WHY ARE HALF OF LATIN AMERICANS NOT ONLINE? A FOUR-COUNTRY STUDY OF REASONS FOR INTERNET NON-ADOPTION

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Abstract

This paper seeks to advance our understanding of the adoption barriers faced by the 250 million people aged 15 and older in Latin America who are not regular Internet users. The data is sourced from large-scale household surveys in four countries: Colombia, Ecuador, Mexico and Peru. The empirical strategy is based on modeling the probability that non-adopters cite different reasons for non-subscription and nonuse, conditional on demographic characteristics. In contrast to developed countries, the findings indicate that high costs and limited service availability continue to be key barriers to residential subscription and, to a lesser extent, individual use. However, the findings also suggest that human capital barriers related to lack of ICT skills and content relevance are also important determinants of digital exclusion for specific groups, such as older adults and indigenous language speakers. In broader terms, the study corroborates the need to study barriers to Internet adoption in different country contexts, but perhaps more importantly across socioeconomic groups.

KEYWORDS: DIGITAL INEQUALITY, LATIN AMERICA, INTERNET NON-USERS, HOUSEHOLD SURVEY

1.	Introduction

Understanding the factors that affect Internet adoption and engagement has been an important research area for the past two decades. Early studies (Katz and Aspden, 1997; NTIA, 1999; Norris, 2001) found strong links between socioeconomic and digital exclusion, driven primarily by disparities in access opportunities and income. As Internet services were progressively deployed more widely, and the combination of technology maturation and competition brought down access prices, researchers began to focus on other factors such as individual skills, motivations and psychological attributes (van Dijk, 2005; Robinson, 2009; Hargittai and Hsieh, 2013; Helsper and Reisdorf, 2013). Further, with adoption approaching near universalization in many developed countries, research began to shift from disparities in basic access (the so-called first-level digital divide) to differences in use and levels of engagement (the so-called second-level digital divide).[1]

In Latin America, where only about half of the adult population uses the Internet on a regular basis (ITU, 2015), questions related to basic access opportunities and adoption remain critical, and the literature that explores the determinants of residential access and Internet use in the region is quite extensive (e.g., Author, 2013; Grazzi and Vergara, 2014; Gray et al., 2016). However, only a handful of studies have examined the interplay between socioeconomic factors and the reasons for non-adoption, among them Correa (2014) and Barrantes and Cozzubo (2016). Further, some of these studies are based on small samples or qualitative fieldwork with specific socioeconomic subgroups, from which results cannot be extrapolated to the general population.

This study provides a unique empirical analysis of the unconnected population in four Latin American countries: Colombia, Ecuador, Mexico and Peru. The four countries were chosen

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[1] For a more detailed discussion see Van Dijk (2013).

based on their similar demographic characteristics as well as the availability of comparable data. All of them are upper-middle income economies (per the World Bank's classification) that face numerous challenges to extend the deployment and adoption of Internet services, including persistent poverty, a rugged topography, vast development inequality across regions, and the marginalization of a large indigenous population, among several other challenges.

The study makes three unique contributions to the extant digital divide scholarship. First, the data is sourced from government-administered, nationally-representative household surveys. High data quality and large samples allow for analyzing how demographic characteristics affect the reasons for non-adoption. This is unfeasible in studies with small samples of non-adopters. Second, the study demonstrates that the drivers of digital exclusion vary considerably across socioeconomic groups, and offers quantitative estimates about the isolated effect of demographic variables on the various drivers, including high costs, lack of skills, and relevance. Third, the research context differs from most of the extant literature, which is based on fieldwork carried out in developed countries, thus providing comparative insights that shed light onto the dynamics of digital exclusion in developing contexts.

Overall, the findings validate the suggestion that digital exclusion is a multifaceted problem that requires a variety of coordinated policy responses (Warschauer, 2003; Wyatt, 2008). For some groups, the results suggest that supply-side initiatives are required to lower first-level access barriers related to service availability and high costs. For others, demand-side initiatives seem to be more appropriate to promote awareness, ICT skills, and content usability. In sum, a one-size-fits-all approach is unlikely to meet the diverse challenges involved in closing the digital divide in Latin America.

The paper is organized as follows. The next section surveys the existing literature on the drivers of non-adoption, from which a series of research hypotheses are derived. Section 3 describes the data and methods used, while section 4 provides an overview of the research context in the four countries studied. The main results are presented in section 5, followed by a discussion of the findings and their policy implications in section 6. The paper closes with a brief conclusion in section 7.

2.   Prior literature and hypotheses

There is a vast literature that examines how different socioeconomic attributes affect the appropriation of new communication technologies. More specifically, many studies examine the role of different demographic characteristics in the decision to subscribe to residential Internet services (Vicente and Lopez, 2006; LaRose et al., 2012), to use the Internet regardless of location or access device (Grazzi and Vergara, 2014; Buchi et al., 2016), and the levels of engagement and types of use (Livingstone and Helsper, 2007; Hargittai, 2010; Van Deursen and Van Dijk, 2014). However, studies that directly address reasons of non-adoption are less common. This is partly explained by the fact that this type of analysis often requires primary survey data, which can be expensive and difficult to collect. By contrast, the determinants of adoption can be readily studied using existing industry subscription data in combination with basic demographic indicators.

Further, much of the extant literature regarding the reasons for non-adoption is in the context of developed countries with very high adoption rates. For example, Helsper and Reisdorf (2016) offer a comparative analysis of reasons for nonuse in the UK and Sweden. Based on a

longitudinal design of about 2,000 respondents per year between 2009 and 2013, the study finds that lack of interest is cited by the large majority of nonusers (about two-thirds), followed distantly by lack of skills (about 10 percent) and high costs (less than 5 percent). Their analysis reveals that the share of nonusers citing lack of interest has grown over the years, which validates the need to further examine attitudes and forms of online engagement to understand nonuse.

The same dataset is used by Dutton and Blank (2013) to examine the reasons for nonuse in the UK. In this cross-sectional study with about 2,600 respondents, the authors find that nonusers represent about 18 percent of their sample. Within this population, lack of interest is the most cited reason for not being online (82 percent), followed distantly by skills (7 percent) and costs (5 percent). Reasons for nonuse are disaggregated by occupational status and type of employment, revealing no large differences except, unsurprisingly, a strong association between blue collar occupations and affordability barriers to adoption.

