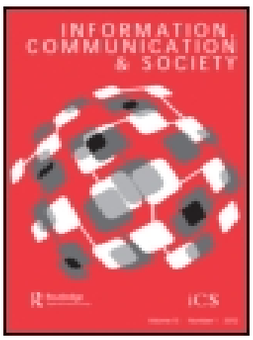

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Age for learning, age for teaching: the role of inter-generational, intra-household learning in Internet use by older adults in Latin America

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ABSTRACT

Given the accelerated aging of the global population, countries must prepare to assure their older adults' welfare. The Internet appears to be a means of ensuring that everybody, regardless of age, has access to information and can stay in touch. Data so far show the existence of a digital divide, so the question becomes: Is there a way to accelerate the digital inclusion of older adults? Using microdata from Buenos Aires (Argentina), Lima (Peru) and Guatemala City (Guatemala), this paper focuses on the role of younger people in the household in the process of Internet adoption by older adults. Regression analysis confirms that younger people play a pivotal role in the adoption process, but not in intensity of use, in which living with a spouse or partner is important for increasing the number of hours spent using the Internet.

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KEYWORDS
Digital divide; elders; Internet; technology adoption; developing countries

1. Introduction

Many countries now have aging populations because of decreased mortality rates and a significant drop in fertility rates. According to demographic estimates for the aggregate global population, the number of older adults aged 60 and over will more than double, from 841 million people in 2013 to more than 2 billion by 2050 (United Nations, 2013), which is expected to be the first year when the number of older adults exceeds the number of minors in the world. Developed countries are currently experiencing accelerated aging of their populations, while developing countries are following the same trend, but still have a few decades to go before their population pyramids invert.

Global aging has significant social and economic consequences. They include issues related to social and economic support,[1] concerns about health and age-related illness and concerns about pensions and the social and economic inclusion of older adults. These concerns raise the question of how to ensure quality of life as people age.

Given this situation and the need to act quickly and effectively to avoid the potential negative consequences of the inversion of the global population pyramid, information and

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communications technologies (ICTs) offer ways not only to improve channels of communication between individuals but also to facilitate the exchange of information and facilitate everyday tasks, such as buying, government-related interactions (i.e., obtaining national ID) or getting news, reducing transaction costs. Specifically, the Internet has expanded worldwide, with the promise of connecting those who are not included and those who have health problems or disabilities (Chu, Huber, Mastel-Smith, & Cesario, 2009; Eastman & Iyer, 2005). As the population of older adults grows, the Internet emerges not only as a tool for their social inclusion but also as a means of improving various aspects of quality of life.

Taking an optimistic view, the Internet benefits older adults in the area of health, providing relevant information and enabling them to obtain higher quality services at lower prices; it enables older adults to remain active and to continue learning through virtual activities that could be more convenient, given their physical and cognitive limitations; and it allows immediate and less-expensive communication with relatives and friends. The services and activities it offers make the Internet an effective tool for combating the four plagues identified as characteristics of old age: loneliness, boredom, lack of assistance and decreased mental abilities (Opalinski, 2001).

Despite this potential, there is a clear gap in ICTs (*e-inclusion*) between age groups in most countries; this is termed the digital divide. It refers to inequalities in access, adoption, use and knowledge of ICTs among different population groups, among which older adults are one of the groups excluded from new technologies. This divide comes along other divides among countries, Latin America being one of the regions that lags behind, as Figure 1 shows.

Our study aims to help fill two gaps in the literature, highlighted by Bailey and Ngwenyama (2010). First, there is a gap regarding the effect of inter-generational interaction on Internet adoption by older adults, and second, focusing in capital cities of three Latin American countries. Following Milligan and Passey (2011), we seek evidence of the impact on ICT adoption of older adults living in the same household as minors. The impact of inter-generational interaction could be ambiguous. On the one hand, it could create

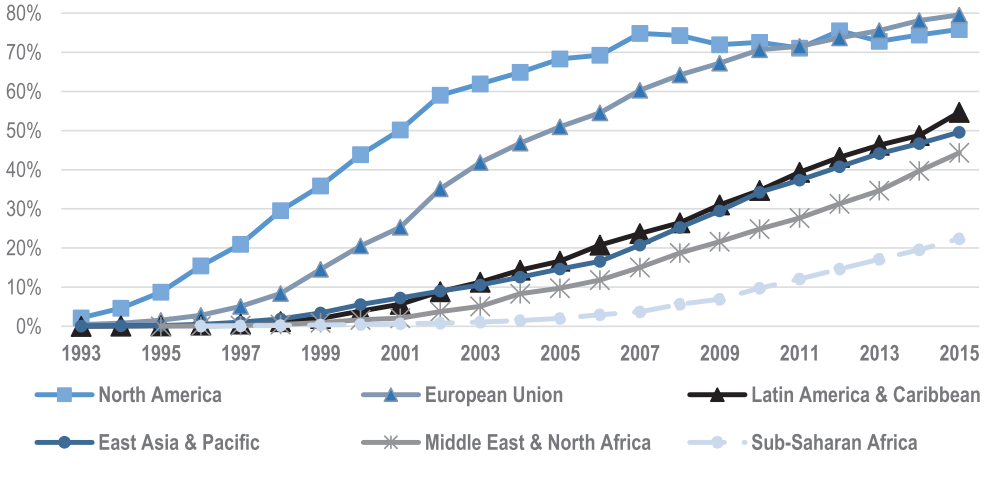

Figure 1. Individuals using the Internet (% of population). Source: World Development Indicators – World Bank. Compiled by authors.

positive externalities that facilitate the adoption of ICTs by older adults. On the other hand, the effect could be perverse, if it inhibits learning and older adults' relationship with new technologies because they are ashamed to show younger family members that they do not know how to use the devices. Our work also directly addresses the possible effects of family interaction in households that include older adults, as a possible determinant, along with socioeconomic factors, of access to and use of ICTs and the Internet. These possible interactions have not been studied in the context of less developed countries, where extended families, composed of different age cohorts, tend to cohabitate.

