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Digitalisation in the Lives of Urban Migrants

Evidence from Bogota

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Bonn, August 2019

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Keywords: Migration, Digitalisation, E-government, Colombia

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Abbreviations

COL $	Colombian dollar
DANE	*Departamento Administrativo Nacional de Estadística* / Colombian national statistics office
ICT	information communication technology
ICT4D	information communication technology for development
ID	identification
IDP	internally displaced person
IMEI	international mobile station equipment identity (identity number for a mobile device)
IOM	International Organization for Migration
NGO	non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
SIM	subscriber identify module (small chip that identifies the phone to the mobile network)
STS	science, technology, and society
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
US$	United States dollar

Executive summary

As increased migration, particularly to urban centres, and digitalisation play a greater role in development cooperation, more research on how these phenomena interact will become critical. These phenomena are particularly acute in middle-income countries, but efforts to understand the role of digital technology and digitalisation in the lives of urban migrants is a relatively new field for both researchers and policymakers. Information communication technologies (ICTs) offer pathways for potentially making it easier for migrants to settle in, whether it be through e-government programmes or by accessing social networks that can help in finding housing and work.

As development cooperation has increasingly expanded into migration and integration processes, opportunities for using ICTs to support different facets of migrants' lives have emerged. Indeed, global agencies like the International Organization for Migration (IOM), (Office of the) United Nations High Commissioner for Refugees (UNHCR) and many development agencies have been integrating ICTs into their work with refugees and forcibly displaced people at an increasing rate. Unfortunately, the excitement to innovate often outpaces knowledge about how ICTs actually fit into the lives of migrants and forcibly displaced people, leading to duplication of efforts and new tools not always being fit for the intended purpose (Hounsell, 2017; Hounsell & Owuor, 2018).

To fill this gap we gathered original survey data in Bogota comparing the ICT use patterns of people who have lived in Bogota for varying spans of time, as well as more recently arrived Venezuelan migrants. While the data provides interesting insights about ICT use between locals and migrants, we also identified a number of challenges that come with gathering data in "hidden" communities that can be used to guide future research on urban displacement.

For policymakers to implement digital programmes targeted to migrants, we identify a new factor that influences internet access among migrants after controlling for economic and social factors: duration of time in a neighbourhood. Our interpretation of this finding is that, when migrants arrive in a new city, it takes time to establish an address and networks – this leads to a lag in ICT uptake[1] and use compared to their more established neighbours. Without an address, it is impossible to have home internet, making it harder to use e-government and digital services. To deal with this, donors and development agencies should continue to focus on helping migrants establish an address, and coordinate with governments to establish recognised IDs for foreign migrants with claims to protection status. This recommendation is not unique to Colombia, and represents a global issue when trying to improve digital access for migrants.

Our results also show that uptake of e-government services remains a challenge. Citizens generally do not interact with their governments more than a few times a year. Adding an ICT layer to these limited interactions if people lack a full spectrum of access to ICTs and the internet means that uptake of e-government services will be limited. Especially when working with vulnerable or "hidden" populations, development organisations need to put

1 Throughout this paper "uptake" describes when a citizen identifies and begins using a new technology or software application.

significant resources into education and outreach so that the populations they are trying to reach know about the service, and its value. Our data shows that, over time, there is demand for ICTs, and we see evidence of increased uptake among Venezuelan migrants as they stay in the same neighbourhood longer. Using face-to-face services to help migrants establish an address, obtain an ID, and navigate bureaucracy early on could support the willingness and ability to use e-government and ICT services later.

The data collected in Bogota paints a potentially positive picture about using ICTs with migrants and migrant communities. However, ICTs and the internet are not a "silver bullet" – newly arrived migrants often need immediate services that are better provided face-to-face. Once these initial needs are met though, there is demand among migrants for ICTs, and migrants actually gain similar access to the internet as their Colombian peers. By effectively engaging migrants early on, meeting basic initial needs, then transitioning to digital platforms, development and humanitarian agencies could help migrants become more self-sufficient through greater access to ICTs and e-government platforms.

1 Introduction

Migration and digitalisation are increasingly important topics in development policy and research. These trends are particularly acute in developing economies, but efforts to understand the role of digital technology and digitalisation in the lives of urban migrants represents a relatively new field for both researchers and policymakers. While development policy has raced ahead in the search for innovative technology-oriented solutions for achieving better economic and social outcomes for urban migrants,[2] empirical research on the role of technology in the lives of migrants is only beginning to catch up, creating a gap between policy and empirics. Exacerbating this gap, much of the empirical work on technology in the lives of migrants and refugees has been done in wealthy countries (see, for instance, Cadagnone & Kluzer, 2011; Kabbar & Crump, 2007; Siddiquee & Kagan, 2006). By using Bogota as a case study, we help bring a perspective from an upper-middle income country into the emerging literature on migration and digitalisation.

To reduce this gap and build on the growing literature on digitalisation in development programmes focused on migrants (for example, Hounsell, 2017; UNHCR [Office of the United Nations High Commissioner for Refugees], 2016) we identified two guiding questions. First: Is there a difference in the aggregate ICT use between migrants and natives; and secondly: How does the time living in the same neighbourhood influence the use of ICT and e-government services? "Difference in ICT use" and "access" includes whether there are differences between migrants and their Colombian neighbours in the use of mobile phones, home internet, and the use of e-government services. In this paper "difference in use" means access to and the decision to use an ICT tool, as opposed to differences in how people use the same tool. These differences bear exploring since there is a well-established literature on the digital divide (for instance, Norris, 2001; Warschauer, 2004; Freimel, 2014; Hargittai, 2018) which has evolved beyond basic questions of geography and income. We aim to explore how migrant versus local status correlates with differences in access to and use of mobile phones, home internet, and e-government services, and how time in the same neighbourhood affects how much or how often migrants use ICTs in comparison to their Colombian neighbours. Over time, the social, economic, and administrative factors that migrants face should change – so does their access to ICTs change as well?

We use an original survey dataset with 800 respondents collected in Bogota, Colombia, that produced a comparative sample of Colombians who moved to Bogota in the last seven years, Colombians who have lived in Bogota more than seven years, and recently-arrived Venezuelan migrants, in order to better understand variations in access to and use of ICTs. At a practical level, we also had the opportunity to explore differences in how migrants and natives used e-government services and other digital tools for improving access to public services (such as health and education), which is a theme with a direct connection to ongoing migration and refugee policy. Along with migration, the Colombian government is currently undertaking public digitalisation programmes such as Vive Digital,[3] which aim to bring more Colombians online and, since 2015, have been updating their ICT regulatory rules. ICTs in development and public administration remain

2 Examples include UNHCR's Innovation Unit and their ongoing work in digital education, and the World Food Programme's digital identity and cash transfers systems.

3 More on Vive Digital is available in English at https://www.mintic.gov.co/portal/604/w3-propertyvalue-14684.html.

comparatively under-researched in Latin America, so using Colombia as a case study brings data from a new region into the literature.

We start by outlining how urban migration research has evolved over time, and then transition to a specific analysis of urban migration into Bogota. The historical perspective is important: forced migration and economic migration have increasingly become interwoven over the last decade, a pattern that has led to terms like "mixed migration". In this paper we use the term "migrant" to describe forcibly displaced people from Venezuela. The other categories of respondent are people who have lived in Bogota more than seven years, and those who have lived in Bogota less than seven years. Of those who arrived within the last seven years, we asked what motivated their move to Bogota in order to understand their migration decision.

The role of development policy in influencing economic and social outcomes for urban migrants creates the space to dive deeper into the role of digital technologies in development cooperation. We use the second section to provide a background on the evolution of information and communication technologies for development (ICT4D), and the ways that increased fixed-line and mobile internet access are affecting economic development and public administration. We integrate this review with the background on migration, showing how development cooperation has used ICTs to support migration and integration. We then lay out a set of guiding hypotheses to evaluate the differences between migrants' and locals' use of ICTs and e-government services.

This sets up our empirical analysis of our survey data. While there is a great deal of excitement about the potential for technology to improve development outcomes, empirical research on this topic remains relatively new. The data collection process itself presented unique challenges for finding respondents who had recently moved, and could be described as a "hidden" population. We will explain the processes we used, and the problems we encountered, since this could inform future survey research with hidden or vulnerable communities. For the data analysis on ICT use patterns, we do not aim at causal identification. Instead, we focus on theoretically guided descriptive analysis of the relationship between migration status and ICT use and access. We use this analysis to derive policy recommendations and directions for future research.

2 Urban migration and integration: general trends, and the case of Colombia

Migration into Bogota is highly mixed. Colombians move from rural areas seeking safety through IDP (internally displaced person) registration and seeking work; a recent influx of Venezuelans have arrived fleeing the current economic and political turmoil in their home country. Urban centres play an important role in providing economic opportunities, safety, and access to administrative services that may not be available elsewhere, and have played a key role in major movements of people over time: in Colombia, urban population growth increased from 1.4 per cent in 2012 to 1.9 per cent in 2018 (World Bank, 2019). In this paper, we look at three cohorts: Colombians who have lived in Bogota more than seven years; Colombians who moved to Bogota less than seven years ago; and Venezuelan migrants. More on how these cohorts were decided on will be covered later in the paper.

While the focus of this paper is on urban migrants in Bogota, it is important to point out that urban migration and the related many policy issues are generalisable to large cities in many low- and middle-income countries. Examples of research on this topic outside Colombia include Kenya (Agesa & Agesa, 1999; Agesa & Kim, 2001; Agesa, 2004), Malaysia (Khoo & Pirie, 1984; Siwar & Kasim, 1997) and a large body of China-specific literature (such as Chan & Zhang, 1999; Zhao, 1999; Giles & Mu, 2017). While this literature often focuses on economic migration decisions and job-seeking, it also covers urban refugees who flee violence in their home regions and settle in cities. Thus, further case analysis of urban migration in Bogota not only adds to knowledge of this specific case but also contributes to wider debates on development and urban migration.

While there has been research on Colombian rural-urban migration from a traditional labour-seeking perspective (for instance, Aysa-Lastra, 2011; Calderón-Mejía & Ibáñez, 2016), Colombia, and Bogota in particular, is an interesting contemporary case because of the mix of migration drivers – people displaced by violence or forced to migrate due to economic or social circumstances. The issue of internally displaced people is central to the modern discussion around urban migration and displacement in Colombia. During Colombia's civil war and through the current peace process, the country had the largest number of IDPs in the world: 5.7 million, with 1.9 million making progress toward a durable protection solution (IDMC [Internal Displacement Monitoring Centre], 2019). It is outside the scope of this paper to go into detail about the internal Colombian conflict, but its associated violence shapes patterns of internal migration to a significant degree. Steele (2017, 2018) identified how displaced communities were targeted based on political loyalty, and that violence was used by paramilitaries to push *Union Patrióca* supporters out of districts prior to elections. Displacement led to further risks (Steele, 2017, 2018); people on their own remained vulnerable, but displaced people banding together became an easily identified target. These patterns of violence over decades have been central to displacement and forced migration in Colombia.