Reisford and Groselj (2015) also use data from the Oxford Internet Surveys (OxIS) in the UK in their study of motivational factors and Internet engagement. This study is particularly valuable in at least two respects. First, because the authors go beyond a dichotomous categorization of users and nonusers, proposing instead a four-category typology of engagement (nonusers, low users, regular users, and broad users). Second, because results show how attitudes toward the Internet are strong predictors of belonging to such categories, in some cases comparable in strength to traditional socio-economic factors such as income and education.

A 2013 study by the Pew Research Center finds somewhat different results for the US (Zickuhr, 2013), although non-trivial differences in the response categories makes precise comparisons difficult. The study finds that about a third of nonusers cite lack of relevance (which can be associated with lack of interest) as the main reason for nonuse, followed closely by usability reasons (which is strongly associated with lack of skills). Possibly the most interesting difference is that high costs are cited by about 20 percent of US nonusers, significantly higher than in the UK and Sweden.

A related study by van Deursen and Helsper (2015) examines Internet nonuse among older adults in the Netherlands. Using a telephone survey of 4,414 adults, the authors identified 401 nonusers (about 9 percent), resulting in 221 completed surveys. In this study, the authors disaggregate the analysis of reasons for nonuse by demographic characteristics. The findings suggest that these reasons do not vary significantly in this subpopulation, although the small sample size may be preventing the detection of more significant effects. The more interesting results suggest that male respondents are more likely to cite lack of interest as the main reason for nonuse, while education is positively correlated with citing lack of time. This is consistent with other studies suggesting that highly-educated older adults are less engaged in online activities due to a higher time opportunity cost (Goldfarb and Prince, 2008).

In the Latin American context, several studies have examined the determinants of Internet adoption. However, as noted, very few have delved into reasons for non-adoption. For example, previous studies have found a strong link between household income and Internet adoption in Latin America (Gamboa and Gutierrez, 2008). This allows the following hypothesis to be formulated:

H1: **Income** will be positively correlated with lack of interest and negatively correlated with high costs as the main drivers of residential non-subscription and individual nonuse.

Another consistent finding is the strong (negative) correlation between age and Internet adoption. For example, using survey data from Argentina, Peru and Guatemala, Barrantes and Cozzubo (2016) find that older adults are significantly less likely to be online, and that lack of digital skills and attitudinal factors represent the main barriers to adoption. The following hypothesis thus follows:

H2: **Age** will be negatively correlated with high costs and positively correlated with lack of skills and interest as the main drivers of residential non-subscription as well as individual nonuse.

The findings related to gender gaps are less consistent, with some studies reporting more male Internet use (e.g., Gray et al., 2016) and others reporting no significant gender differences in adoption or use patterns (e.g., Wasserman and Richmond-Abbott, 2005; Hilbert, 2011). Despite non-conclusive findings in the literature, the following hypothesis is formulated for testing:

H3: Reasons for non-subscription and individual nonuse will vary by **gender**, with men less likely to cite high costs and more likely to cite lack of interest.

Previous studies have also found a (positive) correlation between educational attainment and adoption, likely due to greater skills and ICT exposure among the more educated (Grazzi and Vergara, 2014). It follows that:

H4: **Educational attainment** will be negatively correlated with lack of skills as the main driver of residential non-subscription and individual nonuse.

The presence of children at home has been found to promote residential adoption as well as individual use. For example, a study by Correa (2014) employs a mixed-methods design that includes a survey of children-parent pairs (sample size = 242) in three schools in Santiago de Chile. The results indicate that children play a significant role in adults' ICT skills acquisition, validating the hypothesis of bottom-up transmission of skills from youths to adults within the household. This allows to formulate the following hypothesis:

H5: The presence of **children in the household** (<18 years old) will be negatively correlated with lack interest and positively correlated with high costs as the main driver of residential non-subscription and individual nonuse.

Finally, language skills are another factor consistently found to predict Internet adoption. For example, Katz (2010) finds that recent Hispanic immigrants to the US with limited English abilities rely on their children as proxy Internet users. Similar findings are reported in survey-based studies by Ono and Zavodny (2008) and Pearce and Rice (2014). Despite the lack of specific studies for Latin America, the extant literature suggests that:

H6: **Non-native Spanish speakers** will be more likely to cite lack of skills and interest, and less likely to cite high costs as the main drivers of residential non-subscription as well as individual nonuse.

3.   Data and methods

The data used in this paper is sourced from the household surveys administered by National Statistical Offices (NSOs) in Colombia, Ecuador, Mexico and Peru. These are nationally-representative, large-scale surveys administered face-to-face on an ongoing basis. Interviews are administered to heads of household or spouses, who in turn provide information on other household members. Originally designed to track basic socioeconomic indicators such as employment and poverty, these surveys have recently incorporated ICT modules, including questions about residential Internet access, Internet use, and in some cases the reasons for non-adoption.

It is important to note that these surveys are not uniform across countries. As shown in Table 1, there are variations in sample size, as well as differences in the questionnaires administered which are noted throughout the analysis. Therefore, each country is analyzed separately, and comparisons should be interpreted as indicative of common patterns rather than as precise estimations of differences between countries. Each NSO provides the individual and household sample weights that adjust for non-response rates. These weights are used to compute all the statistics in the analysis that follows.

TABLE 1: Survey Characteristics

Country	Survey	Sample	Sampling strategy	Year
Colombia	Encuesta Nacional de Calidad de Vida (ENCV)	76,026	Probabilistic stratified sampling for urban and rural conglomerates	2015
Ecuador	Encuesta Nacional de Empleo, Desempleo y Subempleo	112,821	Probabilistic in two stages with geographical stratification	2015
Mexico	Modulo Tecnología de Información en Hogares	82,477	Probabilistic stratified sampling for urban and rural areas	2014
Peru	Encuesta Residencial de Servicios de Telecomunicaciones (ERESTEL)	53,203	Probabilistic sampling for conglomerates stratified by region	2014

There are two main outcome variables of interest. First, the main reason given by respondents for not subscribing to residential Internet access. Second, the main reason given by respondents for not using the Internet on a regular basis (regardless of subscription status or location of use). In order to identify non-subscribers, the questionnaires utilize a simple question regarding whether the individual lives in a household that subscribes to an Internet access service (regardless of access technology). In turn, respondents who report not having used the Internet in the past 12 months (regardless of location or device) are considered nonusers.