This paper is organized as follows: in the next section, we review the literature about the digital divide and the use of ICTs and Internet, followed by an explanation of the Technology Acceptance Model (TAM) that guides the empirical strategy; the fourth section explains the empirical strategy. The fifth and sixth sections present and discuss the results, and the seventh section presents the conclusions.

2. Literature review

Older adults are the fastest growing group of new Internet users (Eastman & Iyer, 2005); nevertheless, and despite the many benefits identified as resulting from Internet adoption (Campbell, 2005; Gatto & Tak, 2008; Jiménez, García, Jiménez, & Bermúdez, 2007; Kiel, 2005; Milligan & Passey, 2011; Muñoz, 2002; Opalinski, 2001; Saboor, Sahaf, Sum, & Pourghasem, 2015; Selwyn, 2004; Sum, Mathews, Pourghasem, & Hughes, 2008), penetration of Internet use among older adults has been lower than expected in developed countries and lower still in developing countries. According to data from 2012 (Figure 2), only half of the older adults in the United States had Internet access, compared to rates of more than 70% for the rest of the population and over 90% for the youngest cohorts.[2] This global phenomenon has been termed the digital divide, and it has been defined as the existence of inequalities in access to, use of and knowledge of search strategies and connection quality between age cohorts or income quintiles of the population (Eastman & Iyer, 2005).

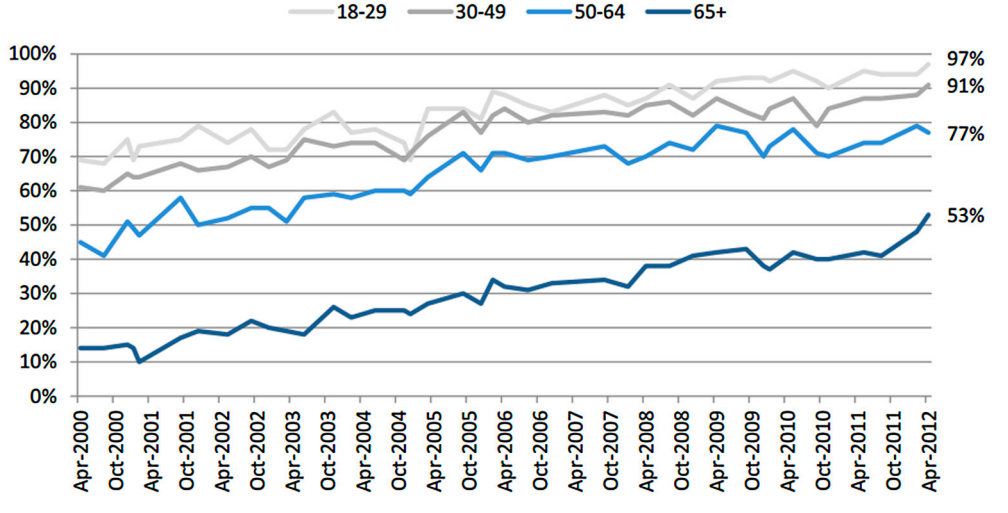

Figure 2. Percentage of US adults who use the Internet – 2012. Source: Zickuhr and Madden (2012).

Eastman and Iyer (2005) also confirm that the digital divide is becoming what they call a 'gray gap,' in reference to the divide that is developing between older adults at the higher end of the age spectrum and those who are just entering that category. The existence of the gray gap reveals that age is a determining factor in ICT adoption (Barbosa & Amaro, 2012), and that the divides are also reproduced within the cohort of older adults.

Selwyn (2004) notes that few older adults have access and that the degree of access is stratified by marital status, educational level completed and gender in the United Kingdom. Eastman and Iyer (2005) and Gatto and Tak (2008) highlight the influence of income variables, education and age on older adults' Internet use. Both studies note the importance of family structure as a highly influential sociodemographic variable in Internet adoption by older adults; in the literature on the topic, however, there is a gap regarding the effect of family composition.

The existence of the digital divide in the older adult population is attributed to a series of barriers that complicate their access to ICTs, causing them to be called 'technophobes' who fear or avoid technology (Barbosa & Amaro, 2012). This stereotype has resulted in stigmatization of and discrimination against older adults regarding their interaction with the Internet and has created preconceived notions about their inability, inferiority and lack of interest in using the Internet, as well as a paternalistic attitude.