There is more to migration in Colombia than just the civil war, though it remains in the background of other migration and displacement processes, including changing economic circumstances and land grabbing. In the 1970s, there was a great deal of economic migration in Colombia (Martine, 1975) but, as the civil war progressed, disentangling economic migration and forced displacement in Colombia has become difficult. People were displaced and then sought work either through self-employment (Bozzoli, Brück, & Wald, 2013), or displaced people moved to new communities and the existing residents moved to seek work elsewhere (Morales, 2018). Land grabbing has also become a factor as the peace process has progressed; this comes with its own violence, as paramilitaries dispossess people of land that is then used for extractive and agricultural industry (Grajales, 2013, 2015). While we find in our data that people moved to Bogota for reasons beyond the threat of violence or the experience of violence, it is clear that internal migration in Colombia is highly influenced by the legacy of conflict.

After arriving, migrants and displaced people have to integrate at some level – it could be just finding enough work to earn money and move on or putting down longer-term roots in a new city. As Ibáñez and Vélez (2008) note, these new arrivals will likely be facing a deficit due to economic losses prior to moving along with stressors related to health and access to public services (Davies & Jacobsen, 2010; Carrillo, 2009; Schultz et al., 2014). This is especially true of those people who were displaced by violence as opposed to having more control over their migration decisions (Aysa-Lastra, 2011).

ICTs offer pathways for potentially making it easier to settle in, whether it be through e-government programmes or by accessing social networks that can aid in finding housing and work. In the following section, we will review how ICTs fit into the development agenda including a specific focus on development and migration.

3 The digital migrant? Evolving roles of technology in settlement and integration

As the development cooperation field plays an increasing role in migration and integration processes, opportunities for using ICTs to support different facets of migrants' lives have emerged.[4] Indeed, global agencies like the International Organization for Migration (IOM), the United Nations High Commissioner for Refugees (UNHCR) and many development agencies have been integrating ICTs into their work with refugees and forcibly displaced people at an increasing rate (Martin-Shields, 2017). At the same time, national governments, including Colombia's, have begun offering e-government services and expanded public internet access to citizens, via programmes such as Vive Digital. In Colombia, there is at least technical scope to implement digital programmes for urban migrants; 71 per cent of the population have mobile phone-based broadband internet access (GSMA [Groupe Speciale Mobile Association], 2019), while fixed-broadband internet grew from 0.02 to 13.45 subscriptions per 100 inhabitants between 2000 and 2018 (ITU [International Telecommunication Union], 2019). The excitement to innovate, though, has outpaced knowledge about how ICTs actually fit into the lives of migrants and forcibly displaced people, leading to duplication of efforts and new tools not always being fit for their intended purpose (Benton & Glennie, 2016). We review the literature that shows how ICTs have improved outcomes for refugees, demonstrating that the potential is there for ICTs and digitalisation to help improve social and economic outcomes for migrants. But this still begs the question that our empirical strategy aims at: In a country like Colombia, do the migrant communities have requisite access to ICTs to take advantage of digital tools and e-government programmes?

Refugees who have been relocated to third party countries have been a primary interest group for research on ICT use. While resettled refugees are different demographically and experientially from migrants in Bogota, there is evidence that we can draw upon to support this study. Kabbar and Crump (2007) use a sample of newly arrived refugees in Wellington (New Zealand) to identify factors leading to ICT use; they found that there was both an education and gender divide among ICT users. Highly educated males were often the first to adopt new tools, while older females with less education tended not to use ICTs. Their policy recommendations included establishing community support programmes to help people build skills, and identifying demographic groups who would need further support to build ICT skills and therefore integration into the community. This result highlights that one important factor is the role that community or government support can play for increasing ICT use among newly arrived migrants.

These efforts for supporting ICT and e-government use among refugees, particularly with a focus on integration and preventing digital divides, have also been undertaken in Australia,

4 While the term "ICT" can include a wide range of technologies, in this paper we define "ICT" as a mobile phone, fixed-line broadband internet, or e-government websites.

the United Kingdom, and the wider European Union. In the Australian context, Alam and Imran (2015) found that, while there is potential for ICTs to support the greater social inclusion of newly arrived refugees into communities, greater government and community efforts are needed to increase access to ICTs and opportunities for training on how to use them. It was evident in the case of Wellington that, without some training and support, the value of ICTs for refugees is limited, and they resort to their pre-existing skills and knowledge. In cases where there is community support, ICTs can help in enabling integration and empowerment. In the United Kingdom, refugee women who participated in Community Internet Projects were reported to experience greater empowerment within their communities, and the internet was useful in finding networks and building a narrative about their life in the United Kingdom (Siddiquee & Kagan, 2006). Across the European Union, ICT access initiatives for migrants showed that, while ICTs were helpful in supporting integration, community level-ICT interventions (especially in poorer cities and regions) on their own were not enough to overcome the significant hurdles associated with access to education, language, health and other public services (Cadagnone & Kluzer, 2011).

Social media plays a key role in supporting the maintenance and extension of social networks among refugees. Social media use has been found to be positively associated with bridging (that is, loose connections across groups that may provide information and new perspectives), bonding (that is, close relationships within groups that may provide emotional support) social capital, and maintaining social bonds (that is, valuable connections kept throughout life changes) (Ellison, Steinfield, & Lampe, 2007). In the case of refugees, social media can support them in their migration process, as well as in their integration to host countries. Migrants that move from one location to another have the possibility to monitor the stories of those living in their home community (Komito, 2011), which may facilitate the migration process by reducing the emotional costs associated with migration (Dekker & Engberson, 2014).

When refugees resettle in a host country, ICTs can help them learn the local language and get familiar with the new society they will live in (among other things, understanding regulations, participating in events where locals and refugees get together (AbuJarour & Krasnova, 2017). In addition, refugees can use social media to learn about the current situation in their home country; this occurs partly because they can find useful information from friends and former neighbours in those applications and partly because they may not trust mainstream or official (government) media (Charmarkeh, 2013). An example of the role of social media in both migration and integration of refugees can be found in the Netherlands, where access to social media helps refugees build and maintain existing and new social networks in their new communities, which can have further effects on wider social integration (Alencar, 2018; Dekker, Engbersen, Klaver, & Vonk, 2018).

One of the key gaps our work begins to fill is how digitalisation and e-government in migrants' lives manifests itself in middle-income countries. Many of the examples from our literature review are from OECD and other industrialised countries – this is a major gap since the vast majority of migrants and refugees live and settle in cities in low- and middle-income countries. We see that, in countries where there is capacity to provide ICT access to refugees, there are positive outcomes. But what about in settings where there is less capacity for municipalities to provide public ICT services to migrants? Do the target communities have private access to ICTs already? The following section elaborates on the data collection process and empirical strategy we used to explore migrants' access to ICTs and the differences in how locals and migrants access digital technologies.

4 Empirical strategy

The relationship between urban migration and digitalisation is complex and multivariate. To better understand this complexity we administered a survey that sampled both Venezuelan migrants and two cohorts of Colombians in Bogota. Respondents' provided data on a number of economic, social, migratory and technology factors. The survey provided us with an opportunity to carry out a descriptive analysis of migrants' and locals' ICT usage. We had the help of IPSOS Colombia in creating the sample and organising the data collection.

Part of what made this work challenging in comparison to traditional ICT for development (ICT4D) and science, technology and society (STS) research was doing survey work that aimed to capture a larger sample of migrants. As noted previously, much of the empirical literature on the topic is ethnographic and done in developed countries, where visa registration and formal addresses make migrants and refugees easier to find. Thus, we took on two challenges: using survey methods instead of ethnography; and doing so in an open urban space where migrants are often a hidden population. In many ways we were "learning by doing", and the experience itself could be useful for other researchers preparing similar fieldwork.

Initially we planned to compare officially registered internally displaced persons in Bogota to a cohort of Colombian non-IDPs who had lived for a longer period in Bogota, and a cohort of Venezuelan migrants. After negotiating with colleagues from IDP registration centres,[5] it became clear that the bureaucratic hurdles to access registration lists from which to create a sample were too high. Census data would not help either; there was a formal survey of IDP households in the early 2000s (Ibáñez & Vélez, 2008), but since we wanted to ask new, specific questions about ICTs this would not help us. Our focus shifted to creating a cohort of Colombians who had arrived in Bogota in the last seven years, and considering this our "internal migrant" cohort.

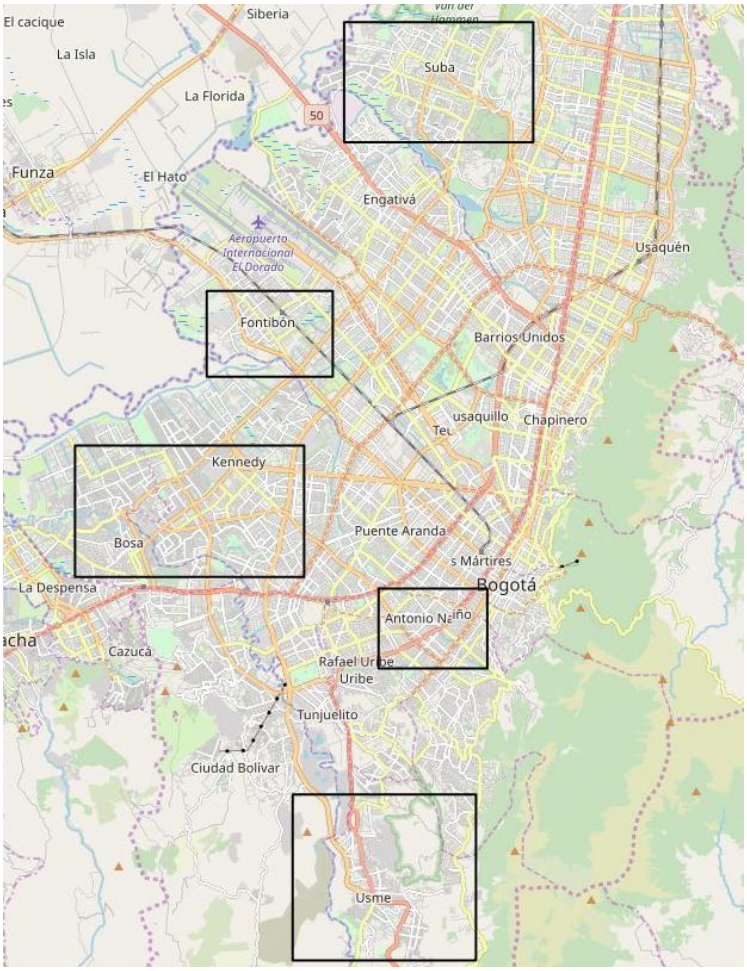
Does arriving in the last seven years make someone an "internal migrant"? A Colombian living in Bogota would not generally be considered a "migrant" since he/she did not cross a national border, and we could not find a consistent temporal definition defining the term "internal migrant".[6] In terms of demographic data, the Colombian statistics office (DANE) estimates that between 2010 and 2020 approximately 160,000 people will migrate into Bogota (DANE [Departamento Administrativo Nacional de Estadística], 2019). The 7-year cut point essentially served to make sure we had a cohort of Colombians who had arrived in Bogota for the first time in the 2010s and would be likely to still be settling in and integrating into the city.[7] As a starting point, our primary sampling areas were neighbourhoods known as migrant arrival hotspots. With the help of IPSOS, we started by mapping in the general vicinities marked in the map in Figure 1.