Large sample size and high data quality come at the expense of limitations in the questionnaires. All surveys ask non-subscribers about the reasons for not contracting home Internet services. More importantly, there is consistency in the response categories presented, which relate to 1) high cost of the service, 2) lack of interest/relevance, 3) lack of Internet skills, and 4) limited service availability. However, only the Mexico and Peru surveys query nonusers about reasons for nonuse. Another limitation is that information regarding the primary language spoken at home is not available for Colombia and Mexico.

The analysis is based on the main reason for non-subscription or nonuse cited by respondents, thus ignoring multiple responses. The empirical strategy follows Reisdorf and Groselj (2015) in the use of multinomial logistic regression to examine the effect of different

socioeconomic factors on the probability of citing different barriers to adoption. More specifically, for each country a multinomial logistic model estimates the probability that a non-subscriber or nonuser cites a reason (with respect to a reference category), conditional on various demographic covariates.

Multinomial logistic regressions (MLR) are commonly used to model categorical outcome variables. As in standard logit analysis, multinomial models predict the odds of response in one category with respect to a base category. However, the key difference is that the comparisons are estimated simultaneously within the model, thus generalizing the logistic model to non-binary outcomes. As Agresti (2002) shows, fitting separate binary logistic models to multiclass data is not only less efficient but results in larger standard errors.

Given the large sample sizes, significance levels (p-values) are not enough to interpret results, since it is possible to identify statistically significant effects that are negligible in magnitude (Kline, 2004). Rather, the analysis emphasizes the effect size (in odds ratios) associated with the demographic covariates of interest on the reasons for non-subscription and nonuse.

4.   Research context

About half of all Latin American adults continue to be disconnected from the opportunities associated with Internet adoption. Despite industry subscription data that suggests steady growth in the past decade, adoption data collected through household surveys suggests that the rate of growth has slowed down significantly in recent years (ITU, 2015). In the four countries covered

in this study, only about a third of the population had a residential connection in 2014/2015. For comparison, the average in the EU-28 countries in 2015 was 83 percent.[2]

Unsurprisingly, there are large differences in home broadband penetration by income levels (Figure 1). For example in Colombia, residential adoption in the lowest income decile is only 11.4 percent, climbing steadily thereafter to reach 74.3 among the wealthiest 10 percent. Inequality is even greater in Ecuador, where residential adoption is almost eight times higher in the top relative to the bottom income decile, and slightly lower in Mexico and Peru (about five times higher in the top relative to the bottom income decile).
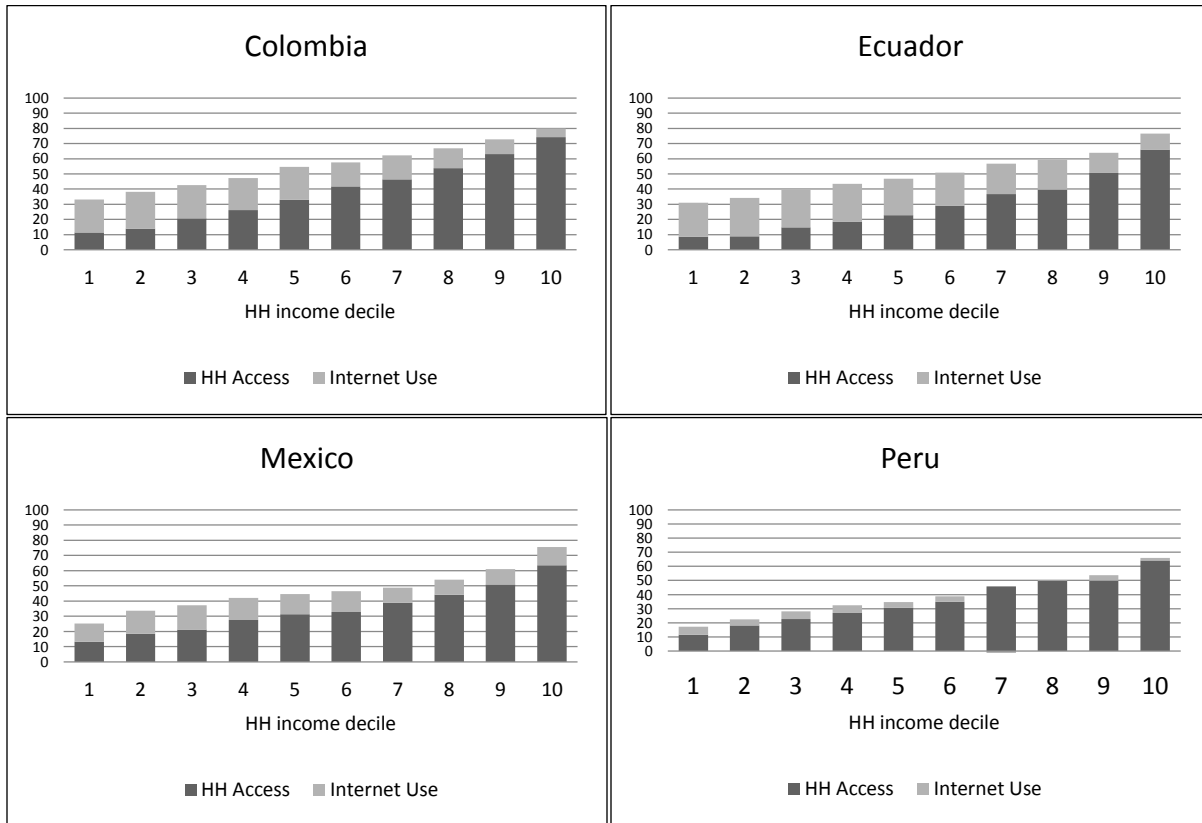
Internet users in Latin America thus heavily rely on access in workplaces, schools, cybercafés, libraries and other public spaces (Proenza, 2015). Relatively high urbanization rates (ranging from 64 percent in Ecuador to 79 percent in Mexico) and the proliferation of public access opportunities have enabled rapid growth in the number of Internet users in the region, despite limited residential adoption. In addition, mobile broadband offers a relatively cheap (though often limited) access alternative to the less affluent (e.g., Berglind, 2016).