In identifying and characterizing those barriers, Blaschke, Freddolino, and Mullen (2009) group them in five types:

(i) Problems characteristic of age: Such as limited visual capacity, problems with manual dexterity and mobility in general, cognitive and memory challenges, and limitations on everyday activities. The loss of fluid intelligence (Barbosa & Amaro, 2012) and the degree of cognitive ability demanded by ICT use (Eastman and Iyer 2005; Saboor et al., 2015), involving memory, reasoning, attention, learning, problem-solving ability and use of fine motor skills, are areas in which older adults typically suffer age-related deterioration.

(ii) Characteristics of existing technology: This group of barriers includes the complexity of interfaces, small type size, problems of use related to system design, computer jargon and the fact that many technologies are extremely complicated to use or do not work properly. Added to these problems is the difficulty of obtaining devices designed for people with disabilities or physical problems and the small number of user-friendly pages for older adults (Chu et al., 2009).[3]

(iii) Attitudinal issues: The lack of benefits perceived by older adults, in particular, leads to a lack of interest that becomes a barrier to access. In addition to this perception, the belief that the technology is hazardous, expensive, complicated and very difficult to learn, combined with the lack of confidence in their skills for ICT use, often becomes a prohibitive factor imposed by the older adult's own preconceived notions (Gatto & Tak, 2008)

(iv) Training and support: This group includes financial constraints on obtaining training in the use of ICTs and the lack of specialized workshops that meet the needs of older adults. Learning to use the Internet requires knowing how to use a computer and databases, what information is available and how files are saved (Saboor et al., 2015). To solve problems related to accessibility, the European Commission has launched a project known as the Web Accessibility Initiative (WAI) to improve web access for older adults (W3C-AGE) (Vilte, Saldaño, Martín, & Gaetán, 2013).[4]

(v) Costs: Costs of new technologies are still prohibitive for households in which older adults live. As Kiel (2005) notes, very few households of older adults in the United States have their own computers. The lack of a computer and inequality between territories and socioeconomic levels are still barriers to Internet access for older adults (Jiménez et al., 2007). The dissuasive effect of such barriers is more pronounced in developing countries.

Additionally, the lack of exposure of elders to ICT at work or in the daily routine might help develop a perception of anxiety and mistrust, influencing individual negative attitudes toward the new technologies and the avoidance of their adoption (Mesch & Talmud, 2011).

The bibliography review by Milligan and Passey (2011) shows that according to data from the European Union for 2010, the digital divide appears to be associated with specific technologies or certain online practices, and not with the entire set of technologies and forms of Internet use, as is often believed, because older adults engage in intensive use of electronic mail and websites that provide news.[5]

Of the barriers identified above, one obstacle characteristic of age is the strong influence of generational differences on the use of ICTs. As social identity theory indicates, these consist of characteristics such as the person's social context of origin, age, gender, degree of knowledge and membership in different community groups; cooperation between individuals is more likely when these are shared (Bailey & Ngwenyama, 2010). Mutual assistance can therefore be expected between people who identify as socially similar, and will be even stronger in people who share the same social representations, understood in this case as meanings attributed to the technologies by each group, based on its identity and norm; these tend to vary between generations and could facilitate communication within the same group, because there are common meanings.

The question, therefore, is how Internet adoption by older adults is influenced when they interact with young members of the household. As Bailey and Ngwenyama (2010) note, few studies have identified this effect, and research on the impact of such inter-generational interactions through ICTs will be very useful.

Various authors agree that effective Internet adoption by older adults occurs in contexts in which they find an appropriate reason to be interested in and to use ICTs. One example of this type of motivation for older adults is the possibility of connecting with grandchildren or other relatives when they are geographically dispersed (Vilte et al., 2013).

When the household includes young members, older adults are more interested in ICTs when they see how younger people use them, and inter-generational transfer of knowledge occurs despite the digital divide (Bailey & Ngwenyama, 2010). We can classify this phenomenon as older adults taking advantage of positive externalities related to ICTs when there are younger relatives who act as 'warm experts,' because they are friends or relatives who are knowledgeable about ICTs and are familiar with the situation of the novice user (Bakardjieva, 2005; Fernández-Ardèvol, 2014).

Evidence of the potential benefit for Internet adoption by children in the household has not been found for elders but some quantitative research has proved a positive relationship for the case of adults. This is the case of Korupp and Szydlik (2005), who found that the presence of children aged 12–24 was important in the Internet use of German households. On the other hand, Chesley (2006) showed that the presence of underage members did not

account for explaining Internet use by parents but the role of the spouse, specifically husbands, was an influencing variable in the likelihood that their wives will use cellphones or pagers.

In addition, Eynon and Helsper (2015) proposed that children in the household may

> influence adults' Internet use in three main ways. First, by providing a reason for acquiring home Internet access; second, by increasing adults interest in using the Internet for a range of different purposes; and third, because children might teach or motivate adults to improve their online skills.

Their empirical research showed that having children in the household was significantly and positively related to Internet use, home Internet access and the number of places adults access the Internet. However, it did not make a difference to adult's confidence or skills toward the Internet.

Intra-family relationships therefore may play an important role in Internet adoption by older adults, because many begin to use it as a result of relatives' efforts to stay in touch and to include them in the information society. As Vilte et al. (2013) and Barbosa and Amaro (2012) point out, in relationships between generations, young people (grandchildren) encourage and explain the use of ICTs to older people (grandparents); as the children grow up, they typically give their old devices to the older adults to facilitate access (Gatto & Tak, 2008). Another key characteristic of the environment that can have a major influence on access is that older adults see that their peers are already using new technologies (Opalinski, 2001). Gatto and Tak (2008) show that older adults who have spouses or partners are more likely to use computers.