5 As part of the Colombian government's efforts to provide support to IDPs, *Centros Dignificar* (Dignity Centres) were set up to provide initial settlement support for displaced people.

6 The Australian Bureau of Statistics (2009) uses 1- and 5-year timelines when it evaluates internal migration between Federal Territories, and there are still debates about the generational periods after which Europeans who emigrate to Australia cease to have a migrant identity (see Marinaro & Walston, 2010). Short of a legal definition, like crossing a border or being a registered IDP, the 7-year cut off served to give us a respondent group who had arrived relatively recently.

7 Potential intervening factors that could influence differences in ICT access between someone who arrived in Bogota 2 years before versus 6 years before are addressed in the analysis section.

Figure 1: Initial general sampling areas for Colombian internal migrants



Source: OpenStreetMap (2019) with modifications by authors

The long-term population cohort was drawn from all neighbourhoods using an IPSOS sampling frame; since the other cohorts were collected face-to-face, IPSOS also collected this cohort face-to-face instead of by phone. The short-term cohort of Colombian respondents, the "urban migrants" in this paper, posed the biggest challenge. The neighbourhoods/approximate geographic areas in Figure 1 represented a starting point for using a snowball approach to building a sample of recent arrivals. Using a snowball approach comes with obvious limitations but given the "hiddenness" of the population and privacy issues around registration data it represented a practical way to create a sample (Schultz et al., 2014). The Venezuelan respondents were located in the same neighbourhoods and identified alongside the short-term residents during the snowball process. The irregularity of geographic information, lack of population data, and privacy restrictions for accessing the official IDP registration data meant that representative surveys of IDPs and migrants in Bogota were difficult. It is important to note that, even if we had had access to the registration data, the IDP registration lists themselves came with built-in biases around who registered, and who updated their contact information over time. We will discuss in the Conclusions section how this current data paucity presents an opportunity for future researchers to find ways to incrementally build a population frame where official data does not currently exist.

The questionnaire had four main sections (demographic; technology use; migration and mobility; and happiness and quality of life), plus a screening section to filter unsuitable respondents. The survey was conducted from October to November 2018. The screening section assured that participants were at least 18 years old and had lived in Bogota for at least two months. The country of birth was also recorded at this stage. Among the set of demographic questions, we recorded: gender, socio-economic status as measured in the Colombian income group scale (1-9); marital status; number of children; number of members in the household; education level; current occupation; employment status in the last year; hours worked during the week (on average); monthly income; household monthly income; bank account (yes/no); assets (does the respondent own a refrigerator; bicycle, etc).

The ICT-related questions covered: ownership of ICT devices (computer, mobile, tablet); ownership of smartphone (yes/no); mobile phone post-paid subscription; who one usually communicated with using a mobile phone; how much a person spent on his/her mobile plan (monthly); communication and social media applications respondent uses; purpose of communication and social media applications; time spent on social media (daily); use of other apps (Uber, Netflix, etc); access to broadband internet (provider and cost); use of public Wi-Fi; safety accessing internet; use of e-government services; and ICT as a source of news. As noted earlier, when we talk about uptake, this means the decision to start using new ICTs or internet services.

Our ICT-related hypotheses are relatively straightforward – we have data on migrants and Bogotan natives, which provides an easy starting point for analysis:

H1: *There is a difference in ICT access between urban migrants, foreign migrants, and long-term residents.*

Understanding whether there is a difference in access and use of ICTs between these three groups is an important starting point. In our analysis, we will look at ownership of mobile phones, wired internet at home, and uptake of e-government services. Both results could be interesting: If there are no differences, it means that there is either i) scope for e-government and digital services to be accessed by all respondents regardless of migrant status if access is uniformly high, or ii) no scope, if nobody in the sample has access. If there is a big difference, particularly in favour of Bogotan locals accessing ICTs at higher rates, then this means we have to think more carefully about how differences in access across mobile phones, wired internet and e-government influence outcomes for urban migrants. If uptake among migrants is higher, this indicates that development strategies integrating ICTs into migrant support programmes have more scope for success.

The second hypothesis is important since migrants and displaced people tend to move regularly (Schultz et al., 2014), but to access ICTs like mobile phones, or to set up an internet connection, one generally needs a stable address and valid identification (such as a national ID card, passport, and so on).

H2: *The longer migrants stay in the same neighbourhood, the more likely they are to access and use digital tools (ICTs including mobile phone/tablet/computer, wired internet, e-government services).*

To access a mobile phone account one generally needs an ID and address; a longer tenure in one neighbourhood would allow a migrant to at least establish a physical home. For wired internet, one needs a permanent address, and generally proof of residence; again, for

migrants, longer tenure in a neighbourhood would correlate with these outcomes. To use e-government services, people also need to know what is locally available, which takes time – for example, Eppler et al. (in press) find that many urban refugees in Nairobi lacked initial knowledge of the different e-government and digital tools available to them.

These are very basic starting points for uptake of ICTs and e-government services, but are often overlooked in the design and deployment phases of digital tools for migrants and refugees. These two hypotheses provide interesting theory-building avenues and represent a chance to broach policy-relevant questions that require theory-driven interpretation, which we will do in the Discussion section of the paper.

4.1 Descriptive statistics

This section offers a descriptive analysis of the variables of interest. In line with the purpose of the paper, the survey asked participants to indicate their place of birth (country and state) as well as for how long they had lived in Bogota. We used this data to categorise migrants two ways. A Colombian "migrant" in Bogota is someone who was born elsewhere in Colombia and had lived in Bogota between 2 months and 7 years (23.1 per cent); second, a foreign migrant in Bogota is one who was born outside of Colombia and had lived in Bogota between 2 months and 7 years (14.4 per cent). Combined, foreign and Colombian migrants in Bogota make up 37.5 per cent of the total sample (Table 1).

Table 1: Migrant status

Variables	Labels	N	mean	sd	min.	max.
id_migrant_c	Migrant (Colombian in Bogota)	800	0.23	0.42	0	1
id_migrant_f	Migrant (Foreigner in Bogota)	800	0.14	0.35	0	1
id_migrant_fc	Migrant (Foreigner and Colombian in Bogota)	800	0.37	0.48	0	1
Source: Authors						

Given the recent migration influx from Venezuela to Colombia, most of the foreigners in our sample are from Venezuela (14 per cent). Cross tabulating the migrant status and the reason to change residence, the main motivation to move is related with work and subsistence reasons, followed by family issues, armed conflict, and education (Table 2).

Table 2: Residence change reason among migrants

	Frequency	Per cent
Work/subsistence	178	63.1
Natural disaster	10	3.5
Armed conflict	21	7.4
Education	17	6.0
Health	8	2.8
Family issues	48	17.0
Source: Authors		

Our survey collected demographic variables useful to understand different dimensions of respondents. Among these were age; personal and household income bracket; marital status; education; and employment. Women made up 50 per cent of our sample; 48.2 per cent of the sample was single; 16.5 per cent married; 10 per cent divorced; 5 per cent

widowed; and 20.3 per cent in a de-facto marriage. Education level and employment status are shown in Table 3.

Table 3: Education and employment status

Education	Frequency	Per cent		Work (current)	Freq.	Per cent
None	6	0.9		Self-employed	292	36.5
Preschool	90	11.3		Business owner	27	3.4
Primary	177	22.1		Employed (private)	190	23.8
High school	316	39.5		Employed (public)	60	7.5
Technical	186	23.3		Worker (cooperative)	6	0.8
College	24	3		Worker (household)	20	2.5
Graduate	1	0.1		Worker family business (no wage)	14	1.8
				Unemployed (searching)	91	11.4
				Unemployed (no searching)	100	12.5

Source: Authors

Regarding income, two questions were asked: personal and household income. Our data is categorised using Colombia's official socio-economic strata, of which there are six levels (Hudson and Library of Congress Federal Research Division, 2010, pp. 101-103). For 2018, the minimum wage (Strata 1) in Colombia was COL$ 781,242 equivalent to US$ 244.[8] 38.8 per cent of respondents in our sample were in this Strata, while another 46.1 per cent were in Strata 2. When household income is measured, 69 per cent of the sample had a household income between Stratas 1 and 2. Hudson and the Library of Congress (2010) point out that 89 per cent of the Colombian population were in Strata 1-3. In our sample, 90.4 per cent of individuals were in Strata 1-3, so our sample is reasonably in line with national numbers.

Table 4: Personal and household socio-economic strata

	Income (personal)		Income (household)	
	Frequency	Per cent	Frequency	Per cent
Strata 1 (< COL$ 781,242)*	311	38.8	187	23.4
Strata 2 (COL$ 781,243 - $2,343,726)	369	46.1	365	45.6
Strata 3 (COL$ 2,343,727 - $3,906,210)	44	5.5	121	15.1
Strata 4 (COL$ 3,906,211 - $5,468,694)	13	1.6	49	6.1
Strata 5 (COL$ 5,468,695 - $7,031,178)	3	0.4	21	2.6
Strata 6 (> COL$ 7,031,179)	4	0.5	15	1.9
No answer	56	7.1	42	5.3
TOTAL	800	100	800	100

*Minimum wage as of 2018. The 2019 minimum wage is COL$ 828,116 which is approximately US$ 257.
Source: Authors

Table 5 shows descriptive statistics for our ICT variables. Mean, standard deviation, minimum and maximum are shown for the sample indicated in column N. Beginning with ICT count, we found that on average our sample holds 1.59 ICT devices (among mobile phone, tablet and computer); 86 per cent of the sample holds a smart phone; 65 per cent pay

8 Using the November 2018 exchange rate of COL$ 3,200 per US$ 1.

for a mobile phone data plan. On average among our sample, people use about 2.2 apps across three different categories: communication apps (WhatsApp, Telegram, Facebook Messenger, IMessage, Skype, and Hangouts); social network apps (Facebook, Twitter, Instagram, Google plus, Snapchat, LinkedIn); general purpose apps (Youtube, Spotify-Deezer-Apple Music, Netflix, Uber-Cabify, Waze, Google maps). Sixty-seven per cent of our sample has internet at home; of this group 84 per cent have a contract with an internet service provider; 30 per cent gain access through a public WiFi spot; and 29 per cent use Vive Digital kiosks[9]. In cases where N is less than 800, it indicates non-applicability of the question to the respondent, not a missing response.