Individual use rates are significantly higher than household connection rates, with a population average hovering around 50 percent in the four countries studied. Again, individual use varies widely across income deciles, but differences are smaller relative to those for residential access (Figure 1). For example in Colombia, the share of Internet users in the bottom income decile is 33.1 percent, climbing to 80 percent in the top decile. This ratio between top and bottom earners (of about 2.4) is similar in Ecuador, but somewhat higher in Mexico and

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[2] Source: Eurostat. Available at http://ec.europa.eu/eurostat/statistics-explained/index.php/Digital_economy_and_society_statistics_-_households_and_individuals (visited February 9, 2017).

particularly Peru, where Internet use ranges from 17 percent in the bottom to 66 percent in the top income decile (a ratio of about 3.8).

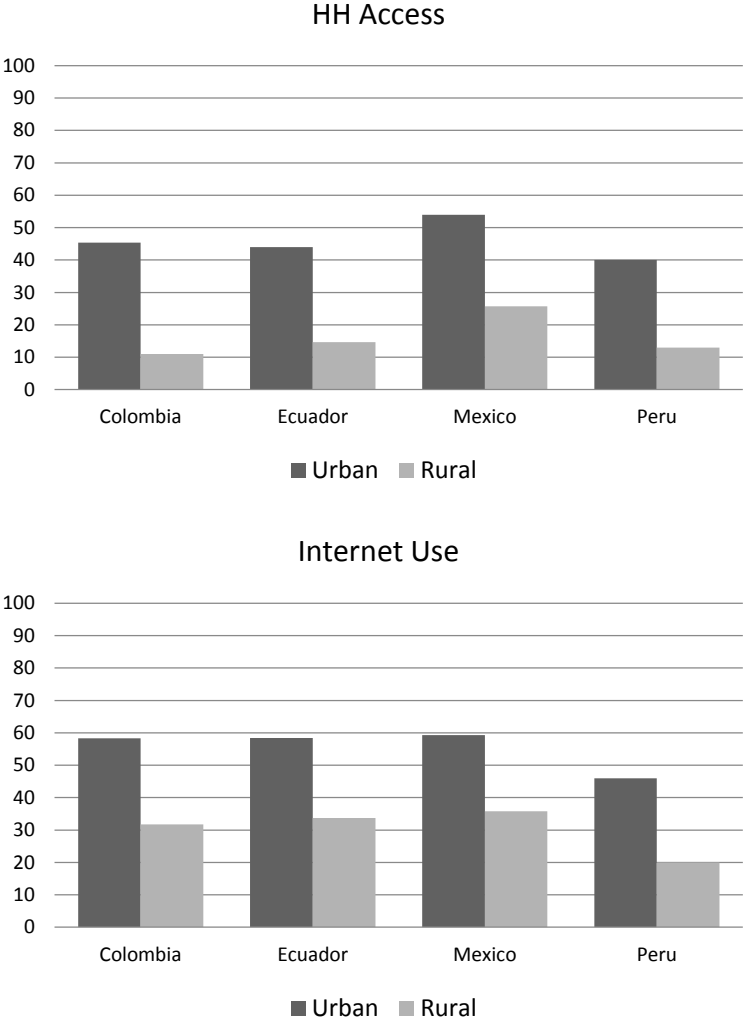*FIGURE 1: Residential access and Internet use by income decile (%)*

Sources: DANE, INEC, INEGI, OSIPTEL.

After income, the strongest predictor of residential adoption and individual use is location (urban vs. rural). The four countries present rugged topographies, high rural poverty, and major deficits in basic infrastructure and public service delivery in rural areas. As a result, both residential access and individual Internet use are significantly lower than in urban areas. For example in Colombia, average residential adoption drops from 45.4 percent in cities to 11.7

percent in rural areas. Similarly, individual use is about half among rural dwellers (31 percent in rural vs. 58 percent in urban areas). As Figure 2 shows, Ecuador, Mexico and Peru present similar connectivity challenges outside the main urban centers.

FIGURE 2: Residential access and Internet use by location (%)

Sources: DANE, INEC, INEGI, OSIPTEL.

Overall, the research context in the four countries is similar, and representative of the average situation of other countries in Latin America. Only a third of the population has a home Internet connection, with large differences by income and location. Whereas residential connectivity levels among the wealthiest 10 percent are comparable to those in developed nations, only about 1 in 10 poor Latin American live in connected households. Digital inequalities are less dramatic when considering individual use, but overall adoption among adults remains at just about 50 percent. Understanding first-level digital divides thus remains an important research topic in the region.