The literature review in Milligan and Passey (2011) shows two possible effects of this inter-generational interaction. First, they note that many older adults have learned to use ICTs indirectly, by seeing how they are used by relatives and friends. In the report on Older Adults and Digital Inclusion prepared for the United Kingdom (Age Concern & Help the Aged, 2009), it was found that most elderly people have learned what the Internet has to offer them thanks to their children, grandchildren or partners, and by watching how those people use devices. The authors note, however, that the presence of younger family members may inhibit older people's learning and their relationship with the technology. It was found that older adults in the United Kingdom are embarrassed about their lack of computer and Internet skills, especially when they are with young members of their families, because the younger people become impatient with their lack of knowledge of ICTs, while the older adults blame themselves for feeling that they 'have to know' how to use the devices (Age Concern & Help the Aged, 2009).

Given this ambiguity in inter-generational relationships about ICT use and adoption, Milligan and Passey (2011) add to the research agenda the task of finding evidence of the impacts and influences of children and grandchildren on the adoption of technology by their parents and grandparents. It is to closing this gap in the literature, which Bailey and Ngwenyama (2010) also highlight, that we aim to contribute with this study.

3. Conceptual model

Understanding the Internet as a new technology, we follow Lee, Han, and Chung (2014) and their Technology Acceptance Model (TAM) to conceptualize Internet adoption and

use by older adults, following the recommendation by Niehaves and Plattfaut (2014) to aggregate sociodemographic variables,[6] as shown in Figure 3.

According to Lee et al., the most significant factors in Internet use or nonuse are the person's educational level and economic resources, considered approximations of socioeconomic level. In second place for them is the potential user's perception of the net's usefulness, which will determine expectations of the gains expected from potential adoption and, therefore, the decision about whether to invest time in learning to use ICTs. Older adults who perceive that Internet access will be more useful to them are more likely to use it (Eastman & Iyer, 2005). Related to usefulness, the older adult's expectation of ease of use is also a factor, taking this population's characteristics into account, as physical and mental impediments can make using a computer more complicated. Fourth, they consider expected enjoyment of ICT use, as older adults also become frustrated during the process of learning and use of ICTs, because much of the content is not adapted in a way that is user-friendly for them. Finally, Internet stress, understood as frustration and lack of control over situations (Lee et al., 2014), and the 'subjective norm' are included as explanatory variables. In the case of the former, older adults may become discouraged quickly, although this only occurs in the stage of intention to adopt and the early periods of adoption; with practice, users will be able to handle most content or find solutions on their own or online. The subjective norm refers to the encouragement that older adults receive from relatives or peers to adopt ICT use, which plays a silent role in Internet adoption by the elderly. Those relatives, particularly younger family members, could be the ones providing positive externalities and posing as warm experts.

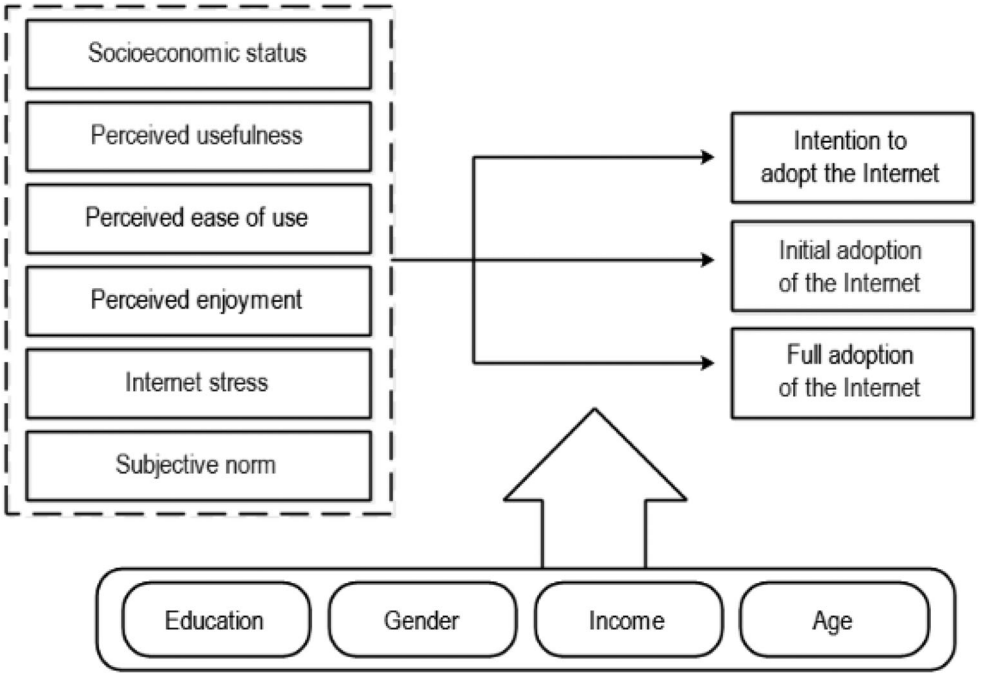

Figure 3. TAM model with sociodemographic variables. Source: Adapted from Lee et al. (2014) and Niehaves and Plattfaut (2014). Compiled by authors.