Table 5: ICT variables descriptive statistics

Variables	Labels	N	mean	sd	min.	max.
p13_count	ICT device, count	800	1.599	0.730	1	3
p14	Cell phone, smart device	704	0.861	0.346	0	1
p15	Cell phone, data	704	0.655	0.476	0	1
p18_count	Cell phone, communication apps (count)	626	2.216	0.923	1	6
p19_count	Cell phone, social network apps (count)	607	2.133	1.161	1	6
p22_count	Cell phone, apps (count)	617	2.233	1.253	1	6
p23	Internet, at home?	800	0.671	0.470	0	1
p24	Internet, at home (contract)?	537	0.849	0.358	0	1
p26	Internet, public place free WiFi?	800	0.307	0.462	0	1
p27	Internet, public place Vive Digital?	246	0.297	0.458	0	1

Source: Authors

Our survey also accounted for the monthly mobile phone and internet expenditure, as well as how safe participants feel using the internet. Table 6 shows the expenses among five expenditure brackets. Cell phone payments turn out to be cheaper, while internet access is costlier. In relation to internet safety, of those who use the internet, 24 per cent of respondents reveal they do not feel safe using this technology.

Table 6: Cell phone and internet expenditure (only respondents who use these tools)

	Cell phone (expenditure)		Internet expenditure (home)	
	Frequency	Per cent	Frequency	Per cent
Less than COL$ 10,000	142	20	20	4
COL$ 10,001 – 50,000	325	46	113	21
COL$ 50,001 – 100,000	177	25	249	46
100,001 – 150,000	24	3	108	20
More than COL$ 150,000	12	2	21	4
No expenditure	24	3	26	5
TOTAL	704		537	
US$ 1 = approx. COL$ 3,200				

Source: Authors

9 Vive Digital is a free internet access initiative promoted by the central government of Colombia in urban and rural areas of the country. The initiative entails a booth located in a public place where locals gather to reach internet access.

Drawing on these descriptive statistics, the following section addresses the key hypotheses in the first part of the empirical strategy section, before moving into a discussion of the theoretical and policy implications of the results.

5 Regression analysis

Despite public efforts to increase ICT and internet access, such as through Vive Digital, there is a great deal of variation in who uses which kinds of ICTs and digital services. So how do locals and migrants differ in terms of access? How do individuals use e-government services that facilitate social and economic interactions with local public administration? In this section, we explore the correlates of ICT and internet access as well as e-government use. In particular, we focus on how foreign and domestic migrants differ from locals on these dimensions. Given that registering for many services requires a permanent address as well as proper identification, we also explore to what extent the length of residence moderates possible differences between locals and migrants. Since ICT access and use tend to vary with demographic characteristics (such as age), and since our survey shows that migrants differ from the wider population (for instance, being much younger on average), a simple comparison between groups will distort the net difference between migrants and locals. To overcome these shortcomings, we use regression models to hold demographic and socio-economic variables constant. Hence, our statistical analysis compares if and how much Venezuelan migrants differ from short-term and long-term Colombian residents with regard to ICT and internet access as well as e-government use, even when they have the same demographic and socio-economic characteristics.

In our regression analysis, we use the following outcome variables: We define ICT access as a binary variable, which takes on the value 1, if an individual possesses either a computer, a tablet or a mobile phone. If a respondent owns no such devices, the variable is coded 0. We proceed similarly with internet access. We define a binary variable as whether an individual has an internet connection, which takes on the value 1 if the respondent has access to the internet via either a private network, via a free public Wi-Fi service, such as Vive Digital, or via a mobile data plan.

To analyse the use of e-government services, we asked respondents whether they used a list of 10 e-government services, ranging from collecting information online to digital tax payments. This information allowed us to describe how likely an individual was to use e-government services more generally. However, to do so, we needed to account for the fact that each service differed, and usage of specific services provided a different degree of information about the general tendency of individuals to use e-government. First, quite naturally, the level of complexity for each service varies. This implies that only individuals with a high tendency to use digital tools will use more “difficult” tools, while less “difficult” services are used more frequently among a broader group of respondents. Furthermore, some services are of importance more regularly in individuals’ lives, while other services might only be relevant under specific circumstances. In order to have a chance to use these latter services, it requires that, incidentally, a specific service was recently relevant in an individual’s life. The more idiosyncratic a service is, the less it provides reliable information about individuals’ general e-government tendency and its use does not allow us to “discriminate” between individuals with a high or low e-

government tendency, because not using this service may simply be due to the fact it was not relevant to the individual.

This implies that not all items on our list of 10 services are good proxies for a tendency to use e-government. Although we could theoretically speculate whether the use of a specific service is a good proxy for the tendency to use e-government, we were able to proceed with a more systematic methodological solution and overcome this challenge: Based on the variables which e-government services respondents claimed to use, we were able to draw on an Item Response Theory (IRT) estimation to calculate the individual tendency to use e-government services, while simultaneously accounting for varying complexity (or "difficulty" in IRT terminology) and how idiosyncratic the relevance of each service was ("item discrimination" in IRT terminology).[10] As a result, we obtained a continuous estimate of each individual's inclination to use e-government services, which we used as a dependent variable in our analysis.

Given that we had two binary outcome variables, we used Probit regression models for binary dependent variables to assess how ICT and internet access could be explained. For the continuous measure of e-government use, we used a linear regression model. Our core independent variables were the two binary variables distinguishing foreign (that is, predominantly Venezuelan) migrants as well as domestic migrants. To probe the role that length of residency had on the difference between migrants and locals, we included a variable that documented the time in months that a respondent has lived in his current neighbourhood, and then further interacted this variable with the binary migrant variables.

We included two types of control variables. First, we added demographic variables, including age; gender; whether an individual has children; the household size; marriage status and the level of education. These variables account for the fact that older as well as less educated individuals tend to use ICT less (Selwyn, Gorard, Furlong, & Madden, 2003; Hernández-Encuentra, Pousada, & Gómez-Zúñiga, 2009). Our second list of control variables captured respondent's socio-economic status. Socio-economic variables are in part a result of migrant status: for example, migrants often have difficulties finding employment and earn less compared to locals. Therefore, we included these variables in a second step to see if adding these variables reduced the effect of the migrant variable. If this was the case, it implied that at least a part of any possible difference in ICT access between migrants and locals stemmed from the different socio-economic status of migrants relative to locals.[11]

This second list of control variables contained respondents' income; whether they currently have employment; whether they are unemployed; or whether they are not part of the

10 Specifically, we used a 2-Parameter Item Response Theory Model, which estimates for each e-government service i the probability that a respondent j uses this service: $P(service_{ij}) = \frac{\exp(\alpha_i(\theta_j-\beta_i))}{1+\exp(\alpha_i(\theta_j-\beta_i))}$, whereby θ_j is the estimated tendency to use e-government services and β_i is the difficulty of a specific services, while α_i is the item discrimination, that is, the extent to which a specific service contains information about a person's tendency to use e-government services. We can integrate out θ_j, estimate β_i and α_i using maximum likelihood estimation and, subsequently, predict θ_j using these predicted parameters (StataCorp, 2017, pp. 52f., 144ff.).

11 Excluding socio-economic variables that are determined by migrant status allows one to estimate the total effect of migration on ICT access. Including these variables isolates the effect of migrant status, which cannot be explained by socio-economic differences.

workforce. Furthermore, we add an indicator whether an individual held a bank account, which is a prerequisite for many contract-based ICT services. Lastly, we included city-zone fixed effects in all models, in order to eliminate any influence based on different levels of infrastructure, such as varying network connectivity in respondent's neighbourhoods.

6 Results

As a first, basic descriptive analysis, we compared the average ICT access and use among locals with those among domestic and foreign migrants. We indeed found an average difference in ICT access, however only for our foreign migrant sample (that is, Venezuelans in Bogota). While 91 per cent of Bogotan long-term residents acknowledged that they possessed at least a computer, a tablet or a mobile phone, only 85 per cent of Venezuelan-born respondents answered this question in the affirmative (one-sided p-value=0.02).[12] In contrast, domestic migrants did not differ significantly from locals, with around 90 per cent indicating that they possessed at least one such ICT device. We did not find statistically significant differences in average internet access among long-term residents or either migrant group.

As discussed above, a basic descriptive comparison between each group is likely not a valid comparison, since migrants and locals differ on multiple dimensions. For example, respondents in our foreign migrant sample were on average 5 years younger compared to the Bogotan long-term residents in our sample (one-sided p-value=0.001). Hence, we proceeded with the regression analyses outlined above.

6.1 ICT access

Table 7 gives the results of our Probit models of ICT access. Models 1 and 2 include only demographic variables and exclude socio-economic variables, which are most likely (at least partially) a result of migrant status. Holding demographic variables constant, Model 1 indicates a statistically significant lower level of ICT access for foreign migrants, but not for internal, that is, domestic migrants. Based on Model 1, our estimates indicate that, on average, the probability that a Venezuelan migrant in our sample owns a device allowing for ICT access is 13 percentage points[13] lower compared to a Bogotan long-term resident with the same demographic characteristics. We did not find a meaningful difference between domestic migrants and locals.

12 Based on a two-sample t-test.

13 95 per cent confidence interval: [-16 per cent; -10 per cent]. Specifically, we calculated the predicted probabilities for each respondent in the sample under the assumption that the respondent was a migrant or a local and then took the difference between both probabilities. The reported average difference in the predicted probability was the average of the individual differences among all individuals in the sample.

Table 7: Access to ICTs

	(Model 1)	(Model 2)	(Model 3)	(Model 4)
Foreign migrant	-0.68***	-1.37***	-0.41**	-1.18***
	(0.05)	(0.19)	(0.17)	(0.25)
Internal migrant	-0.17	-0.24	-0.22	-0.21
	(0.27)	(0.22)	(0.22)	(0.15)
Residency (in months)	0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Foreign migrant Residency (in months)		0.08***		0.11***
		(0.03)		(0.03)
Internal migrant Residency (in months)		0.00		-0.00
		(0.01)		(0.01)
Female	0.08	0.04	0.19**	0.16***
	(0.10)	(0.07)	(0.09)	(0.05)
Age (continuous)	-0.01***	-0.02***	-0.01***	-0.02***
	(0.01)	(0.01)	(0.00)	(0.00)
Married	0.01	0.07	0.13**	0.20***
	(0.08)	(0.07)	(0.06)	(0.05)
Divorced	0.30	0.33	0.34	0.34
	(0.26)	(0.26)	(0.22)	(0.22)
Widowed	0.24**	0.29**	0.23	0.31
	(0.10)	(0.13)	(0.26)	(0.26)
Non-formal union/partnership	-0.09	-0.09	-0.02	-0.01
	(0.11)	(0.11)	(0.15)	(0.15)
Number of children	0.06	0.05	0.04	0.03
	(0.04)	(0.04)	(0.04)	(0.04)
Household size	-0.05***	-0.04***	-0.05**	-0.05**
	(0.01)	(0.01)	(0.02)	(0.02)
Primary	0.24	0.19	0.33	0.28
	(0.55)	(0.58)	(0.63)	(0.66)
High school	1.17*	1.09	1.06	0.99
	(0.64)	(0.69)	(0.75)	(0.78)
Technical	1.58**	1.51*	1.37	1.28
	(0.75)	(0.78)	(0.92)	(0.95)
College	1.78***	1.72***	1.28**	1.22*
	(0.48)	(0.54)	(0.58)	(0.63)
Social Strata 1-2 (<COL$ 781,243-$2,343,726)			0.26***	0.23***
			(0.06)	(0.07)
Social Strata 3-6 (>COL$ 2,343,727)			-0.19	-0.22
			(0.22)	(0.21)
Unemployed			-0.17*	-0.14
			(0.09)	(0.10)
Not part of workforce			-0.24	-0.22
			(0.23)	(0.23)
Assets, bank account			1.10***	1.08***
			(0.21)	(0.19)
Constant	0.91*	1.07*	0.50	0.66
	(0.50)	(0.55)	(0.54)	(0.55)
Observations	690	690	640	640

