Internet Adoption and Use in Cameroon

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Abstract

The aim of this study was to analyse the changes in the determinants of Internet adoption and use in Cameroon. The study used two individual surveys carried out in 2008 and 2015. Using discrete choice models and a comparative analysis, the study was able to highlight three major results. Firstly, following the emergence of equipment that was more compatible with third-generation (3G) mobile technology (smartphones and tablets), possessing a "traditional" mobile telephone, which could enable Internet adoption in 2008, was no longer relevant in 2015. Other factors, such as being unemployed or possessing a laptop, which were not significant in 2008, had an impact on Internet use in 2015. Secondly, most of the socio-economic and social network factors which influenced Internet adoption and use in 2008 were still relevant in 2015. The key factors were the respondent's education level, his/her age, and the number of Internet users in his/her social environment. Finally, the study found that the coefficients associated with the marginal effects of most of these invariant factors increased over time both in the Internet adoption and Internet use models. This means that as the Internet penetration rate increased and the means used to have Internet access became more diverse, the first-level and second-level digital divides tended to worsen.

These results are likely to help the government develop and implement more effective digital policies aimed at promoting mass Internet use in Cameroon. One will think first and foremost of policies aimed at training and informing the people who do not have Internet access. However, it could also be policies that target those who already use the Internet but are "isolated", and who do not have access to information and expert advice in their vicinity, and, who, as a consequence, use the Internet in a sub-optimal way and are likely to be disappointed.

Key words: *Internet adoption, Internet use, ICT, digital divide*

1. Introduction

Background to the study

Information and communications technology (ICT) has grown over the past decade thanks to the mobile telephone revolution and the exponential growth of the Internet. Today, information is instantaneous and available worldwide. According to the International Telecommunication Union (ITU), there were more than six billion mobile phones and more than one billion Internet users in the world at the beginning of 2013. This digital revolution is based on the Internet, which is the vehicle for the convergence of telecommunication protocols that enable a simultaneous transmission of text, sound and image. The presence of a fast, and mobile, Internet connection ensures that citizens are not excluded from today's information society (ITU, 2013).

Having been connected to the Internet since 1997 (Lange, 2008), Cameroon has since been resolutely committed to being part and parcel of the "information and communication society". But, as in most African countries, mobile telephony is the main driver of access to ICT in Cameroon, where the ICT sector gets between 28% and 29% of the total investment expenditure and knows no funding gap (Dominguez-Torres and Foster, 2011). Despite this, on the whole, the country relies more on public expenditure (60%, against 40% from the private sector) to fund its ICT sector than the other infrastructure sectors (Briceño-Garmendia et al, 2009).

The Internet is used in almost all areas of life and has become part and parcel of today's life the world over. It is capable of stimulating economic development, facilitating integration into the world economy and increasing productivity, that is, in a nutshell, creating a high value-added economy in Cameroon (Tamokwe, 2008). In addition, at the individual level, the Internet creates opportunities for developing social skills and enhancing communication. Thus, it offers the youth the possibility of further opening up to the world and confronting a multitude of viewpoints, especially through blogs, videos and websites. For students at all levels of education, the use of social media is very relevant and beneficial in their realization of team projects, since social media enables an exchange of ideas and collaboration irrespective of distance.

The digital divide issue is at the heart of much of the debate on public policies. Initially, the notion of digital divide referred to the gap between those who had access to digital information (the information rich) and those who were deprived of the content and the services which ICT could offer (the information poor) (Valenduc and Brotcorne, 2008). This technical perspective, labelled "first-level" divide, places the technological equipment at the centre of analysis and assumes that access to ICT is a necessary condition

for achieving wealth irrespective of the economic, institutional and cultural environment in which this ICT is disseminated.

The definition of the digital divide has evolved over time. Today, it is no longer limited to a technical consideration of only ICT infrastructure, but has been extended to include the use of this infrastructure. Kling (1998) proposes a double interpretation of the digital divide by distinguishing between: (i) technical access, that is, access to telecommunication and computer infrastructure; and (ii) social access, which refers to an intellectual and social dimension that is necessary for an effective exploitation of ICT. The idea is that access to ICT and, more specifically, the Internet, does not automatically imply the use of it, that is, a "good" use of it, that which maximizes its usefulness. The logic of this reasoning lies in the fact that a reduction in digital inequality is not simply a question of increasing the number of connected people.