4. Empirical strategy

Our research hypothesis is that, after controlling for demographic and socioeconomic variables, family structure influences Internet adoption and degree of use by older adults. We specifically postulate that the presence of minors in the household promotes Internet access, as it is a positive externality that enables older adults to learn to use the Net, as well as an intrinsic motivation for them that promotes effective adoption (Vilte et al., 2013). We also postulate that the presence of other older adults in the household will have a positive impact on their relationship with new technologies. We employ a count model to explain the number of days per month that an older adult uses the Internet, emphasizing the role of family composition. As Greene (2003) notes, information of this type, positive whole numbers, can be analyzed with conventional multiple regression analyses, but the predominance of zeroes as small values and a discrete distribution of the dependent variable makes us inclined to use more efficient techniques that take these characteristics of the variables into account. We chose to estimate a Hurdle model, because it differentiates the process that generates data for all observations - which include zero and positive whole numbers - from the process that generates information for positive values of the dependent variable (Greene, 2003).

The Hurdle model thus relaxes the assumption that the initial decision about whether to use the device and the subsequent decision about the number of days the older adult decides to use the Internet, given that he or she previously decided to do so, stem from the same data generation process. It therefore becomes a model with two independent stages: first, considering the decision about whether or not to use the Internet; and then, given that people have decided to connect to the Internet, they indicate the amount of time they wish to devote to that activity. Our two-stage Hurdle regression form follows the specification:

$$\text{Prob}(Y_i = 1) = \alpha + \beta_1 \text{Children}_i + \beta_2 \text{Spouse}_i + \boldsymbol{X}_i^{'}\beta_3 + \boldsymbol{S}_i^{'}\beta_4 + \varepsilon_i, \tag{1}$$

$$N_i = \alpha + \gamma_1 \text{Children}_i + \gamma_2 \text{Spouse}_i + \boldsymbol{X}_i^{'}\gamma_3 + \boldsymbol{S}_i^{'}\gamma_4 + \nu_i; \quad \forall N_i > 0\,, \tag{2}$$

where the dependent variables, Y_i and N_i, are a dummy variable denoting if the older adult uses Internet and a continuous variable denoting the number of days of Internet use per month, respectively. The first part therefore will use the entire sample of observations, while the second part of the estimate will use only the observations with positive count values. Our hypothesis variables are the number of children in the household (Children_i) and the presence of the spouse (Spouse_i). The vector $\boldsymbol{X}_i$ denotes the TAM explanatory variables and the $\boldsymbol{S}_i$ vector the country, age, gender and devices controls. The specific definition, type of indicator, relation to the TAM and summary statistics of the variables included in the regression model are presented in Table 1.

For the selection of the specific regression techniques, we calculated Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) information criteria, pseudo R^2 and squared correlation as showed in Appendix Tables A1 and A3 for each stage, respectively. Following these statistics in order to gain a better fit, we chose a probit model over the logit for the first stage and a Hurdle Negative Binomial over a Hurdle Poisson for the second.[7] Marginal effects calculated in Table 3 indicate the effect of the

Table 1. Regression variables characterization and summary statistics.

Type of variable	TAM operationalization	Indicator	Average	Std. dev.	Median	Min	Max
Dependent Variable	Use Internet	Used Internet at least once[d]	0.38	0.49	0	0	1
	Days of Internet use last month	Number of days of Internet use	7.45	11.42	0	0	30
Hypothesis variables	Children presence	Number of children in household	0.23	0.63	0	0	4
	Spouse presence	Married or cohabiting[d]	0.55	0.50	1	0	1
Explanatory Variables	Socio-economic status	Years of education	9.52	4.22	11	0	18
		Total average monthly spending	1202.9	1077.1	976.8	106.5	15577.4
	Perceived usefulness	Agrees: Internet is a need[d]	0.62	0.49	1	0	1
	Perceived enjoyment	Agrees: Internet to be integrated[d]	0.85	0.36	1	0	1
	Internet Stress	Agrees: Internet is a waste of time[d]	0.23	0.42	0	0	1
	Subjective Norm	Learned to use with family or friend[d]	0.17	0.38	0	0	1
	Perceived Ease of Use	Has a job[d]	0.40	0.49	0	0	1
Control Variables	Geographic Location (country)	Argentina[d]	0.48	0.50	0	0	1
		Peru[d]	0.26	0.44	0	0	1
	Age	Age in years	65.55	4.24	65	60	91
	Gender	Male[d]	0.47	0.50	0	0	1
	Devices	Devices per capita in the household	1.02	0.65	1	0	4
		Has own device[d]	0.83	0.38	1	0	1

Note: The superscript d indicates the dummy variables.
Source: Survey about Internet Use: Platforms and Open Data – 2014. Compiled by authors.

variables in the **x** vector toward the probability of the older adults accessing the Internet and the intensity of usage.