All models are Probit models and include city zone fixed effects. Standard errors in parentheses
* p < .1, ** p < .05, *** p < .01
Source: Authors

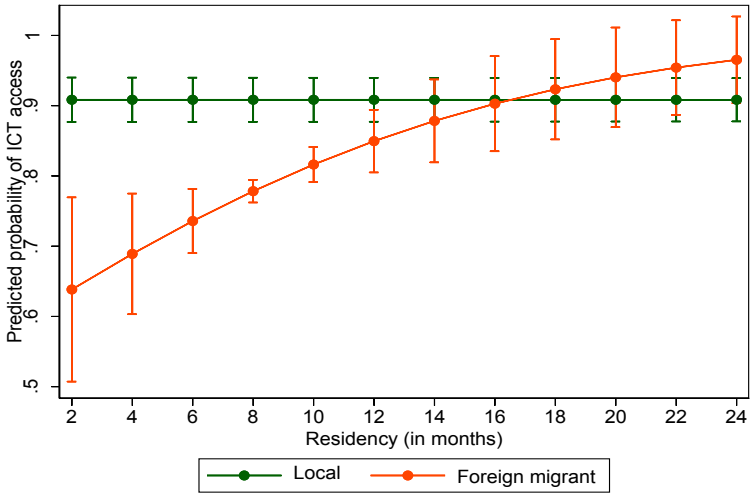
As suspected, age and education predicted ICT access, with younger and more educated individuals being substantively more likely to possess ICT devices. In Model 1, the average predicted probability of having ICT access at the age of 20 is 93 per cent. In contrast, at the age of 50, it is only 84 per cent. Similarly, based on the estimates from Model 1, the average

probability of ICT access increases by about 8 per cent, when the level of education increases from merely a high school degree to a college education.

Given that the age and education level differ between migrants and locals, comparing ICT access across individuals who have the same demographic characteristics reveals a much stronger difference between locals and foreign migrants than suggested by the simple comparison of the group average. While we found only a difference in 6 percentage points in the simple group comparison, accounting for the difference in demographic variables indicated that the actual gap between individuals with identical characteristics was likely more than twice as big. Our results therefore present partial support for our hypothesis that migrants differ in access to technology: Foreign migrants appear substantively more disadvantaged than locals. In contrast, we find no clear difference between domestic migrants and long-term residents.

Model 2 accounts for our hypothesis that the gap between long-term residents and migrants changes with the length of residency in a given locality. The negative coefficient estimates for foreign migrants in Table 7 indicate that foreign migrants are less likely to possess ICT devices in their early phases of residency. However, the positive coefficient estimate for the interaction with residency time indicates that this gap narrows with the length of residency in a Bogotan neighbourhood. As in Model 1, there appears to be little difference or change over time between domestic migrants and locals.

Figure 2: Average predicted probability of ICT access for Bogotan long-term residents and foreign migrants, depending on length of residency (without control variables)



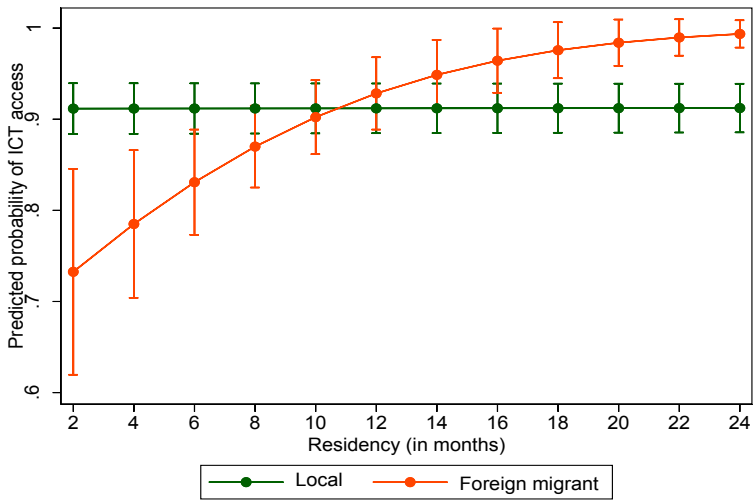
Notes: Bars indicate 95 per cent confidence intervals.
Source: Estimates based on Model 2 in Table 7

To allow for a more transparent interpretation of our results, Figure 2 plots the average predicted probability of having ICT access for locals compared to foreign migrants, depending on the time since an individual moved to their current neighbourhood. The graph highlights that, during their initial residency, foreign migrants have a dramatically lower likelihood of possessing ICT devices. However, over time, the gap relative to locals decreases. At the end of the first year, the confidence intervals begin to overlap. By the second year of residency, migrants from Venezuela have roughly the same ICT access.

The small number of foreign migrants who have lived in their current neighbourhood for over two years (N=6) all report having ICT access.

Models 3 and 4 (Table 7) repeat the analysis in the first two models but introduce variables describing an individual's economic situation. The results confirm the findings from the earlier models. As expected, the poorest individuals and unemployed respondents have a substantively lower likelihood of possessing ICT access. Based on Model 3, once we account for these variables, foreign migrants still had a probability of owning ICT devices which was on average 6 percentage points[14] lower than for similar local respondents. This implied that, even when we compare unemployed and poor locals with similar foreign migrants, migrants are disadvantaged in ICT access. Nevertheless, the difference decreases to about half the estimated difference in Model 1. This implies that a substantive amount of the difference in ICT access appears to be due to the unfavourable economic situation of foreign migrants. However, these economic variables do not explain the entire difference. Hence, there appear to be additional, non-economic hurdles for foreign migrants, which bar access to ICT tools. The potential factors at play here will be explored further in the Discussion section.

Figure 3: Average predicted probability of ICT access for Bogotan long-term residents and foreign migrants, depending on length of residency (with control variables)



Notes: Bars indicate 95 per cent confidence intervals.
Source: Estimates based on Model 4 in Table 7

Accounting for the economic situation also provided further intriguing nuances regarding the speed with which migrants took up ICT. Figure 3 assessed how the gap between locals and foreign migrants evolved with the length of residency, when we account for an individual's economic situation. Not only did we see a lower probability of ICT access among the Venezuelan migrants during the first year in their Bogotan neighbourhood (which disappeared), but we also observed that, after six months and once we account for the economic situation, migrants seemed to overtake locals in ICT access over time. This implied that, despite being disadvantaged in the initial period of their residence, foreign

14 95 per cent confidence interval: [-.12 per cent; -.01 per cent]

migrants appeared to be more eager to possess ICT devices over the long-run, compared to locals with similar socio-economic status.

6.2 Internet access

We repeated the same analysis to assess internet access. Table 8 displays our Probit model estimates for internet access. As in the case of ICT, age and education are central determinants of internet access, with younger and more educated individuals being much more likely to have internet access through either internet at home, a public Wi-Fi service, or mobile data. Once we account for the fact that migrants differed in age and education from locals, we found a statistically significant difference between foreign migrants and locals. On average, a Venezuelan migrant was about 10 percentage points[15] less likely to have internet access than a Bogotan long-term resident with the same demographic characteristics. Again, based on Model 5 in Table 8, we find little systematic differences between domestic migrants and long-term residents.

Table 8: Internet access

	(Model 5)	(Model 6)	(Model 7)	(Model 8)
Internet access				
Foreign migrant	-0.51***	-0.72***	-0.20	-0.35***
	(0.08)	(0.13)	(0.13)	(0.13)
Internal migrant	-0.07	-0.75***	-0.09	-0.58**
	(0.10)	(0.25)	(0.11)	(0.23)
Residency (in months)	-0.00	-0.00*	-0.00**	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Foreign migrant Residency (in months)		0.02***		0.01*
		(0.01)		(0.01)
Internal migrant Residency (in months)		0.03**		0.02**
		(0.01)		(0.01)
Female	0.06	0.06	0.17	0.16
	(0.11)	(0.11)	(0.11)	(0.11)
Age (continuous)	-0.02**	-0.02**	-0.01**	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
Married	0.27	0.29	0.31	0.31
	(0.28)	(0.30)	(0.27)	(0.28)
Divorced	0.17	0.16	0.29**	0.25
	(0.16)	(0.16)	(0.12)	(0.16)
Widowed	-0.26	-0.22	-0.28**	-0.25
	(0.16)	(0.19)	(0.13)	(0.16)
Non-formal union/partnership	-0.15	-0.18	-0.16	-0.21
	(0.16)	(0.17)	(0.16)	(0.18)
Number of children	-0.02	-0.03	-0.06	-0.05
	(0.05)	(0.05)	(0.06)	(0.07)
Household size	0.05	0.06	0.05	0.06
	(0.07)	(0.07)	(0.07)	(0.07)
Primary	-0.91***	-0.64*	-1.17***	-0.98***
	(0.34)	(0.36)	(0.31)	(0.34)
High school	0.29	0.53	0.01	0.18
	(0.41)	(0.50)	(0.48)	(0.53)

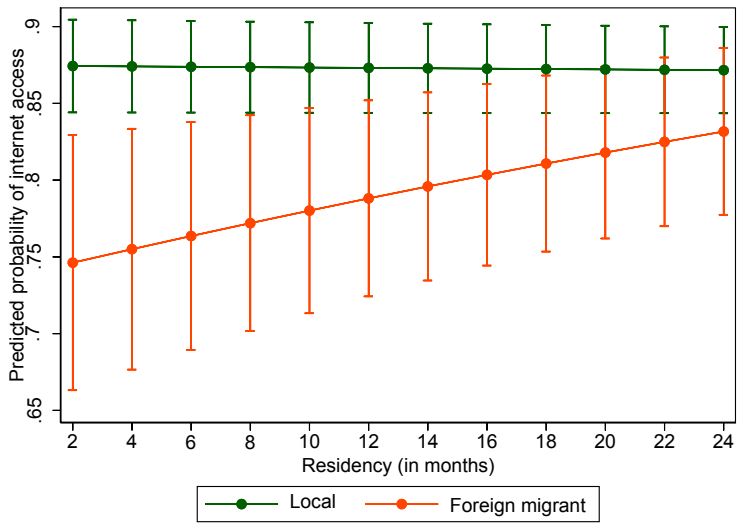
15 95 per cent confidence interval: [-.13 per cent; -.06 per cent]