The bulk of research carried out on ICT in general and the Internet in particular, and even on available data, is most often of a macroeconomic nature. In this connection, the issues to be addressed will focus on endowment in equipment and infrastructure. However, while such aggregated data do indeed highlight the duality of space, they do not account for the individual dynamics of adopting and using ICT, dynamics which are equally important but often ignored, while, from such a perspective, the likelihood of seeing the gap deepen on a long-term basis exists (Suire, 2007). That is why this study focuses on individuals and tackles issues related to the determinants of Internet adoption and usage in Cameroon.

The Cameroonian government in the face of Internet development

The Cameroonian government is responsible for the entire national policy on ICT development. But it has created specific institutions to oversee the implementation of this policy. To this end, the Office of the President plays a key role, to the extent that it defines and gives orientation to the national ICT policy, while the Office of the Prime Minister is tasked with follow-up, ensuring that the policy is effectively implemented. The National Assembly passes legislation governing telecommunications.

There are other institutions in addition to these three. The National Agency for Information and Communication Technology (Agence Nationale des Technologies de l'Informationet de la Communication, ANTIC) was set up by decree No. 2000/092 of 8 April 2002. The Agency's mission is to promote and ensure follow-up on government action in the ICT area. There is also the Telecommunication Regulation Agency (Agence de Régulation des Télécommunications, ART), which is a public institution under the Ministry of Posts and Telecommunications (MINPOSTEL). ART is specifically in charge of regulating, monitoring and following up the activities of the telecommunications sector in Cameroon. It is responsible for applying the principle of equality in dealing with users on the part of all the telecommunications companies. ART is also responsible for resolving conflicts between the various operators in the sector, notably issues related to interconnection or access to the telecommunications network, to the telephone numbering system, to frequency interference and to infrastructure sharing.

Even though the institutions mentioned above have enacted a range of laws governing the audio-visual and telephone industries in Cameroon[1], only a few legislative measures govern the Internet industry in Cameroon.

Results from different sub-Saharan African countries show that there is no real political will to speed up the expansion of the ICT sector (UIT [ITU], 2013). Corruption and lack of democracy engender practices that appear to show that there is no will to rapidly expand the ICT sector. The diffusion of mobile telephones and the Internet in Africa has a major impact on society, in that these technologies can serve as platforms for challenging the established authority in undemocratic countries. Indeed, they enable access to information from outside the country and its dissemination outside the official communication channels (which are often subject to censure). They further offer platforms for discussing and exchanging ideas and can play an important role during elections in many African countries (in ensuring that the voting process runs smoothly). Rhuea and Sundarajan (2011) have shown that ICT diffusion in a country has a positive and significant impact on civil liberties and increases the probability of political changes taking place in undemocratic regimes. A country can indeed limit the use of technology such as the Internet to reduce the flow of information and, as a result, to easily control its people. Furthermore, a government can promote Internet use with the aim of "spying" on its population and, hence, of controlling the exchange of political views among its citizens. However, from a more virtuous perspective, a government can equally encourage Internet use to enhance transparency in its management and control of its current affairs (e.g., by monitoring elections to avoid fraud and by publishing the results of contests organized by the public service).

A study of the Cameroonian authorities' behaviour vis-à-vis ICT has shown that they are greatly influenced by what donors and international organizations say; these groups are very optimistic about the opportunities that the ICT sector in Cameroon offers for economic, political, social and cultural development (Ewangue, 2013). Even though its attitude has been relatively passive, the Cameroonian government's adherence to all the initiatives promoting the information society is an indication that it considers the Internet to be a technology capable of enabling the country to better face the challenges of the third millennium.