The data come from the Survey about Internet Use: Platforms and Open Data (2014). The objective of the survey was to analyze the use of ICTs (platforms, data and content available on the Internet) and their potential for development in metropolitan areas of the capitals of Argentina, Peru and Guatemala.[8] The population studied consists of men and women over age 13 from all socioeconomic levels in the metropolitan areas of Buenos Aires, Lima and Guatemala City, using a two-stage probabilistic sampling by conglomerates. The sample contains 3600 surveys (1200 households in each city), and only one randomly selected person in each household was surveyed about patterns of use of and access to ICTs; we refer to this person as the 'informant.'

For the purposes of this study, older adults are considered to be informants who were aged 60 or over at the time of the interview; this is the cutoff point frequently used in the literature on the subject (Barbosa & Amaro, 2012). Data analysis was performed for these older adults in the three capital cities.

The variables used are meant to empirically approximate the TAM model presented by Lee et al. (2014), including the recommendation by Niehaves and Plattfaut (2014) to include sociodemographic characteristics of older adults, and emphasizing the role of the presence of younger family members as reflecting the subjective norm variable. We operationalize socioeconomic status in two ways: through the older adult's educational level and the household's average monthly spending. Perceptions of usefulness, enjoyment

and ease of use are operationalized using different dichotomous variables that reflect whether older adults agree that having Internet in the household is a necessity, if they agree that new technologies are important for keeping oneself integrated and whether he or she has a job at the time, respectively. The latter variable is used as a proxy for ease of use, because for older adults, being employed tends to be associated with being active and alert. Finally, the categories of Internet stress and subjective norm are reflected in variables that indicate whether the older adult agrees that the Internet is a waste of time and whether he or she learned to use the Internet from family or friends, in that order, and the presence of younger family members in the household.

For hypothesis variables, family structure was considered through the number of minors in the house, taking 18 as the cutoff age, and whether the older adult is married or cohabiting, to reflect the presence of a partner. Control variables added to the model were the country of residence, the number of devices per capita in the household and the number of devices belonging to the older adult informant. Those suggested by Niehaves and Plattfaut (2014) were also included: age at the time of the survey and gender, since education and income variables were already operationalized in socioeconomic status.

As the appendix shows, in the case of the probit model, the specific estimators calculated in the β vector only provide information about the direction of the relationship – whether it is direct or inverse – between the dependent variable and each of the independent variables. In contrast, marginal effects represent the change in the probability of Internet access by the older adult, given a change in a unit of the independent variable of interest. For the second stage, with the negative binomial regression (NB2) truncated to positive values (TNB2), the values of the β vector are interpreted as semielasticities; in other words, a change in one unit of the independent variable j will affect by $(100 \times \beta_j)$% the number of days per month that the older adult uses the Internet. Marginal effects are interpreted in levels; in other words, an increase in a unit of variable j will increase by AME_j the number of days of Internet use per month.

5. Results

The β vectors estimated for each stage are shown in Table 2, while Table 3 shows the average marginal effects (AME) for each of the explanatory variables.

6. Findings and discussion

Altogether, we find that most of the explanatory variables have a high significance since only four showed no explanatory power in explaining the probability of using the Internet. Analyzing the goodness of fit through the count and pseudo R^2 presented in the regression and the prediction table in the Appendix Table A4, we can confirm that the TAM model has a strong explanatory power at modeling the decision by older adults to access the Internet. Evaluating the variables that operationalize the TAM model, we find that – except for the perceived enjoyment – they are all strongly significant and with the expected sign, which places another probe of the predictive power of the TAM model and of the choice of the *probit* discrete model for this first stage.

Table 2. Hurdle regression.

Variables	(1) Probit	(2) TNB2 REG
Number of children	0.347***	0.0001
	(0.120)	(0.052)
Presence of spouse	0.132	0.240***
	(0.175)	(0.085)
Years of education	0.107***	0.012
	(0.024)	(0.014)
Total average monthly spending	0.00007	0.00002
	(0.0001)	(0.00002)
Agree: Internet is a need	0.762***	0.256**
	(0.195)	(0.130)
Agree: Internet to be integrated	−0.375	0.307
	(0.235)	(0.199)
Agree: Internet is a waste of time	−0.539**	0.258**
	(0.228)	(0.117)
Has job	0.693***	0.045
	(0.177)	(0.085)
Country: Argentina	0.894***	0.181
	(0.242)	(0.138)
Country: Peru	1.178***	0.106
	(0.261)	(0.135)
Age	−0.225	−0.025
	(0.336)	(0.127)
Age squared	0.002	0.0002
	(0.003)	(0.001)
Gender: male	−0.173	−0.145
	(0.178)	(0.102)
Devices per capita in household	1.038***	0.041
	(0.188)	(0.057)
Has own device	0.863**	0.768
	(0.413)	(0.497)
Learned to use from family - friends		−0.060
		(0.076)
Constant	1.951	2.283
	(11.360)	(4.440)
Observations	403	148
p-Value (Wald chi^2)	0.00	0.00
Pseudo R^2	0.427	0.029
Count R^2	0.791	

Notes: Robust standard errors in parentheses.
* $p < 0.1$.
** $p < .05$.
*** $p < .01$.