Technical	0.51 (0.48)	0.78 (0.50)	0.16 (0.54)	0.33 (0.56)
College	1.06** (0.47)	1.27*** (0.47)	0.38 (0.46)	0.54 (0.45)
Graduate	0.97*** (0.24)	1.26*** (0.27)	0.53*** (0.19)	0.74*** (0.23)
Social Strata 1-2 (<COL$ 781,243-$2,343,726)			0.42*** (0.16)	0.42*** (0.14)
Social Strata 3-6 (>COL$ 2,343,727)			0.21 (0.22)	0.24 (0.23)
Unemployed			0.07 (0.38)	0.01 (0.35)
Not part of workforce			0.27* (0.15)	0.24 (0.18)
Assets, bank account			0.94*** (0.13)	0.89*** (0.13)
Constant	1.76** (0.68)	1.62** (0.77)	1.47** (0.65)	1.41* (0.74)
Observations	777	777	722	722

All models are Probit models and include city zone fixed effects. Standard errors in parentheses
* p < .1, ** p < .05, *** p < .01
Source: Authors

In the second step, we again allow the difference between both migrant groups to vary with the length of residency. Figure 4 highlights that we found the same pattern for internet access as for ICT access, when we compared foreign migrants with locals. During the first year of residency in a Bogotan locality, foreign migrants were much less likely to have internet access. However, the gap compared to locals decreased over time and the difference became increasingly difficult to tell apart statistically over the second year. There appeared to be some uptake over time, but not as quickly as for ICT devices.

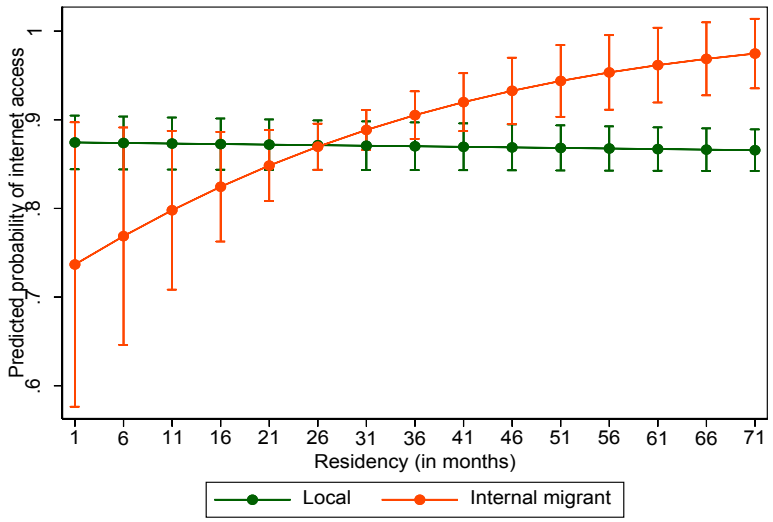
Figure 4: Average predicted probability of internet access for Bogotan long-term residents and foreign migrants, depending on length of residency (without control variables)



Notes: Bars indicate 95 per cent confidence intervals.
Source: Estimates based on Model 6 in Table 8

In contrast to the ICT access analysis in the previous section, we also find a difference for domestic migrants. While almost all Venezuelans have resided in their Bogotan locality for two years or less, the length of residence among domestic migrants varied between one and six years. Figure 5 depicts the predicted probability that an individual had internet access for domestic migrants and locals over this extended time horizon. The graph suggests that there was great uncertainty regarding the level of internet access immediately after moving to a locality. However, among individuals who had lived in the same neighbourhood for more than three years, domestic migrants appeared to have a much higher level of internet access.

Figure 5: Average predicted probability of internet access for Bogotan natives and domestic migrants, depending on length of residency (without control variables)



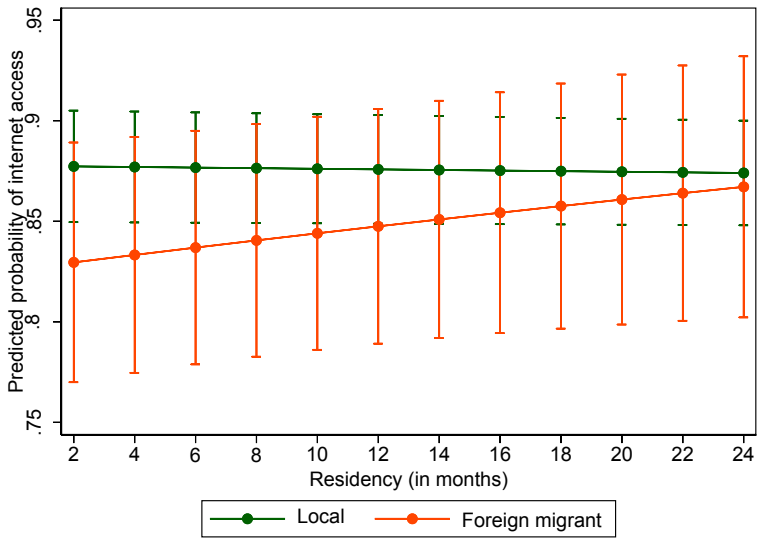
Notes: Bars indicate 95 per cent confidence intervals.

Source: Estimates based on Model 6 in Table 8

As before, we crosschecked the relevance of respondents' economic situation in producing these patterns. Once we had accounted for economic variables in Models 3 and 4 (Table 7), we found no average difference between either foreign migrants and locals, or domestic migrants and locals. It appears that the average difference between both groups uncovered in the first model can largely be explained by the different economic situation between migrants and locals.

This pattern was further confirmed, when we examined the change with the length of residency. Figure 6 displays the predicted probability of having internet access for foreign migrants compared to locals, once we held economic variables constant. Although we see the same uptake pattern, the difference between both groups was much smaller and no longer statistically significant.

Figure 6: Average predicted probability of internet access for Bogotan natives and foreign migrants, depending on length of residency

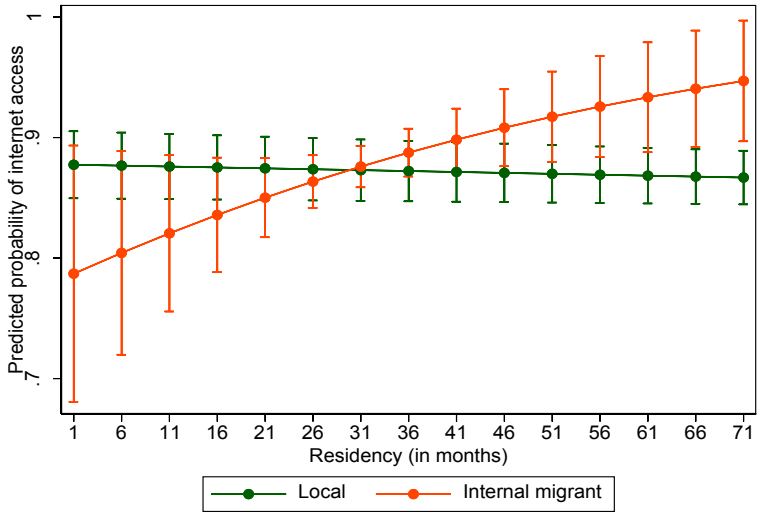


Notes: Bars indicate 95 per cent confidence intervals.

Source: Estimates based on Model 8 in Table 8

We got a similar result when we held economic variables constant and compared domestic migrants and locals. The overall difference became somewhat smaller and the increase in uptake for very long residents became smaller (Figure 7).

Figure 7: Average predicted probability of internet access for Bogotan natives and domestic migrants, depending on length of residency (with control variables)



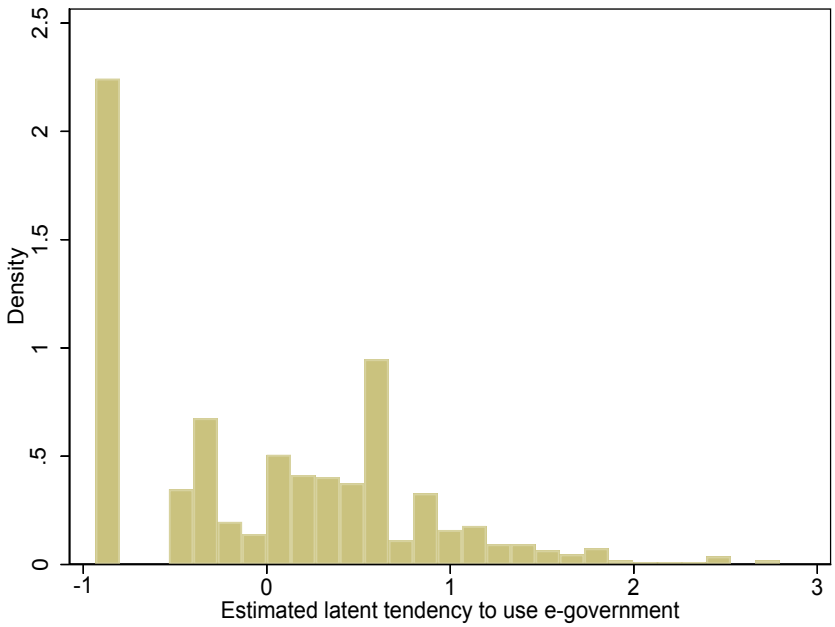
Notes: Bars indicate 95 per cent confidence intervals.

Source: Estimates based on Model 8 in Table 8

6.3 Use of e-government services

We now turn to the use of e-government services and how migrants and locals differed in their overall inclination to use such services. The inclination to use e-government is a latent variable, which we measured using the IRT approach described in the previous section. The variables mean was centred at zero with a standard deviation of 0.79. Figure 8 displays a histogram of this latent variable. The high spike on the left represents the fairly large group which used none of the e-government services we asked for.

Figure 8: Histogram of the estimated latent tendency to use e-government services



Source: Authors

Table 9 displays our estimation results. First, we used a basic model to assess how locals and migrants differed in their estimated tendency to use e-government. Model 9 highlights that foreign migrants are statistically significantly less likely to use e-government services compared to local respondents. The coefficient indicates that foreign migrants were on average almost half a standard deviation less likely to use e-government services. We did not find a significant difference between domestic migrants and locals.