Service provision and competition among Internet service providers in Cameroon

In Cameroon, there is still a monopoly in terms of access to the World Network by submarine cable. This is because the historical public telecommunications operator in the country, CAMTEL (Cameroon Telecommunications)[2], is the only authorized network provider. CAMTEL inherited its role from the Cameroon International Telecommunications Company (INTELCAM) and from the Directorate of Telecommunications at the Ministry of Posts and Telecommunications. However, several Internet service providers (ISPs) share the domestic market.

Depending on its customers' bandwidth consumption needs, each ISP has developed different types of packages. On the whole, the retail broadband market distinguishes

between three types of offers for commercial bandwidths proposed by the ISPs: low speed of less than 128kbps for individual customers, broadband of between 256kbps and 1Mbps for SMEs/SMIs and individuals), and very high speed of over 1Mbps for companies.

The ISPs need to have access to wholesale market capacities (international bandwidth and leased lines) to offer Internet services on the retail market. Since the conditions of access to these resources are similar for these stakeholders, the retail rates offered to the end customer are more or less influenced by the same production costs. Thus, only the level of specific services provided, which those operators can offer to their end customers, determines their trade and financial profit margins. These services are related to factors such as quality of service, links to remote sites, and the specific conditions related to the level of customer activity.

In their market-conquest strategy, the ISPs specialize depending on their ability to guarantee those services to their customers. In this connection, it has been observed that as customer demands vis-à-vis those services increase, the number of customers recorded by the operator tends to diminish (ART, 2012).

The most profitable customers are those who require very high access capacities (ART, 2012). Such are customers like big enterprises. Such enterprises need very high connection speeds to ensure the smooth running of their operations. The ISPs specialized in this offer category have the potential to realize large profits irrespective of the number of their subscribers.

The broadband offers intended for small organizations and households enable the service providers to obtain a monthly income, through intermediate subscribers. The ISPs specialized in this offer category are those that in principle realize more or less large market shares.

It is the general public offers, which are directly made by the ISP to the end consumer that realize the smallest amount of profit by customer. Indeed, often such are relatively low-speed offers which off a quality service without warranty and access prices for which are retail prices (between CFAF 1,000 and 35,000) for daily or weekly access (ART, 2012). The ISPs specialized in this offer category thus potentially have a very wide customer base.

The liberalization of the third-generation mobile (3G) technology at the beginning of 2015 will definitely accelerate competition on the Internet and mobile phone market. Indeed, as of March 2015, the first two mobile phone operators (Orange and MTN) on the Cameroonian market both use 3G technology. They have thus broken the monopoly which their main competitor, Nexttel[3], had for two years (from December. 2012 to December 2014), even though in reality Nexttel's activities started in earnest in September 2014.

To date, despite a large number of ISPs in Cameroon, the rates are still unusually high in the country, relative to its population's purchasing power, as measured by the minimum salary in the country, which is CFAF 36,270 (about US$68) per month.

Table 1 describes the access fees charged by some ISPs to the general public.

Table 1: Internet access fees charged by some ISPs to the general public

ISP	Access technology	Equipment (conditions of access)	Commissioning costs	Speed	Licence fee in CFAF†
CAMTEL	**Dial Up**	Telephone line Personal computer Modem	CFAF15,000 for the new subscribers	56kbps	CFAF15,000
	ADSL*	Telephone line Computer Modem	CFAF 29,350	128/64kbs 256/64kbs	CFAF 20,694 CFAF 29,350
	Wireless (Ctphone)	Telephone line Personal computer ADSL modem	CFAF2,000(for a 7-day access) Free (for more than 7 days)	115 kbps (simple fixed terminals) 230kbps (Walkman/personal stereo)	CFAF23,850
	RENIS	Telephone line Computer An appropriate modem	CFAF 50,000		CFAF 150,000
ORANGE "multimedia"	WiMAX	WiMAXoutdoor modem WiMAX outdoor modem Livebox	CFAF 275,000	128/64kbs 256/128kbs 512/128kbs	CFAF 25,000 CFAF40,000 CFAF75,000
MTN "Networks"	WiMAX **GPRS/EDGE**	USB key SIM card	CFAF 24,000		CFAF 25,000