Analyzing the specific influence of the hypothesis variables for the older adult's initial decision about whether or not to access the Internet, we see that cohabiting with a spouse or partner do not affect this decision. We can interpret this as both elders being in a situation where they seek access to the Internet or both being disinterested given the characteristic of households in which older adults usually live alone or accompanied by another elderly person. In contrast, the number of children living with older adults in the household does have a positive and significant effect at all confidence levels for explaining the decision to access the Internet. This indicates that the inter-generational transfer of knowledge within the household is a positive externality, which tends to occur among older adults when they receive support and instruction from family members who are minors, or are just exposed to new technologies. We thus prove our hypothesis concerning the probability of older adults'

Table 3. Marginal effects, Hurdle regression.

Variables	(1) AME Probit	(2) AME TNB2 REG
Number of children	0.073***	0.002
	(0.025)	(1.063)
Presence of spouse	0.028	4.766***
	(0.037)	(1.616)
Years of education	0.023***	0.238
	(0.005)	(0.292)
Total average monthly spending	0.00002	0.0003
	(0.00002)	(0.0003)
Agree: Internet is a necessity	0.163***	4.799**
	(0.041)	(2.245)
Agree: Internet to be integrated	−0.079	5.515*
	(0.050)	(3.121)
Agree: Internet is a waste of time	−0.114**	5.830**
	(0.048)	(2.911)
Has job	0.152***	0.900
	(0.040)	(1.705)
Country: Argentina	0.180***	3.697
	(0.044)	(2.863)
Country: Peru	0.265***	2.186
	(0.056)	(2.827)
Age	0.005	−0.090
	(0.005)	(0.262)
Gender: male	−0.036	−2.940
	(0.037)	(2.076)
Devices per capita in household	0.218***	0.825
	(0.035)	(1.150)
Has own device	0.171**	10.943**
	(0.071)	(4.767)
Learned to use from family – friend		−1.212
		(1.541)
Observations	403	148

Notes: Robust standard errors in parentheses. d*y*/d*x* for dichotomous variables calculated as the discrete change.
* $p < .1$.
** $p < .05$.
*** $p < .01$.

access to the Internet, because adding a child to the household could increase by 7% the older adult's probability of accessing the Internet.

In the second stage of the regression, the dependent variable was the number of days per month that the older adult uses the Internet, as long as it is greater than zero. In this count model, the point estimators are interpreted as semielasticities, while the marginal effects, calculated as AME, are interpreted in levels.

We found three significant variables: presence of the spouse, perception of the Internet as a waste of time and perception of the Internet as a need. Analyzing the hypothesis variables related to family structure for this stage, we found that the significance is the opposite of what we found in the *probit* segment. This is the number of children in older adults' households does not have a significant influence while the presence of the spouse or partner does have a positive and significant effect at all levels.

Older adults who live with a spouse or partner show an average increase of 24% in the monthly number of days they use the Internet, which translates into 4.76 additional days considering the AME. These results could indicate that minors in the household encourage older adults to access the Internet through inter-generational learning but they have no effect regarding intensity of the older adults' use. In contrast, the spouse or partner

may affect intensity of use, which suggests two possible interpretations. Older adults who already adopted Internet could be the 'warm expert' for the older adult who has not adopted yet, by being a person in the household with whom to discover the Internet, but who would not influence the primary decision about whether or not to use the Internet. Alternatively, the effect could be related to the partners' need for time on his/her own as searching their own space and setting aside interaction with the partner for another type of activity.

To sum up the findings, contrasting the hypotheses about the influence of family structure on Internet access and use intensity by older adults, our results support the influence of subjective norm in the TAM model, as represented by the presence of a partner and minors in the household, because close family members are the ones who influence both the intensity of use and the decision to access the Internet, respectively, in older adults. The results indicate that minors play an initial role of support and transmission of knowledge for older adults in the household, while the role played by the spouse or partner is related to the amount of time spent using the Internet.

7. Conclusions

This study is an effort to contribute to the scant literature about older adults and their adoption and use of ICTs in Latin America. The global phenomenon of population aging, which is also occurring in this region, poses a new challenge for developing countries, as the growing number of elderly people forces them to think about new ways of collecting revenue to pay State expenses, new schemes for health insurance and pensions and new strategies for inclusion. The Internet shows promise for providing information to people who are excluded or who have disabilities or physical or mental limitations; older adults often belong to this group. Theoretically, ICT use by older adults offers a series of potential benefits in areas such as health, learning, activity levels, entertainment and hobbies, personal well-being, communication and everyday activities.

Despite those benefits, older adults in this region and in other countries are excluded from the information society because of a diverse set of barriers caused by age-related problems, difficulties in operating technologies because of their characteristics, attitudinal barriers on the part of older adults, lack of training and support in the use of ICTs, financial barriers or simply lack of exposure to the technology that does not allow them to obtain devices or Internet connection services.

One opportunity for overcoming barriers of lack of support and attitudinal barriers arises from the family structure, which influences older adults' adoption and use of ICTs. Through a positive externality that exists when there are minors in the household, children could promote older adults' Internet use through inter-generational learning in the use of new technologies, serving as *warm experts*.

Using the TAM model and data from the Survey about Internet Use: Platforms and Open Data – 2014 conducted in Buenos Aires, Lima and Guatemala, we offered a quantitative empirical analysis and contrasted the main hypotheses, using an inferential analysis through count model regression.

The regression was carried out using a count model in two independent stages, with two data-generation processes: the decision by older adults to access the Internet and the

number of days per month they use the Internet. The estimation was performed with a set of explanatory variables that operationalize the TAM model for both stages of the regression.