Table 9: Use of e-government services				
	(Model 9)	(Model 10)	(Model 11)	(Model 12)
Foreign migrant	-0.38**	-0.34**	-0.37**	-0.44***
	(0.10)	(0.11)	(0.10)	(0.07)
Internal migrant	-0.05	-0.08	-0.03	-0.10
	(0.07)	(0.06)	(0.05)	(0.09)
Residency (in months)				0.00
				(0.00)
Foreign migrant Residency (in months)				0.01
				(0.01)
Internal migrant Residency (in months)				0.00**
				(0.00)
ICT access		0.24*	0.04	0.03
		(0.12)	(0.13)	(0.13)
Internet at home		0.38***	0.22***	0.22***
		(0.03)	(0.03)	(0.03)
Public internet		0.19**	0.08	0.08
		(0.06)	(0.05)	(0.05)
Internet through Vive Digital		0.15*	0.16*	0.14*
		(0.06)	(0.08)	(0.06)
Mobile data		0.25**	0.14	0.15
		(0.07)	(0.08)	(0.08)
Female			-0.10*	-0.11
			(0.05)	(0.06)
Age (continuous)			-0.01***	-0.01***
			(0.00)	(0.00)
Married			0.12	0.14
			(0.12)	(0.12)
Divorced			0.06	0.07
			(0.06)	(0.05)
Widowed			0.05	0.07
			(0.10)	(0.10)
Non-formal union/partnership			0.16*	0.16*
			(0.07)	(0.07)
Number of children			-0.01	-0.01
			(0.02)	(0.02)
Household size			0.01	0.01
			(0.01)	(0.01)
Primary			0.18	0.19
			(0.12)	(0.10)
High school			0.25*	0.25**
			(0.10)	(0.09)
Technical			0.42**	0.42**
			(0.13)	(0.11)
College			0.56**	0.55**
			(0.20)	(0.18)
Social Strata 1-2 (<COL$ 781,243- $2,343,726			-0.04	-0.04
			(0.05)	(0.06)
Social Strata 3-6 (>COL$ 2,343,727)			0.02	0.01
			(0.18)	(0.18)
Unemployed			0.11	0.10
			(0.16)	(0.15)
Not part of workforce			-0.04	-0.05
			(0.08)	(0.08)
Assets, bank account			0.20***	0.19***
			(0.03)	(0.04)
Constant	0.07	-0.63***	-0.36	-0.32
	(0.05)	(0.08)	(0.19)	(0.22)
Observations	800	800	742	742

Note: All models are OLS models. Models 3 and 4 include city zone fixed effects. Standard errors in parentheses

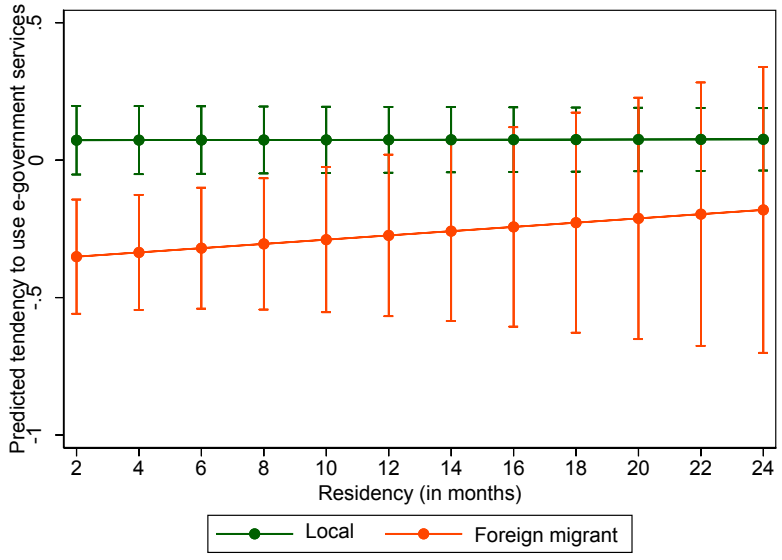
* $p < .1$, ** $p < .05$, *** $p < .01$

Source: Authors

The difference may purely be the result of the different level of ICT and internet access, which we uncovered in the previous sections. Therefore, Model 10 in Table 9 accounts for ICT access as well as various forms of internet access. Although an internet connection at home increases the likelihood that a respondent uses e-government services, accounting for these variables does not alter the finding that foreign migrants were substantively less likely to use e-government services.

As in the previous sections, both demographic and socio-economic differences between migrants and locals may explain the level of e-government service usage. However, including these indicators in Model 11 did not alter our findings. Lastly, we assessed if the length of residency moderated the difference between migrants and locals. The coefficient estimates in Model 12 provided little evidence that this was the case. Figure 9 displays the predicted tendency of e-government usage among foreign migrants and locals. It appears that, if any change occurs over time, the differences between foreign migrants and locals were clearest in the early period of residency. At later points in time, the estimation uncertainty was too large to draw any clear conclusions. Similarly, Figure 10 highlights that the e-government usage among domestic migrants was comparable to locals, but seemed to increase over time. However, for almost all domestic migrant respondents, except for the domestic migrants with the longest residence in Bogota, we observed a similar e-government usage compared to locals.

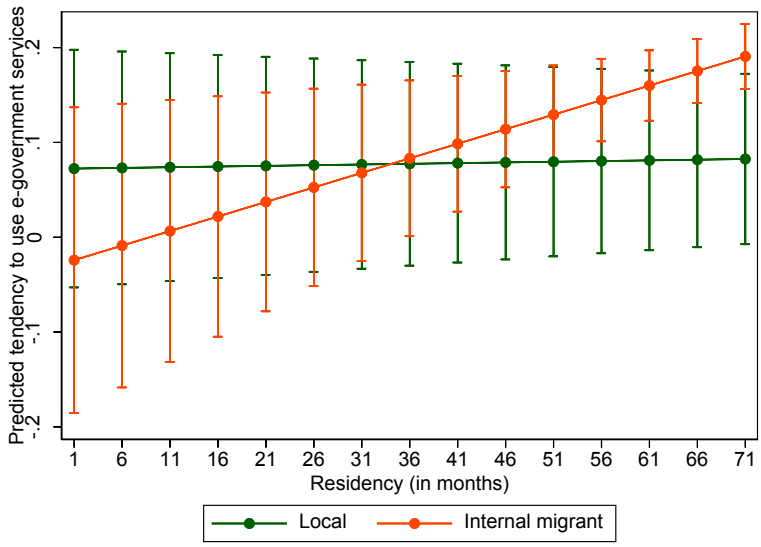
Figure 9: Average predicted tendency to use e-government services for Bogotan natives and foreign migrants, depending on length of residency



Notes: Bars indicate 95 per cent confidence intervals.

Source: Estimates based on Model 12 in Table 9

Figure 10: Average predicted tendency to use e-government services for Bogotan natives and domestic migrants, depending on length of residency



Notes: Bars indicate 95 per cent confidence intervals.

Source: Estimates based on Model 12 in Table 9

Given that foreign migrants appear to differ substantively in their general tendency to use e-government services, we used the estimated parameters of the Item Response Theory Model (described in Footnote 7), as well as the estimates from Model 12 in Table 9 to predict the average probability that a Bogotan native as well as a foreign migrant uses one of the specified e-government services.

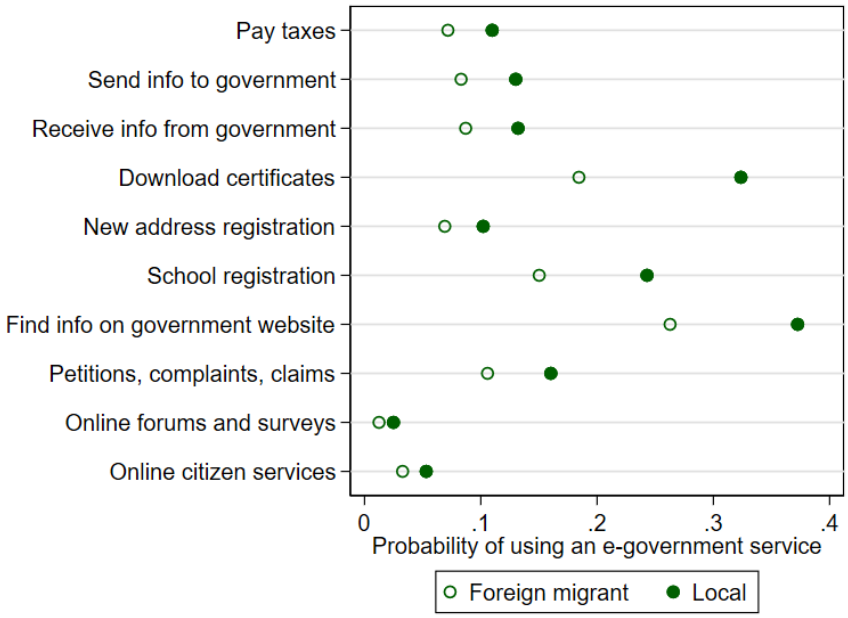
Figure 10 is based on the average predicted tendency to use e-government for a local and a foreign migrant based on Model 4 and depicts the respective predicted probability for each e-government service surveyed for both groups.[16] The graphical comparison highlights that e-government services were used very differently. While some services were used hardly at all, such as online forums, a sizeable proportion of the Bogotan long-term residents used digital means to receive certificates or access administrative websites to find answers to questions. Nevertheless, even for the most likely used services, the predicted probability that these services are used remains modest.

Among foreign migrants, the likelihood that any e-government service was used was even smaller. In part, this result might be due to the fact that migrants generally interacted less with public administration. It is certainly true that we did not expect the recently arrived to file tax reports, either paper-based or online. However, as individuals settle in, they start to send their children to school or interact with local administration on a basic level. Yet, we did not see such an uptake for foreign migrants, indicating that there may be more to this gap than a spurious correlation induced by a difference in administrative contacts. More

16 The formula in Footnote 10 provides an S-shaped Logit function, which gives the predicted probability of using a specific service based on the IRT estimates. The dot in Figure 10 is the predicted probability at the predicted tendency to use e-government, based on Model 12, Table 9. The Appendix gives the full information and plots all individual Logit functions for each individual service.

strikingly, the gap between locals and foreign migrants was biggest for the easiest and most common e-government services.

Figure 11: Average predicted probability to use different types of e-government services for Bogotan natives and foreign migrants after two months of residency



Source: Estimates based on Model 12 in Table 9

Importantly, these results accounted for internet and ICT access and held constant all demographic and socio-economic variables in the model at each individual's values. Hence, promoting internet connectivity among foreign migrants is unlikely to close the gap alone. In the following discussions, we highlight where our results can provide further policy-relevant insights.

7 Discussions and conclusions

There are two takeaways this section will evaluate: the first represents the challenges and lessons from trying to do survey work with hidden populations; the second – after accounting for the limits of the data – what is learned about ICT use among our different survey cohorts.

Before moving on to results, it is important to reiterate the challenges, and thus the limitations, in the data. The long-term resident cohort and Venezuelan data was based on proper sampling frames, but finding the short-term Colombian cohort (the "urban migrants") required working from scratch. Schultz et al. (2014) note that many of these respondents in this cohort do not have consistent addresses or steady housing and assuming they register at IDP centres, it is only an initial registration. Over time, many IDPs do not update addresses and contact information, becoming "invisible" again. Our "urban migrant" group included people seeking work as well as people displaced by violence. Additionally, from what we know about the evolution of internal urban migration in

Colombia, these factors are likely to be endogenous. It is unlikely we captured the *most* vulnerable migrants in our sample, since such people are incredibly difficult to find. However, this data is a starting point for future survey work that can continue building knowledge on urban migrant populations' ICT use. One thing that would help significantly would be the collection of official IDP or migrant arrival data at the Department or, better still, at the municipality/locality level. From a policy perspective, donors working on IDP and migration issues should provide greater support and resources to partner countries' statistics offices to undertake this kind of data collection.