5.   The drivers of digital exclusion: Key results

a. Barriers to residential adoption

Table 2 presents descriptive statistics for the main barrier cited by respondents who do not subscribe to residential Internet service in the four countries analyzed. The results corroborate that, generally speaking, affordability remains the most relevant barrier to adoption of home Internet. The exception is Peru, where lack of interest is cited as the primary barrier. This is a somewhat surprising result, given that affordability levels in Peru are similar to those found in other countries (author, 2013). A possible explanation is the widespread availability of public access locations in the country (Proenza, 2015), which reduces incentives to adopt residential services.
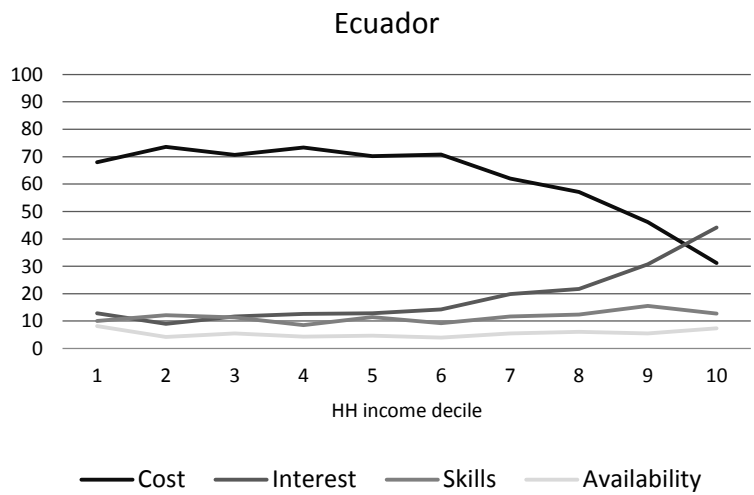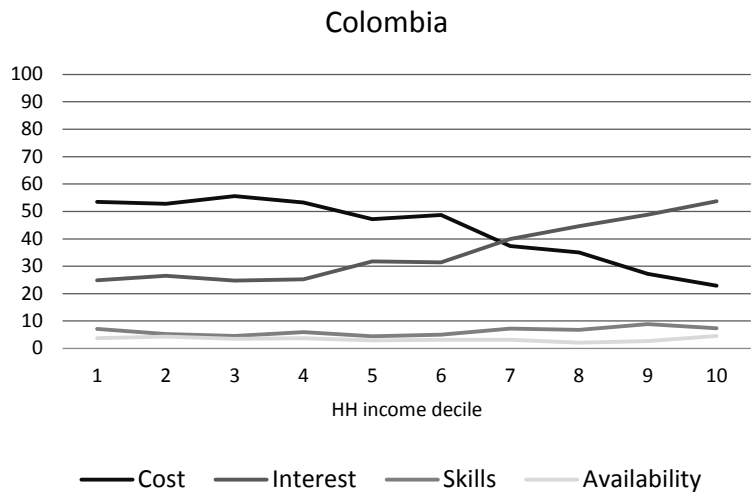
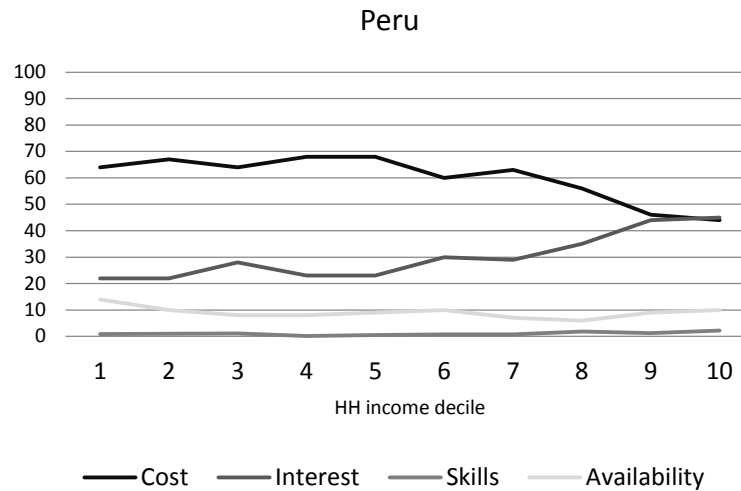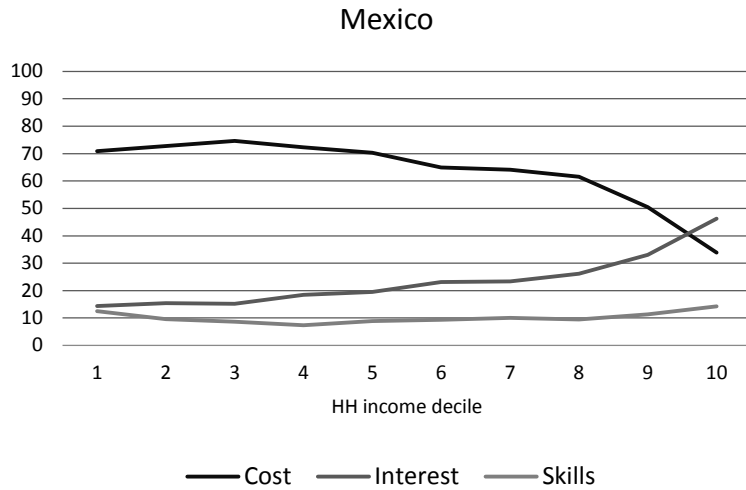*TABLE 2: Main reason for non-subscription by country*

	COL	ECU	MEX	PER
Cost	52.6	72.0	69.2	29.8
Interest	27.2	12.2	19.5	38.1
Skills	3.74	7.7	8.8	0.5
Availability	3.94	6.3	n/a	8.6
Others	12.4	1.6	2.42	22.8
Total	100	100	100	100
Valid observations	*50,589*	*76,868*	*70,558*	*34,184*

Sources: DANE, INEC, INEGI, OSIPTEL.

As expected, barriers for non-subscription vary significantly across demographic groups. As an example, Figure 3 summarizes the results regarding reasons for non-subscription by income decile. The results reflect both general regional patterns as well as variations that reflect country-specific market conditions as well as government initiatives. For example, in 2012 Colombia introduced a program to subsidize Internet access to low-income households, modeled after existing programs for other utilities. This explains why affordability barriers are generally lower in Colombia, with cost peaking at 56 percent in the third income decile and falling consistently thereafter. By contrast, in Ecuador, Mexico and Peru (where no comparable subsidy programs exist), cost barriers peak at around 70 percent between the second and the fourth income deciles, dipping below 50 percent only in the top income quintile.

FIGURE 3: Main reason for non-subscription by income decile (%)

Colombia

Ecuador

Mexico

Peru

Sources: DANE, INEC, INEGI, OSIPTEL.

Results for the multinomial regression model are presented in Table 3. In these models, other demographic characteristics are included alongside household income, which allows for examining their simultaneous effect. The models estimate the probability that non-subscribers cite one of the response categories as the main barrier for adoption, relative to the base category. Since descriptive results show that affordability is the most important barrier to residential

connectivity, the models use cost as the reference category. The coefficients thus estimate how demographic factors affect the odds of citing lack of interest, lack of skills and availability relative to the odds of citing cost as the main barrier for residential subscription.