The results show that the family structure in households with older adults is significant in explaining Internet adoption and use. We found that the presence of minors in older adults' households encourages their access to the Internet, although it had no significant effect on intensity of use. Living with a spouse or partner, however, showed an increase in intensity of Internet use, but had no effect on the initial decision to use the Internet.

These results show evidence of the transfer of knowledge between children and older adults in the household, which we have called inter-generational intra-household learning. We believe this represents a positive externality for older adults when they live with minors. The findings of the study therefore support the possible importance of interaction regarding ICTs, through the role of *warm experts*, which could enable older adults to overcome barriers that cause the digital divide. Since households in developing countries tend to be composed of extended families, the potential for a significant increase in Internet adoption by the elderly is present. Public policies that incentivize inter-generational interactions can be useful to this end.

Notes

1. Understood as the number of working adults per older adult.
2. Unfortunately, there is no information available about levels of use by age group in Latin America.
3. By 2015, this problem seemed to be overcome in developed countries, where the inversion of the population pyramid is clearer; that is not the case in developing countries, however.
4. http://www.w3.org/WAI/WAI-AGE/ (Retrieved August 17, 2015).
5. The 55–74 age interval is used, because that is the oldest cohort allowed by the design of the *EuroStat* survey.
6. Although the literature indicates that cognitive age should be considered a better measure for this sociodemographic variable, Eastman and Iyer (2005) state that this is strongly correlated with chronological age and can therefore be used as a highly valid proxy variable.
7. A detailed explanation of the model can be found in Barrantes and Cozzubo (2015).
8. The technical specifications and univariate analysis for each capital can be found at http://dirsi.net/web/web/es/noticias-y-eventos/noticia/dirsi-publica-estudio-sobre-uso-de-internet-en-america-latina

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Appendices

Appendix 1: Selection criteria – discrete choice model

Table A1. Goodness-of-fit statistics – discrete choice models.

	Discrete choice models	
Goodness of fit	Probit	Logit
Log verosim (null)	−264.9618	−264.9618
Log verosim (model)	−151.7035	−152.1946
AIC	335.407	336.3893
BIC	399.39	400.3723
Pseudo R^2	0.4275	0.4256

Note: Compiled by authors.

Appendix 2: Test for overdispersion of data

Table A2. Regression – overdispersion test.

$\{(y-\hat{\mu})^2-y\}/\hat{\mu}$	Coefficient	Standard error	*t*-Test	*p*-Value	Confidence interval
$\hat{\mu}$	0.50971	0.11097	4.59	0	0.29157–0.72786

Note: Compiled by authors.

Appendix 3: Selection criteria – count model

Table A3. Goodness-of-fit statistics – count models.

	Count models	
Goodness of fit	Hurdle Poisson	Hurdle NB
AIC	1510.341	1284.309
BIC	1658.302	1436.269
Squared correlation[a]	0.421	0.422

Note: Compiled by authors.
[a]corr(y, $\hat{y}$).

Appendix 4: Goodness of fit –probit model

Table A4. Prediction table – probit.

	$\hat{y}$		
y	0	1[a]	Accuracy rate
0	231	24	91%
1	62	96	61%
Total	293	120	79%

Note: Compiled by authors.
[a]$\hat{y}_i = 1$ if $\widehat{Pr}_i \geq 0.6$.

Appendix 5: Correlations matrix

Table A5. Correlations matrix – regression's variables.

days_inter	1															
Child	0.039	1														
Spouse	0.094	−0.035	1													
Yearseduc	0.366*	−0.152	0.118	1												
Expendit_pm	0.172*	0.130	0.053	0.137	1											
inter_need	0.298*	0.078	0.097	0.159	0.190*	1										
inter_integ	0.135	0.053	−0.022	0.063	0.0889	0.299*	1									
inter_waster	−0.188*	0.103	0.054	−0.204*	−0.044	−0.103	−0.074	1								
Learn_fam_fri	0.501*	0.054	0.010	0.178*	0.096	0.159	0.053	−0.123	1							
Job	0.250*	−0.004	0.064	0.078	0.065	0.095	0.115	−0.01	0.168*	1						
Country_arg	0.007	−0.182*	−0.086	−0.166*	0.073	−0.203*	−0.016	−0.067	−0.028	−0.010	1					
Country_per	0.1660*	0.148	0.033	0.092	−0.128	0.031	−0.022	−0.160	0.170*	0.107	−0.570*	1				
Age	−0.0585	−0.0549	0.0013	−0.054	−0.059	0.020	0.026	−0.003	−0.043	−0.231*	−0.027	0.155	1			
Male	0.0073	0.023	0.222*	0.063	0.037	0.025	0.005	−0.002	0.055	0.220*	−0.189*	0.202*	0.127	1		
Device_pc	0.4729*	−0.092	−0.030	0.410*	0.165*	0.224*	0.156	−0.144	0.340*	0.152	−0.027	0.006	−0.091	0.001	1	
Device_own	0.2942*	0.029	0.048	0.286*	0.094	0.232*	0.050	−0.058	0.193*	0.164*	−0.221*	0.112	−0.083	0.053	0.499*	1

Note: Values adjusted for the *Sidak* correction. Symmetrical matrix. Compiled by authors.
*Correlation significant at 10% or less.