who completed primary school or less are underrepresented in the sample (SORS, 2015a). The education discrepancy is not surprising, as the sample only consists of broadband users and education is proven to be one of the significant factors of fixed broadband diffusion (Lee, Marcu, & Lee, 2011).The share of the employed in the sample (63.13%) is similar as in the population (58.2%) (SORS, 2013). The sample shares of broadband connections by technology (Table 3) are fairly representative of the Slovenian broadband market (Table 2) with a slightly lower representation of Internet users connected to DSL and a slightly higher one to cable in the sample. The fixed broadband penetration rate in Slovenia has been steadily growing in the last few years, reaching 29.5% in July 2016, which is 3.2 percentage points below the EU average (EC, 2016). Slovenia lags behind the EU in penetration, but the infrastructure competition is more advanced than in the EU While DSL still remains the most widely used access technology (39.2%) in 2016, it has a more than one-quarter lower share than in the EU (67%) (Table 2; EC, 2016). In contrast, the share of fibre was more than 17 percentage points higher than the EU average, placing Slovenia among those countries with the highest fibre household penetration rates in the EU.

Table 2. Fixed broadband subscription shares in Slovenia by technology (in %).

	2010	2011	2012	2013	2014	2015	2016
xDSL	58.6	55.3	51.3	48.0	44.6	42.4	39.2
Cable	25.5	26.8	28.8	29.3	31.0	30.8	29.9
Fibre	14.7	15.9	17.4	20.1	21.8	24.3	28.5
Other technologies	1.3	2.1	2.5	2.6	2.5	2.6	2.3

Sources: APEK, 2012; AKOS, 2014a; AKOS, 2015; AKOS, 2017.

Table 3. Descriptive statistics.

Variable	Description	Mean	Std. Dev.	Min	Max
WTPS	Additional willingness to pay for an Internet speed of 30 Mbps (in €)	3.9453	6.1046	0	32.5
DWTPS	1 - respondent is willing to subscribe to an Internet speed of 30 Mbps, 0 - otherwise	0.5813	0.4937	0	1
AGE	Age (in years)	42.1953	12.4996	18	70
EDUC	Education level (scale from 1 to 5)	3.3828	0.8061	1	5
GENDER	1 - male, 0 - female	0.5156	0.5001	0	1
HINC	Household income (in €)	1,554	782	250	3500
DSTUSEC	1 - a student/pupil in the household, 0 - otherwise	0.3406	0.4743	0	1
STEMPL	1 - respondent is employed, 0 - otherwise	0.6313	0.4828	0	1
CITY	1 - household is located in the city, 0 - otherwise	0.6469	0.4783	0	1
DSL[a]	1 - DSL, 0 - otherwise	0.4250	0.4947	0	1
CABEL	1 - cable, 0 - otherwise	0.3422	0.4748	0	1
FIBRE	1 - fibre, 0 - otherwise	0.1922	0.3943	0	1
OTHTEH	1 - other technology broadband access, 0 - otherwise	0.0406	0.1976	0	1
BUNDLE	1 - household is subscribed to a bundled package, 0 - otherwise	0.8500	0.3574	0	1
BILL	Monthly bill for Internet services/ bundled package (in €)	43.4188	15.2227	9	150
LSPEED	1 - download Internet speed below 2 Mbps, 0 - otherwise	0.2031	0.4026	0	1
MSPEED [a]	1 - download Internet speed above 2 Mbps and below 10 Mbps, 0 - otherwise	0.3578	0.4797	0	1
HSPEED	1 - download Internet speed above 10 Mbps and below 30 Mbps, 0 - otherwise	0.2203	0.4148	0	1
NSPEED	1 - download Internet speed not reported, 0 - otherwise	0.2188	0.4137	0	1
MOVIE	Movie, music or games downloading (scale from 1 to 6)	2.9094	1.6334	1	6
USE	Intensity of Internet usage (scale from 1 to 5)	4.9250	0.2808	3	5
QS	Quality of Internet services (scale from 1 to 5)	3.7703	0.8710	1	5
ADM	1 - respondent is subscribed to mobile broadband, 0 - otherwise	0.4641	0.4991	0	1
TS	1 - household is subscribed to incumbent Telekom Slovenije, 0 - otherwise	0.3203	0.4670	0	1

[a]Dummy variable set as a base category in the model estimation.
Source: Authors' calculations.

To summarise, overall our sample is a good representation of the population in most characteristics. Some differences, in particular in education, are expected because our sample consists of Internet users, decision-makers in the households.