continued next page

Table 1 Continued

ISP	Access technology	Equipment (conditions of access)	Commissioning costs	Speed	Licence fee in CFAF†
YooMee	WiMAX YooMee-WIFI premium YooMeeMIFI	USB key Fixed modem Fixed modem	CFAF29,900 CFAF 59,900 CFAF49,900		Between CFAF 2,000 and35,000 per month (depending on the contention ratio)
Ringo	**SCDMA**	Modem Bindibox	CFAF15,000-100,000	256kbs 512kbs 1,024kbs	CFAF25,000 CFAF 50,000 CFAF100,000
Saconets	WiMAX	TheVSAT kit remains the property of the customer. The customer pays for the broadband at least monthly	CFAF1,600,000	256 kbs	Between CFAF24,000 and 75,000 per month (depending on the contention ratio)
Matrix	**Radio loop** WiMAX		CFAF98,000	128/128kbs 256/256kbs 512/512kbs	CFAF25,000 CFAF 49,000 CFAF75,000

†For unlimited monthly access.
* Being in an eligibility zone.
Source: Ministry of Posts and Telecommunications 2015

There are many reasons for these high access or connection fees charged by the different operators. One of them is CAMTEL's monopoly over access to the submarine cable South Atlantic 3 (STA3). Corruption and lack of control within the Telecommunications Regulation Agency also contributes to high supplier profit margins for suppliers between whom there is little competition.

Another possible obstacle to Internet connection is the cost of the equipment and with cost-benefit analysis HOW IS THIS AN OBSTACLE?. In a developing country like Cameroon where many people have few resources, the main concern of much of the population is to meet their basic needs. Given such an economic situation, Cameroonians do not perceive any relative advantage in making a step towards a type of innovation that would cost them more than it would earn them in the short term. This may explain why very few Cameroonians have Internet connection at home.

Internet penetration in Cameroon

Even though the number of households with Internet access seems to have accelerated between 2013 and 2014 in Cameroon, rising from 1.3% to 3.5%, the rate of Internet use among its population has not increased as fast as it wuld have been expected. Indeed, between 2006 and 2015 this rate increased by less than five percentage points, from 2.23% to 6.4% (Dutta and Mia, 2009; Dutta et al, 2015). While this rate is higher than that of some countries in the central Africa sub-region such as Chad (with a rate of 0.60% in 2006 against 2.3% in 2015) and Burundi (with a rate of 0.77% in 2006 against 1.3% in 2015), it is largely lower than that of its large neighbour, Nigeria (with a rate of 2.77% in 2007 against 38% in 2015). This state of affairs can be attributed to factors that enable an individual to determine his/her demand for Internet access.

The demand for Internet access comes from residential and business customers.[4] Depending on category customers find themselves in, access fees and the characteristics of the quality of service are different. For example, the demand for access from business customers (SMEs/SMIs and bigger companies) is often characterized by strong requirements for quality of service, remote site connections (retail leased lines), and specific conditions on the amount of client activities. Meeting these requirements hinges on tariff conditions that are inevitably prohibitive, but which business clientele can accept to ensure smooth running of its services (ART, 2012).

In contrast, the demand from residential customers (the general public), which comprises individual or family offers, is characterized by less strong requirements for access and by dynamic usage; this category needs access fees that are more or less accessible. However, service providers are faced with a profitability constraint: they need to strike a balance between the cost of access to capacity services on the wholesale market, and on the retail market prices they have set. This is why service providers are more interested in making offers that are principally destined for business customers, from whom they get a safer guarantee of profitability than from residential customers.[5] The relatively higher fees charged to the business category of customers can be partly accounted for by the repercussions, on the retail market, of the high cost of wholesale services bought from CAMTEL (lines for urban and interurban transmission and Internet bandwidths).

That said, the costs related to purchasing computer equipment (computer, software, etc.) and taking out a subscription (subscription fee and subscriber package) push most

Internet users to use cybercafé services instead (Tamokwe, 2012).

In light of the analysis above, it can be argued that if deliberate and effective policies are not implemented, it will be difficult for Cameroon to be integrated into the information society or to use ICT as a tool for economic and social development.