The results generally corroborate the association posited in H1 between household income and barriers to residential adoption. The magnitude of the effect is large: a 1 percent increase in household income is associated with an average increase of about 1.4 percent in the odds of citing interest as the main reason for non-subscription. The effect is consistent in the four cases, with some variation in strength across countries (stronger in Ecuador, average in Colombia and Mexico, weaker in Peru).

The results also corroborate H2, which predicts a positive association between age and both interest and skill barriers. These effects are remarkably strong, particularly for skills. Each additional year of age increases the odds of citing lack of interest between 0.5 percent (Mexico) and 1.9 percent (Ecuador). Similarly, each additional year of age increases the odds of citing skill barriers between 0.5 percent (Mexico) and 3.1 percent (Colombia and Peru). Education is also found to affect non-subscription barriers, as predicted by H4. Not surprisingly the effect is largest for lack of skills. For example in Mexico, having a bachelor degree reduces the odds of citing lack of skills (relative to the reference category of incomplete primary education) by 86 percent. The effect is smaller in magnitude but similar in direction in the other three countries. Taken together, these results strongly validate previous findings about the need to attend human capital deficits related to ICTs among older adults and those with limited formal education (Barrantes and Cozzubo, 2016).

As mentioned, the extant literature is ambiguous with respect to how Internet adoption barriers vary by gender. The results of this study provide strong support to the hypothesis (H3)

that men are more likely to cite lack of interest (as opposed to high costs) as the main reason for non-subscription. The magnitude of the effect nonetheless varies by country, ranging from 2.3 percent in Mexico to 11.3 percent in Colombia. Interestingly, the largest gender effects are associated with human capital barriers, with men between 9 percent (Mexico) and 25.5 percent (Colombia) more likely to cite lack of skills as the main barrier for residential adoption (Peru is the exception with men about 12 percent less likely to cite skills).

A possible interpretation of the gender findings is that, due to the persistence of traditional family roles in Latin America, women place a higher value on residential access as an educational tool for children - and therefore are more likely than men to cite affordability as the main adoption barrier. This is consistent with results for H5, which indicate that the presence of children strongly reduces the odds of citing interest (relative to cost) as the main reason for not subscribing at home (between 46 percent in Peru and 72 percent in Mexico). This is a remarkably strong and consistent effect, which suggests the presence of a large unmet demand for more affordable access plans for families with children in school age.

Finally, results from Ecuador and Peru validate H6, which suggests that the limited availability of online content in minority languages reduces demand for connectivity in households where the primary language spoken is not Spanish. The magnitude of the effect is particularly large in Ecuador, where an estimated 2.3 million people (about 15 percent of the total population) speak an indigenous language (King and Haboud, 2002). The odds of citing lack of interest (as opposed to cost) as the main barrier to residential adoption more than doubles in households where minority languages are spoken. The effects are similarly large for lack of skills. For example in Peru, living in a household where Spanish is not the primary language increases the odds of citing skills as the main adoption deterrent by about 60 percent.

TABLE 3: Probability of citing main reason for non-subscription (odds ratios), reference category = high cost

	INTEREST				SKILLS				AVAILABILITY			
	COL	ECU	MEX	PER	COL	ECU	MEX	PER	COL	ECU	MEX	PER
Age	1.013	1.019	1.005	1.010	1.031	1.020	1.005	1.031	0.996	1.002	n/a	0.996
Gender (male=1)	1.113	1.075	1.023	1.068	1.255	1.193	1.090	0.880	0.946	1.011	n/a	1.004
Primary complete	0.954	0.674	0.839	0.942	0.817	0.579	0.754	0.947	1.089	0.875	n/a	1.055
Secondary incomplete	0.975	0.619	0.707	0.795	0.664	0.431	0.440	0.450	1.190	0.950	n/a	0.848
Secondary complete	1.003	0.692	0.861	0.756	0.365	0.310	0.241	0.800	1.127	1.088	n/a	0.817
Bachelor incomplete	0.988	0.597	0.574	0.727	0.447	0.221	0.045	0.399	1.472	0.914	n/a	0.828
Bachelor complete	1.266	1.019	1.242	0.800	0.430	0.447	0.141	0.431	1.639	1.797	n/a	0.860
HH income (log)	1.426	1.609	1.354	1.161	1.177	1.121	0.933	1.823	1.434	1.228	n/a	1.068
Location (urban=1)	0.832	0.686	0.876	0.741	0.588	0.475	0.543	0.280	0.095	0.161	n/a	0.098
Children in HH (yes=1)	0.373	0.367	0.280	0.537	0.177	0.298	0.236	0.221	0.936	0.804	n/a	0.877
Language (not Spanish=1)	n/a	2.172	n/a	1.278	n/a	1.309	n/a	1.604	n/a	1.931	n/a	1.070
Constant	0.118	0.035	0.200	1.507	0.039	0.251	1.011	0.006	0.026	0.053	n/a	0.810
Valid observations	*50,589*	*76,868*	*70,558*	*34,184*	*50,589*	*76,868*	*70,558*	*34,184*	*50,589*	*76,868*	*70,558*	*34,184*

Note: additional controls include number of household members, employment and presence of PC in household.