Around 58% of the respondents expressed an interest in subscribing to the EU fast broadband (Table 3). These Internet users are willing to pay for the E.U. fast broadband on average, calculated as a simple mean, EUR 3.9 more on their current bill, which represents approximately 9% of the average monthly bill. More than half (53.2%) of those reporting a positive WTP would be willing to pay up to EUR 5 and another 30% up to EUR 10. The estimated willingness to make an additional payment appears to be quite low in comparison to the price differences between lower and fast-speed Internet charged by Internet providers. According to EC (2013b) Slovenian providers charge for the triple-play bundle (Internet, TV and fixed telephony) for speeds of 30+ Mbps EUR 72.55, which considerably exceeds the average reported monthly bill of respondents (EUR 43.41). Relatively low WTP may be explained by subscribers' speculations about the behaviour of Internet providers based on their practices adopted in recent marketing strategies. In their campaigns to motivate greater use of faster speeds, Internet providers have been recently repeating promotions to their current subscribers, offering switching to higher Internet speeds without additional payment. They have also been designing new package offers for current Internet users, including higher Internet speeds for almost the same price as for the existing connections. When such practices appear in the market frequently, they may reduce the non-adopters' WTP for migration. This also implies that operators may no longer count on charging higher prices for fast broadband if they want to persuade non-adopters to switch to fast speeds.

The explanatory variables included in the model are listed in Table 3. Broadly, they can be divided in two groups, namely household socio-economic characteristics and characteristics relating to the current use of Internet services. Education levels (*EDUC*) vary from 1 to 5 (1 – no formal education or finished elementary school; 2 – vocational high school (2 or 3 years); 3 – high school (4 or 5 years); 4 – a bachelor's degree and 5 – a master's or a doctoral degree). A further four dummy variables were included for gender (*GENDER*), employment status (*STEMPL*), presence of at least one student or a pupil as a family member (*DSTUSEC*) and household location (rural or urban) (*CITY*). Household monthly income (*HINC*) was included as a middle value of the reported class for each respondent, where respondents could choose from among 10 income groups.

Monthly bill (*BILL*) represents average monthly household expenditure for Internet access and services (for those subscribed only to the Internet) or for a bundled broadband subscription package including all additional charges for excess use above the basic services (for those subscribed to a bundle). In other words, monthly bill includes all average monthly household expenditures for access to the Internet and its services. Monthly bill depends on the speed and type of service (i.e., the Internet only or the type of bundle) which we control for by including these variables in the model.

For the variables intensity of Internet usage (*USE*) and frequency of movie, music or games downloading (*MOVIE*), the frequency increases with a higher number. We assigned number 1 for once or less than once per month and 5 for everyday Internet usage and music/movie/games downloading. The technology of Internet subscribers' broadband access is captured by the dummy variables *CABLE*, *FIBRE*, *DSL* and

OTHTEH, where the latter means other technologies. In addition, a dummy variable reflecting the subscription to mobile broadband *(ADM)* is considered in the model. A dummy variable for bundled services (*BUNDLE*) was included in the model because bundled service packages are the main subscription type in Slovenia, representing 82% of all broadband subscriptions, which is close to our sample (85%). By choosing bundled packages rather than unbundled services, households tend to reduce their monthly expenditures since a bundle is usually cheaper than the sum of charges for the same unbundled services. The highest share and growth was recorded for triple-play packages, while double-play bundles and single services have been constantly losing the interest of broadband customers.[3] Recently, quadruple play has also been attracting more broadband subscribers (AKOS, 2014a).

We also included a dummy variable (*TS*) for the subscription to the incumbent Telekom Slovenije to see if it has an impact on the WTP Although constantly losing its market share, the incumbent retains the leading position in the market (35.5%), which corresponds well to our sample (32.0%) (AKOS, 2014b).

Concerning the quality of Internet services (*QS*), respondents were asked to indicate on a 5-point scale how satisfied they are with the following characteristics of their current Internet provider: Internet speed, connection reliability, customer services, price of services, and provision of additional services (e.g., e-mail, firewall software, etc.). *QS* is calculated as the average score of all answers to those questions for each respondent.

Possible presence of multicollinearity was checked in two ways, firstly by calculating the bivariate correlation coefficients and, secondly, by calculating the Variance Inflation Factor (VIF). The estimated values for all bivariate correlation coefficients are below 0.37, indicating a small possibility of multicollinearity in our data set. The calculated values of the VIF test for all explanatory variables are below 2, which also confirms that multicollinearity is not present in our data set.

6. Results

Drawing on economic theory, we expect positive impacts of household income and education on the WTP We also expect a larger additional WTP for households with a pupil/student, for those more frequently using the Internet and downloading movies and for those with higher service quality. We would also expect that those subscribed to mobile broadband are more experienced users and would be willing to pay more.