Statement of the problem

The role played by ICT in international development has aroused great interest in the digital divide phenomenon, a term which commonly refers to the divide separating those who have access to digital information and those who do not, that is those excluded from the content and services which ICT can offer (Rallet and Rochelandet, 2005).

According to Brotcorne and Valenduc (2008), the digital divide has two dimensions: a material dimension and an intellectual one. The material refers to a lack of means to buy the necessary equipment and pay for access. This dimension is also referred to as the first-level digital divide. The intellectual digital divide has to do more with disparities in ICT usage than with those to do with access. In this sense, the notion of digital divide refers to cognitive-type disparities, those resulting from the lack of adequate skills and basic knowledge required to use ICT and take full advantage of its content. This dimension is the necessary condition for any appropriation of ICT. It is referred to as the send-level digital divide. The idea is that access to ICT, and, more specifically, to the Internet, does not automatically mean being able to use it, and, most importantly, to use it well.

In relation to Internet access and use, huge disparities currently exist between population sub-groups in Africa in general and in Cameroon in particular. These disparities can be attributed to demographic or socio-professional variables (such as age, gender, family composition, education level, income,and employment status) or to geographical and geopolitical variables (i.e., differences between urban and rural areas, and between regions and countries). With the spread of the Internet, some aspects of the digital divide can reduce over time and others can worsen and last for a long time. Against this backdrop, the questions which this study sought to answer were: What are the determinants of Internet adoption and use in Cameroon? Did the digital divide increase or decrease between 2008 and 2015?

The overall assumption underlying this study is that the determinants in question undergo some changes over time, as the Internet penetration rate increases and the means used to get Internet access diversify.

Aim and significance of the study

This study, a continuation of previous studies on the same topic, aimed to analyse the changes over time in the determinants of Internet adoption and use in Cameroon. Its originality lies mainly in the fact that it is the first study to analyse the determinants in question from a pool of data collected over two periods (2008 and 2015). The detailed analysis which the study provides should help the government better develop policies aimed at promoting digital infrastructure and the use of services related to the Internet.

Hypotheses

The originality of this present study determines the overall assumption underlying it, namely that "the determinants of Internet adoption and use in Cameroon undergo some changes over time, as the Internet penetration rate increases and the means to have access to the Internet diversify". To empirically test this assumption, we broke it down into the following four main hypotheses:

- Internet adoption and use in Cameroon is still largely dependent upon the user's socio-economic characteristics.
- The first-level digital divide related to gender and to being an English speaker will tend to reduce while that related to age and to education level will tend to worsen.
- The second-level digital divide related to being an English speaker and to computer skills will tend to reduce while that related to having Internet access equipment will tend to worsen.
- A social environment with low access to the Internet is a permanent hindrance to adopting and using the Internet.

2. Theoretical framework and literature review

Theoretical framework

Studying the acceptability of a system comprises studying and predicting certain behaviour while seeking to understand how individuals are going to use and appropriate new technology. To model the diffusion and adoption of technological innovation and the factors that can influence them, several theories have been proposed.

Rogers' theory of diffusion of innovations

The theory of innovations developed by Rogers (1995) studies the behaviour of different people in society based on the relationships which they entertain between them, and on the mechanisms of adoption or rejection. Rogers' theory seems to be capable of accounting for the complex nature of ICT.

Rogers has proposed three broad categories of factors that account for the diffusion of innovations:

- The characteristics of products or services from the users' point of view, in particular five characteristics: their complexity, their compatibility, the possibility to try them out, their visibility, and their relative advantages;
- The consumer characteristics: that is their cognitive, social, and material resources (money and time);
- The profiles of the different adopter categories as the innovation gets diffused.

The users' perceptions of these characteristics play an important role in the process of exclusion and inclusion, as they explain the factors that trigger or hinder Internet usage. The complexity of interfaces can be seen as an incentive by pioneers, but user-friendly interfaces are indispensable for a wide diffusion. Compatibility determines the extent to which new technologies can be easily integrated into the users' daily lives, at work or at home. The probability of trying out a product depends on the opportunities one gets to familiarize oneself with it and to test it before purchase. Good visibility of usage reduces the uncertainty about the product and facilitates its diffusion. As for the relative advantage, it is not only perceived as a question of technical performance, but also as that of efficiency and facility in use, in relation to a previous situation.