All estimates are significant at p<0.01.

b. Barriers to individual use

Descriptive results regarding barriers to individual use are presented in Table 4. Contrary to the case of non-subscription, the results for Peru suggest that affordability is not a relevant barrier to individual adoption. This is likely due to the combination of affordable mobile broadband alternatives as well as the availability of public access locations throughout the country (recall that the Mexico questionnaire does not include high cost as a response category for individual nonuse).
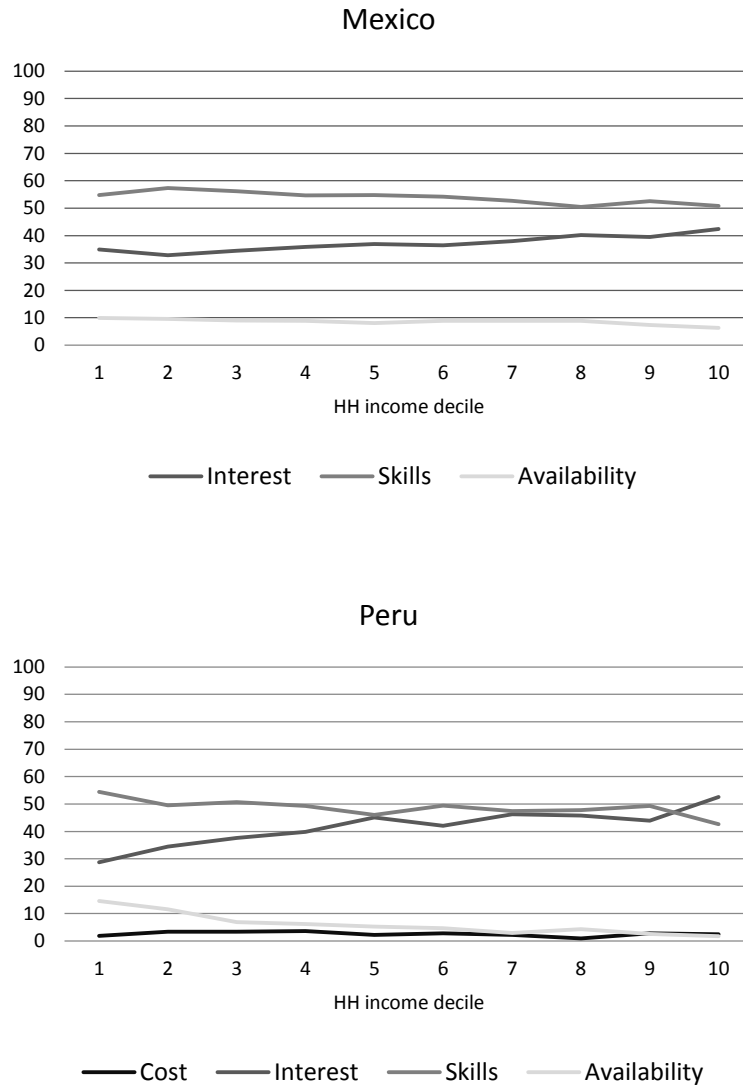
TABLE 4: Main reason for non-use by country

	MEX	PER
Cost	n/a	2.5
Interest	37.8	41.1
Skills	53.4	48.8
Availability	8.3	6.5
Others	0.5	1.1
Total	100	100
Valid observations	*64,420*	*23,092*

Sources: INEGI, OSIPTEL.

Figure 4 disaggregates these results by income decile. In Mexico, lack of skills is consistently cited as the main barrier across income groups, followed by lack of interest. The results indicate only small variations in barriers to adoption by income group, which suggests the presence of other factors, possibly associated with motivation and attitudes as suggested by recent research (e.g., Reisdorf and Groselj, 2015). There are more significant variations in the case of Peru, as lack of interest is increasing with income, while lack of skills is moderately decreasing with income, a result in line with findings for non-subscription.

FIGURE 4: Main reason for nonuse by income decile (%)

Mexico

Peru

Sources: INEGI, OSIPTEL.

Results from the multinomial regression model are presented in Tables 5 and 6. Again, the models estimate the probability that nonusers cite one of the response categories as the main

barrier to adoption, relative to the base category. In the case of Peru (Table 5), high cost is used as the reference category, which allows for comparing results with models for non-subscription. In the case of Mexico (Table 6), availability is the reference category. Hence, an important limitation is that coefficients cannot be directly compared across countries in models for nonuse.

As predicted by H1, income is positively associated with the odds of citing lack of interest (as opposed to cost) as the main barrier to use. Surprisingly, the magnitude of the effect is similar than for non-subscription: in Peru, a 1 percent increase in household income is associated with an increase of about 1.1 percent in the odds of citing interest as the main reason for nonuse (H1 cannot be tested in Mexico because high cost cannot be used as a base category). The results also corroborate the effect of age on barriers to use (H2). In the case of Peru, the magnitude of the effect is even larger than for non-subscription, with every year of age increasing the odds of citing lack of interest or skills by about 4 percent. The effect is quantitatively similar in Mexico where lack of availability is used as the referenced category.

Variations in barriers to use by educational attainment are also found to be large, as predicted by H4. In both countries, having a bachelor degree (relative to the reference category of incomplete primary education) reduces the odds of citing lack of skills by about 85 percent. As for gender variations in reasons for nonuse, the results do not corroborate H3. Contrary to expectations, men in Peru are less likely (by about 23 percent) to cite interest as the main barrier to use, relative to the reference category of high cost. The effect is similar in Mexico, where men are about 7 percent less likely to cite interest (relative to the base category of lack of availability).

The findings generally validate H5: as predicted, living with children reduces the odds of citing interest (relative to high cost) by about 5 percent in Peru. Interestingly, the effect is

reversed for skills, with adults living in households with children about 5 percent more likely to cite lack of skills. This result contradicts the spillover hypothesis whereby children help adults in the household acquire ICT abilities (Selwyn, 2004; Katz, 2010). The magnitude of this effect is even greater when availability is used as the base category in the case of Mexico. Overall, these results point to the need for further empirical investigation of how family dynamics affect Internet engagement in Latin America, along the lines of similar studies in developed countries (e.g., Enyon and Helsper, 2014).

Lastly, there is strong validation for the hypothesis that minority language speakers find online content to be less compelling and more difficult to use (H6). Respondents who report speaking a language other than Spanish at home are more than three times more likely to cite interest or skills (as opposed to cost) as the main reasons for not using the Internet. While the data is only available for Peru, it is consistent with results for Ecuador regarding the effect of language on residential subscription. Overall, the evidence indicates that lack of online content in minority languages presents a very significant adoption barrier to indigenous populations.