Another issue which we wish to reiterate is the *descriptive* nature of our analysis to address a persistent gap in the literature. As with all observational data, unobserved variables may exist which prohibit causal interpretations of our results. Nevertheless, we believe our results provide a sound descriptive assessment of current ICT, internet and e-government use across the different cohorts we chose. As such, it can inform policy and provide a solid foundation for future theory development and research. With these caveats in mind, the descriptive data we collected can be useful in understanding ICT access and use among urban migrants and their neighbours.

We start with Hypothesis 1 – *Is there a difference in aggregate ICT access, including mobile phones, tablets and computers?* We found that foreign migrants had substantively lower access to ICTs (mobile phones, tablets and computers in the model); while economic factors helped explain this difference, once we controlled for them, a substantive difference remained. So, what other aspects of being a migrant could explain the difference? One is access to an ID; if a foreign migrant did not bring a phone and SIM card with him/her, purchasing a new one would be difficult without a government ID. It would not be impossible, though, as there is a robust black market for stolen phones, though the Colombian government passed legislation making it harder to use stolen phones and SIM cards on cellular networks.[17]

We also included tablets and computers in the ICT variable. Beyond economic factors, we propose two reasons why migrants are less likely to have these devices. If one is migrating on foot or hitchhiking, carrying a computer or a tablet takes up space and energy. Once someone arrives in Bogota, there are likely to be more pressing needs than acquiring these devices, and the neighbourhoods that migrants arrive in are unlikely to have stores selling them. For policymakers, the lessons here are that there is more to access than economic factors – developing digital tools for migrants often requires going back to extreme basics, and accounting for factors such as access to an ID; whether a device is practical to carry; and whether conditions in arrival neighbourhoods make digital access possible.

Migrants also lag in internet access. This should not be entirely surprising; to have wired internet, you not only need a house, but a house that is connected to the phone or fibre optic network. Mobile internet access requires one to register a SIM card, which may

17 In response to the size of the market for stolen devices, the government passed Decree 2015/2025, which made it harder to send mobile phones by mail, or to bring them into Colombia (Government of Colombia, 2015). Along with this decree, the Colombian government passed Decree 2142 in 2016, which allowed phones to be shipped into Colombia but the International Mobile Station Equipment Identity (IMEI) number had to be registered with a carrier within 15 days otherwise the phone would not work on local networks (Government of Colombia, 2015).

require an address and ID that newly arrived migrants lack. Something we observed in Figure 7 is that, after controlling for economic factors, the longer the "internal migrant" cohort were in the same neighbourhood in Bogota, the more likely they were to gain access to the internet. After 71 months, they were marginally more likely than long-term residents to have internet access. That said, most of the models show no statistically significant difference between the probability of any cohort having wired internet. One way to interpret this is that the majority of our sample was on the poorer side, and home internet was simply out of reach. The policy recommendation in this case is for donors and humanitarian agencies to make sure that e-government platforms targeted to migrants function well on a smart phone, and do not require too much mobile data to function.

In the analysis where we look at how long people have been in the same neighbourhood, time becomes an interesting factor in ICT update and internet access. In Figure 3, Figure 4, and Figure 7 we can see that the probability that there is a difference between cohorts in terms of ICT and internet access changes over time. In the first four months in one neighbourhood, Venezuelan migrants had significantly lower access to ICTs; if they remained in the neighbourhood 18 months or more they became more probable than respondents from the long-term cohort to have access to ICTs. If we look at internet access for the short-term Colombian cohort in comparison to the long-term cohort, we see a similar pattern: by month 71 of residence in the same neighbourhood, the short-term cohort had a statistically higher probability of having internet access. Given the limitations in the data we wanted to be careful not to overstate the strength of these findings, but they showed that time in a residential area is a potentially fruitful avenue to look into further in order to understand ICT and internet uptake among urban migrants.

Colombians, whether in the long-term or short-term residence cohorts, used e-government services at a higher rate than Venezuelan migrants did. The highest likelihood of use was for seeking answers to questions on government websites, followed by downloading forms and official certificates, and dealing with educational registration matters. One possible reason why the Venezuelans did not use these services as much was a lack of applicability to their administrative needs. We did not ask why respondents did not use e-government services, which will be a question posed in later work, but existing research highlights issues with encouraging citizens to use e-government services (see, for instance, Carter & Bélanger, 2005; Taylor & Lips, 2008; Prosser, Karunasena, Deng, & Singh, 2011). In Australia, for example, with an internet penetration rate of 86.5 per cent, people with internet who do not use e-government services note that either the specific services they needed were not online, or just a preference for wanting to deal with a human being (Australian Ministry of Finance, 2010). To improve e-government uptake, designing tools to meet migrants' specific needs is a starting point, as well as having a good understanding of which services make sense to provide online versus in person.

If we look to the context of developing countries, case analysis of e-government uptake in Niger indicates that, while ICT access has increased, people mostly use it for social reasons; the idea of using it to participate in governance is just not a core digital behaviour (Alzouma, 2015). This mirrors responses from refugees interviewed in Kenya regarding digital services provided by non-governmental organisation (NGOs) and UN agencies – many respondents did not view ICTs as a means for meeting their governance needs (Eppler et al., in press). In our data, the two digital tools people across the sample used the most were WhatsApp (77 per cent) and Facebook (73 per cent) – WhatsApp was the most

used tool among migrants (60 per cent) as well. Debates about how to get people onto e-government platforms from the mid-2000s (such as van Deursen, van Dijk, & Ebbers, 2006; Parent, Vandebeek, & Gemino, 2005) are still going on as we near 2020. Increasing access to, and the use of, e-government platforms in Colombia, as in many other countries, could just be a matter of time and behavioural change.

When we talk about differences in access, it is important to note that this is not a new issue in the study of ICTs in development – the digital divide is a well-researched phenomenon, and the data we gathered continues to point to ways that it manifests itself. The obvious starting points for this divide are often economic but, in our sample, it is not just economic factors at work: we see a difference between Venezuelan and Colombian internal migrants when we control for economic and demographic factors. While we cannot account for all possible variations between all respondents, the results indicate that there are factors unique to the migrant experience, making the use of ICT and e-government services initially harder for migrants than it would be for long-term residents. What is promising though is that over time it appears that migrants gain access to the necessary tools to engage with e-government programmes and connect digitally. This finding highlights opportunities for future research, and indicates that digital development and humanitarian efforts could have a positive impact on the lives of migrants and displaced people as they settle into new cities.

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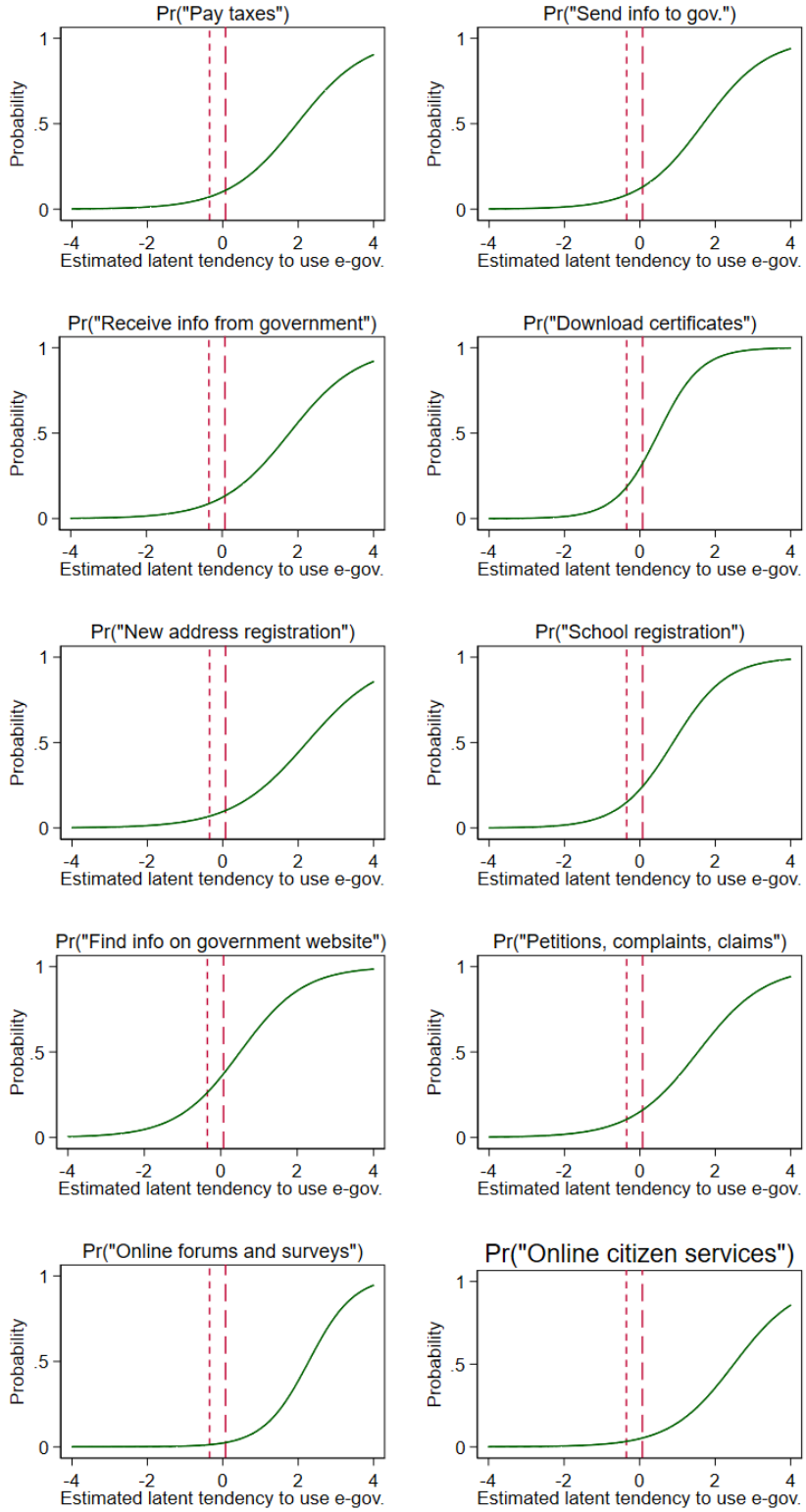
Appendix: Predicted probability curves for e-government use

Figure A1: Predicted probability to use different types of e-government services across different values of e-government usage tendency



Notes: Long dashed line is average predicted tendency for Bogotan locals and the short dashed line depicts the average tendency for foreign migrants after two month of residency.
Source: Estimates based on Model 12 in Table 9

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