The main advantage of Rogers' model is that it offers a dynamic description of the

mechanism of innovation adoption that is capable of identifying different categories of people's behaviour at each successive stage of the diffusion process. Therefore, the arguments to persuade new adopters of innovation and the policies required to promote its diffusion, must be adjusted to take into account the different types of behaviour.

Reasoned Action Theory and Planned Behaviour Theory

According to Ajzen (1991), the Planned Behaviour Theory is an extension of the Reasoned Action Theory, to which the perceived behavioural control has been added. According to Planned Behaviour Theory, any behaviour that requires certain planning can be predicted by the intention to have the behaviour in question. Behaviour is thus directly influenced by the perceived behavioural control which an individual develops (Ajzen, 1991).

In this theory, intention is the result of three conceptual determinants. The first evokes the attitudes vis-à-vis behaviour that indicates the degree of favourable or unfavourable evaluation which a person does vis-à-vis the respective behaviour. The second rests on the perceived social norm that refers to the subjective norms and social pressures which a person is under while adopting a certain behaviour. The third determinant is the perceived behavioural control that refers to the perception which a person has of the personal achievement of the behaviour in question (Ajzen, 1991).

Davis's (1989) Technology Acceptance Model

Based on the Reasoned Action Theory and the Planned Behaviour Theory, the Technology Acceptance Model (TAM) suggests that the acceptance of information technology by its users is essentially determined by two types of perception: the perceived usefulness and its perceived ease of use. Davis (1989) defines perceived usefulness as "the degree to which a person believes using a particular system would enhance his or her job performance", and defines perceived ease of use as "the degree to which a person believes that using a particular system would be free from error."

The Technology Acceptance Model has been much used by several authors who have attempted to explain the reasons why a given technology gets adopted (Lu et al, 2008; Niklas and Strohmeier, 2011) and has been the subject of various improvements and adaptations. One of these improvements has been termed TAM 2, which includes the impact of social influence and certain cognitive aspects to determine the perceived usefulness (Venkatesh and Davis, 2000). A further expansion of the theory is TAM 3, put forward by Venkatesh and Bala (2008). It introduces intrinsic elements such as pleasure as a variable to the perceived usefulness.

The Unified Theory of Acceptance and Use of Technology

To respond to the scattered research on the adoption of technologies such as the Internet, Venkatesh et al (2003) summarized the main models of individual acceptance of ICT to extract from them a unified theory of acceptance and use of technology. Constructed from eight previous models, the Unified Theory of Acceptance and Use of Technology (UTAUT) has facilitated considerably enhanced understanding of the mechanisms of

technology adoption.

Venkatesh et al (2003) have thus demonstrated the significant influence of setting of use (whether voluntary or mandatory) on technology adoption: in a mandatory setting, the determinants related to social influence were found to have a stronger effect. Moreover, the influence of the various determinants was found to vary over time: certain determinants found to be significant on the first measurement became non-significant later with the increase in experience. Similarly, the inclusion of age and gender as moderating variables of the intention to use technology and the actual use of it led to a significant increase in the explained variance.

Based on the summary of different models (Venkatesh et al, 2003), UTAUT comprises:

- Three direct determinants of intention to use: performance expectancy,effort expectancy, and social influence;
- Two direct determinants of usage behaviour: behavioural intention and facilitating conditions;
- Four moderating variables: gender, age, experience, and voluntariness of use.

Literature review

In the scientific literature, several studies have examined how the different factors (demographic, economic, etc.) have interfered with the differentiation of Internet adoption. According to the Graphic, Visualization and Usability (GVU) Center's survey carried out by the Georgia Technology Institute in 1994, the early adopters of the Internet were relatively young (34 years old on average), male, highly educated, with an income higher than average, and who were strongly attracted by new technologies.[6] This finding was confirmed by other surveys (the HomeNet Project, 1995; Hoffman et al, 1996; Pitkow et al, 1998; Cukier, 2007; Kraidy, 2007).