On the other hand, it is more difficult to predict the impact of gender and age. The same refers to the Internet users' characteristics, such as monthly bill, speed, employment, and their residency (urban/rural). While Internet users with a higher monthly bill and faster speeds are assumed to be 'heavier' users, having a strong desire to use a higher speed that makes them pay more, they may also perceive that their current bills are high and may also be more satisfied with their current Internet services, thereby reducing their additional WTP for fast-speed broadband. Regarding employment, on one hand we may expect that those who are employed are used to high speeds at work and would be willing to pay more to enjoy the same quality of services at home, while on the other hand they may be willing to pay less as they may take advantage of the higher speeds at work also for their personal use. It may also be that they have no access to the Internet at work. For these users it is difficult to make any presumptions without knowing their preferences for Internet use. For households living in a city we may assume a positive impact as urban areas enjoy good coverage of competing NGA infrastructures. In contrast, the rural population, being deprived of such offers, may be willing to pay more. Moreover, Slovenia is a small country well covered by highways, which increases mobility and makes the distinction between urban and rural population habits more blurred. The expected effect of these variables, monthly bill, speed, employment and living in a city is thus inconclusive.

Table 4 provides estimation results of the probit and Tobit models. Based on the highly significant *LR* test value in both models, the null hypothesis that all coefficients in the model are equal to zero is rejected. Thus, the models' overall validity is confirmed. The results of the probit model for faster Internet speeds show that age and household income have a statistically significant and positive impact on the decision to subscribe to the E.U. fast broadband. In addition, having a student or pupil in the household, the quality of the Internet services and the subscription to the mobile broadband also significantly and positively influence the decision to subscribe. In line with our expectations, the latter three cases capture heavy or more advanced Internet users and thus have an expected positive impact on the decision to subscribe. Since a positive influence of subscription to mobile broadband (in addition to fixed broadband) is expected, a one-sided hypothesis can be used for testing the impact of mobile broadband subscription (*ADM*). According to our results, fibre access technology and the monthly bill have a negative impact on the decision to subscribe to the E.U. fast broadband. As expected, a high current monthly bill demotivates users from subscribing to a faster speed Internet. Fibre subscription usually implies high-speed Internet, so such users may be satisfied with their current speed and therefore be less likely to change their subscription. Employed are also less likely to subscribe to the E.U. fast broadband. As suggested, a possible reason may be that most employees have access to fast Internet at work and since they mostly use Internet for basic services, such as e-mailing and information searching, they seem to be reluctant to pay for a higher Internet speed at home. According to the Survey on Usage of the Internet by households and individuals (SORS, 2014), the first two purposes of using the Internet reported by almost 90% of consumers are e-mailing and searching for information on goods and services, which can also be accomplished at lower speeds. Similarly, Oni and Papazafeiropoulou (2014) found that also small and medium size enterprises are not making full use of the broadband technology and that the main barrier for effective adoption is the lack of awareness of potential benefits of the technology. Other variables do not have significant impact on subscription to fast broadband.

Similarly to the probit model, estimation results of the Tobit model reveal that the same variables play an important role in explaining the additional WTP for the E.U. fast broadband, with the exceptions of the age and the monthly bill. In addition, the intensity of Internet usage positively impacts the additional WTP for the E.U. fast

Table 4. Estimation results of the probit and Tobit models.

Parameter	Probit model		Tobit model	
	(DWTPS)		(WTPS)	
Constant	−1.7597	*	−17.4879	**
	(1.0510)		(8.0425)	
AGE	0.0105	**	0.0432	
	(0.0050)		(0.0354)	
EDUC	−0.0594		−0.4619	
	(0.0690)		(0.4916)	
GENDER	−0.1924		−0.5645	
	(0.1202)		(0.8666)	
HINC	0.0002	**	0.0016	***
	(0.0001)		(0.0005)	
DSTUSEC	0.3476	***	1.6192	**
	(0.1134)		(0.8004)	
STEMPL	−0.3345	***	−2.9626	***
	(0.1168)		(0.8299)	
CITY	−0.1468		−0.7011	
	(0.1193)		(0.8450)	
CABEL	−0.1662		−1.6443	*
	(0.1347)		(0.9525)	
FIBRE	−0.4731	***	−3.9226	***
	(0.1591)		(1.1892)	
OTHTEH	0.0551		−0.3351	
	(0.2934)		(2.0677)	
BUNDLE	0.0738		−1.1446	
	(0.1660)		(1.2042)	
BILL	−0.0095	**	−0.0336	
	(0.0041)		(0.0293)	
LSPEED	−0.0280		−0.0601	
	(0.1480)		(1.0541)	
HSPEED	0.0183		−0.7004	
	(0.1495)		(1.0748)	
NSPEED	−0.0531		−1.0365	
	(0.1537)		(1.1105)	
MOVIE	0.0130		0.1863	
	(0.0365)		(0.2658)	
USE	0.2646		3.0885	**
	(0.1913)		(1.4823)	
QS	0.2139	***	1.4115	***
	(0.0633)		(0.4625)	
ADM	0.2124	*	1.6962	**
	(0.1100)		(0.7863)	
TS	0.0018		0.0476	
	(0.1278)		(0.9122)	
Log L	−400.4118		−1512.9538	
LR test $\chi^2_{(20)}$	69.43	***	72.67	***
N	640		640	