TABLE 5: Peru: probability of citing main reason for nonuse (odds ratios), reference category = high cost

	INTEREST	SKILLS	AVAILABILITY
Age	1.037	1.042	0.993
Gender (male=1)	0.769	0.801	1.018
Primary complete	0.814	0.938	0.991
Secondary incomplete	0.911	0.841	1.169
Secondary complete	0.800	0.537	0.783
Bachelor incomplete	0.995	0.393	0.774
Bachelor complete	0.502	0.188	0.550
HH income (log)	1.137	1.054	0.930
Location (urban=1)	1.346	0.779	0.101
Children in HH (yes=1)	0.95	1.052	0.877
Language (not Spanish=1)	3.390	3.164	4.557
Constant	1.721	4.319	12.152
Valid observations	23,092	23,092	23,092

Note: additional controls include number of household members and employment.
All estimates are significant at p<0.01.

TABLE 6: Mexico: probability of citing main reason for nonuse (odds ratios), reference category = availability.

	INTEREST	SKILLS
Age	1.052	1.063
Gender (male=1)	0.927	0.856
Primary complete	1.163	1.112
Secondary incomplete	0.739	0.491
Secondary complete	0.699	0.275
Bachelor incomplete	0.820	0.163
Bachelor complete	0.471	0.129
HH income (log)	0.997	0.986
Location (urban=1)	0.833	0.92
Children in HH (yes=1)	1.060	1.284
Constant	0.898	1.093
Valid observations	64,420	64,420

Note: additional controls include number of household members and employment.
All estimates are significant at p<0.01.

6.   Discussion and policy implications

It is generally acknowledged in the literature that the drivers of digital exclusion depend on various socioeconomic factors. However, how each of these factors affects the different barriers to adoption is less well understood, particularly in developing country contexts where general adoption levels are well below those found in developed countries. In broad terms, this study corroborates the need to study digital exclusion in different country contexts, but perhaps more importantly across socioeconomic groups.

In contrast to developed countries, high costs and limited service availability continue to be key barriers to residential subscription and, to a lesser extent, individual access in Latin America. The urban/rural gap in service coverage remains significant, and is an important determinant of observed differences in residential adoption. Further, affordability emerges as the main deterrent to adoption for all but those at the very top of the income distribution. Taken together, these results illustrate the continued need for policies that promote lower access prices (including subsidies for low-income families as in the case of Colombia) as well as Internet infrastructure expansion into the rural areas in the region.

However, supply-side factors offer only a partial explanation. The findings indicate that human capital barriers related to ICT skills as well as relevance barriers related to content availability and awareness are also important determinants of digital exclusion. Older adults are a case in point. Lack of interest and skills are strongly associated with age as the main barrier to adoption, both in terms of residential subscription and individual use. This suggests that lowering prices and improving accessibility will have a modest impact on adoption among the elderly, and will perhaps be less cost-effective than training and awareness programs specifically designed for this population.

The results also shed light onto gender differences in barriers to adoption, but results are somewhat surprising. Several studies have argued that ICT skills training programs targeted at women are critical for closing the digital gender divide in the developing world (e.g., UNESCO, 2013). However, the evidence for Latin America suggests that enhancing human capital maybe even more critical for men, who are more likely than women to cite skills barriers to home broadband adoption over cost concerns. This is potentially associated with gender sorting into different jobs, as women outnumber men in service occupations that require at least basic ICT skills (Gasparini and Marchionni, 2015). The regression models control for being employed but not for type of employment, which opens question for future research about interactions between job categories and gender gaps in Internet engagement.

The findings also highlight the importance of understanding how family dynamics affect adoption incentives. This is particularly true for residential subscription, since Internet access represents a household – rather than an individual- asset. As shown, affordability is significantly more relevant as an adoption barrier (relative to both interest and skills) when children are present in the household. In other words, many families in Latin America are aware of the value that home access has for their children, but nonetheless find services to be unaffordable. This suggests the existence of an unmet demand for low-cost access alternatives for families with children, as well as an opportunity for governments to develop subsidy programs for residential connectivity tied to ICT-in-classrooms initiatives. Uruguay provides an interesting reference point, as state-owned operator Antel has aggressively marketed entry-level Internet services to low-income households in combination with Plan Ceibal, a large-scale educational program that distributes laptops to students in public schools across the country (Rivoir, 2009).

At the same time, the evidence, while not conclusive, indicates that children may not be transferring ICT skills to adults within the household, as suggested by several studies (e.g., Katz 2010). By contrast, there appears to be a substitution effect, whereby the presence of children discourages adults from acquiring Internet skills. This alternative hypothesis has been explored by some authors (Correa et al., 2015), and deserves more scholarly attention in future studies. At the very least, the results suggest that bottom-up skills transfer may not take place unless other motivational factors are present.

Finally, the results indicate the need to promote online content and services in indigenous languages as part of digital inclusion policies. As shown, indigenous language speakers are significantly less interested in using the Internet, as well as less motivated to acquire the necessary ICT skills. This is true even after controlling for income and other demographic factors, which is critical because of the enduring association between indigenous groups and rural poverty in the region. Governments have an important role to play to address this gap, given their role in the provision of online services associated with education, health and other public services. Further, many countries in Latin America have a long-standing tradition of support for linguistic diversity in media content (Lopez, 2009). The lessons learned from these initiatives represent a natural springboard for designing policy instruments that promote a more linguistically diverse and inclusive Internet in the region.

7.   Conclusion

Digital inequality remains a vexing challenge for Latin America, one that both reflects and perpetuates the socioeconomic disparities that have characterized the region for generations.

In broad terms, the findings in this study suggest that the diffusion of the Internet is unlikely to resemble that of other ICT innovations such as the telephone and broadcasting. As coverage increased and prices dropped, these technologies became part of daily life for most Latin Americans. However, the Internet is, at its most basic, a general-purpose technology that allows information sharing and dissemination. Adoption is therefore contingent on the acquisition of new skills and the availability of relevant content and applications that make the underlying technology valuable. As such, the drivers of Internet adoption are far more complex.

While cost and availability remain critical barriers, the results point to a combination of demographic and human capital factors that constrain Internet uptake in the region. However, much remains to be understood about the drivers of digital exclusion across socioeconomic groups, let alone countries with different levels of development and policy environments. This study has uncovered many of these variations, taking advantage of large-scale household surveys in four Latin American countries. But more in-depth studies are clearly needed, both quantitative and qualitative, to advance our understanding of digital inequalities in less developed countries.

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