Other researchers were interested in the determinants of the various Internet uses (Goldfarb and Prince, 2008; Drouard, 2010; Coneus and Schleife, 2010). They found that socio-economic factors (age and income) played an important role in the decision to use the Internet but did not have an effect on the choice of what to use it for (electronic mail, social networking, online games, online banking, etc.). These uses were found to depend rather on the availability of time, on computer skills, and on the accumulated experience in Internet use.

Research in this area on the African continent remains relatively limited. However, a few studies have been conducted. From a sample of 200 individuals working at 10 universities in Kenya and Nigeria, Oyelaran-Oyeyinka and Adeya (2004) found that younger people were more inclined to adopt the Internet than older ones. The authors did not find any significant difference between male and female respondents in terms of Internet use. Their findings, however, cannot be generalized to the entire population because of the very small sample size used.

Pénard et al (2012), using survey data collected from households in Gabon, compared the determinants of the adoption of the Internet and mobile phones using a discrete choice model. They found that Internet users were generally highly educated and young people.

On a somewhat different topic, Bettina Anja (2013) studied the future of Cameroonians' family and friendship relationships in this era of mobile phones and the Internet. Using survey data collected from Freiburg (Germany) and Buea (Cameroon), the author found that the mobile telephone and the Internet were often the source of discontent and alienation within families or groups of friends.

Using survey data collected from 2,650 people in Cameroon, Mukoko (2012) sought to explain the determinants of the adoption and use of computers and the Internet among individuals. The author found that lifestyle and two key psychological factors, namely perceived usefulness and the difficulty perceived by an individual, played a particularly important role in the adoption and use of computers and the Internet in Cameroon.

With the aim of understanding the factors that stimulated or hindered Internet adoption and use in Africa, Pénard et al (2015) used a micro-econometric approach and the same database as Mukoko (2012). They found that Internet users in Cameroon tended to be young, male and had a family member living abroad. The probability of using the Internet was also higher among English-speaking respondents and among respondents who held an "executive position and higher intellectual profession". Further, the authors observed that the services for which the Internet was used differed according to age and level of education. For example, the younger generation (below 21 years of age) preferred to use it for games, while the older generations preferred to search for (local and international) news. Overall, these results show that a double digital divide exists in Africa.

Mboko (2013) studied the role of peer effect on Internet adoption and use by members of tontines in Cameroon. Using a simple Probit model, he found that this peer effect had a positive impact on Internet adoption. This finding confirms that of studies conducted in the USA and Europe on the positive role played by associations in the early stages of ICT diffusion.

Based on the same survey on households in Cameroon, Tamokwe (2013) analysed the determinants of Internet access and use in sub-Saharan Africa. Using discrete choice (Probit) models, he found that Internet use was explained by social and demographic characteristics: the probability of an individual adopting the Internet depended on his/her socio-economic characteristics, especially his/her age (the younger the person was, the higher the probability that he/she would adopt the Internet) and his/her level of education (positive effect).

In all the above empirical studies on Cameroon, the authors analysed the digital divide on the basis of just one survey conducted in 2008. However, at that time desktop and laptop computers were practically the only means to access the Internet. Moreover, a single survey cannot serve as a basis for analysing the stability or otherwise of the determinants of Internet adoption and use over time. The principal originality of this study lies in the fact that it resolved to overcome this limitation by collecting new data in a new survey conducted in 2015. It is thus the first study to analyse the determinants of Internet use based on two individual surveys in Cameroon?, while considering types of equipment (smartphones, tablets, etc.) that enable a person to access the Internet even when mobile. This study's advantage is that it enables a comparative analysis capable of highlighting the stability or otherwise of the relevant determinants in relation to the changes that may have affected them between 2008 and 2015.