Standard errors in brackets.
*** Significant at 1%, ** Significant at 5%, * Significant at 10%.
Source: Authors' calculations.

broadband, while accessing the Internet via cable negatively impacts the additional WTP

In both models, the direct influence of the current Internet speed on the WTP for the E.U. fast broadband is not statistically significant. The results also indicate that households with fibre on average exhibit a lower WTP compared with households with DSL These results are also consistent with the findings of Ida and Sato (2006) for Japanese broadband customers whose WTP for an additional 1 Mbps is lower for those with access to fibre than for those without it. Fibre users have higher symmetrical (download and upload) Internet speed than DSL users, which allows them faster access to online content via their higher download capacities. Thus, our presumption is that their higher download speed may demotivate them to pay more for additional speed.

7. Conclusion

Our paper contributes to the knowledge about, first, users' willingness to subscribe to, and second, to pay for high-speed NGA, which is the key issue for achieving the E.U. Digital Agenda's high-speed targets and for bridging the NGA demand gap. The literature review reveals that such studies have been, in particular, rare for the E.U. The study analyses the demand side of NGA network deployment in Slovenia with a particular emphasis on the factors that impact consumers' WTP for NGA Fixed broadband subscriptions with speeds of at least 30 Mbps are still rare, although the deployed NGA networks allow subscriptions with higher speeds. Hence, the current broadband speeds remain far below the targets set in the E.U. Digital Agenda.

The analysis reveals a substantial gap between the WTP for higher Internet speeds and the actual high-speed broadband prices charged by operators. This may be attributed to the lack of applications and services requiring higher speeds, since the current lower speeds satisfy the needs of everyday broadband Internet use. Baake, Kamecke and Wey (2007) argue that when new networks with higher download capacities are not used for the delivery of new services, they will not induce greater willingness to pay. This implies that the recovery of NGA investments will be problematic for operators, so they should offer not only NGA technologies with higher speeds, but also stimulate the provision of new high-speed applications and services. Health monitoring, online content storage and management services, and desktop sharing were identified as applications with the greatest potential in the short term that could stimulate users to switch over to the NGA networks (Evens, Seys, Boudry, De Vlieger, Verdegem, & De Marez, 2013).

Our results confirm that characteristics of the current use of Internet services and characteristics of Internet users both significantly influence the WTP for NGA In particular, the presence of a student or pupil in the household, household income, subscription to mobile broadband, subscription to fibre, the quality of Internet services, and the employment status play an important role in explaining WTP decision. This confirms the findings in Evans (2011) that heavy and advanced users who require a high-speed and reliable Internet show the greatest interest in NGA technologies and are the most likely to migrate to NGA networks.

Finally, we should note some limitations in our analysis and some directions for further research. First, conditions in the broadband market could have changed since the study was conducted in 2013. Nevertheless, despite the steady increase in demand for fast broadband since then, the demand gap of the same size still persists together with similar market conditions. Of course, the established relationship among explanatory variables and the willingness to subscribe/pay could be slightly different in magnitude. However, due to similar market conditions and the size of the demand gap they would presumably impact the WTP in the same way, which should be examined in further research. Second, the analysis is based on stated preferences and it models hypothetical behaviour, which may to some extent differ from how Internet users actually behave and may result in overestimating WTP or providing strategic answers. Final validation of the results by analysing revealed rather than stated preferences concerning the migration to NGA leaves scope for further research.

The results of our analysis provide useful insights for Internet service providers how to design new or adjust existing broadband packages to foster migration to next-generation networks (NGN) and high-speed broadband. Targeting high-income households with a student or pupil in the family, and improving the quality and range of services seems to be an effective strategy for fostering migration to NGN Our findings may also help policymakers adopt policies and strategies aiming to reduce the demand gap and achieve the set E.U. Digital Agenda goal. For instance, they may, on the supply side, stimulate the development of value-added services and applications, which could drive the adoption of NGA The investigation of supply side stimuli for bridging the demand gap opens the venue for further research.

Notes

1. In such cases, conventional regression methods (OLS method) result in biased coefficient estimates.
2. Advantages and weaknesses of open-ended questions are explained in Frew, Whynes, and Wolstenholme, (2003).
3. A single offer only includes broadband, while a double-play package bundles broadband with fixed telephony or TV. A triple-play package includes broadband, fixed telephony and TV, whereas a quadruple-play package also includes mobile services.

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