3. Data and methodology

Source of data and presentation of variables

Source of data

The data used in this study were obtained from two surveys on the use (by individuals and households) of ICT in Cameroon. The first survey was conducted within the framework of the Inter-university Scientific Cooperation Programme, bringing together the University of Douala (Cameroon), the University of Rennes 1 (France), the Omar Bongo University in Libreville (Gabon), and CEPS/INSTEAD of Luxemburg, on the theme: "Digital divides and social interaction: A comparative analysis of the modes of Internet diffusion and use in Central Africa and Europe". The survey was carried out in 2008. Data were collected from Douala (85.59% of the sample), Buea (9.4% of the sample) and Limbe (4.72% of the sample).

The data were collected about the respondent's socio-economic characteristics (gender, age, languages he/she could speak and read, education level, marital status, income level), his/her sociability (membership of associations, of tontines[7], his/her travels outside the country), his/her possession of computer and electronic equipment (TV, computer, MP3 reader), his/her computer skills, and his/her usage of the mobile telephone, the computer and the Internet.

The second survey was conducted by the Theoretical and Applied Economics Research Group (Groupe de Recherche en Economie Théorique et Appliquée, GRETA) of the University of Douala.[8] It collected data about the same characteristics as the first survey, plus data on the use of smartphones and tablets,[9] which are increasingly being used for Internet adoption and use. This second survey, carried out in 2015, collected data from 2,266 respondents from Douala (39.19% of the sample), Yaoundé (34.47% of the sample), Bafoussam (10.59% of the sample), Limbe (7.90% of the sample), and Buea (7.85% of the sample).[10]

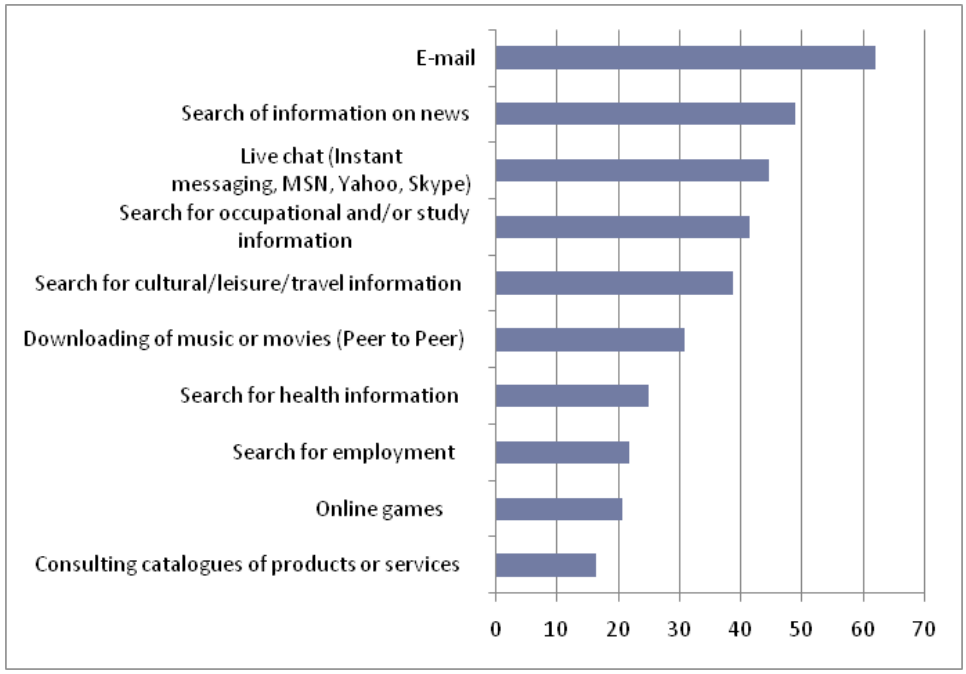
Explained variables

Unlike most of the research which has been done in developed countries, which equates the decision to adopt the Internet with having Internet access at home, this study uses the binary variable "having used the Internet by oneself or having been assisted in using it"

as an indicator of Internet adoption.[11] The choice was adopted because in 2008 less than 2% of the respondents had a computer at home while more than 97% of Internet users had regular access to the Internet outside their homes. This is a dichotomous variable which takes the value 1 for an individual, who chose to have access to the Internet and the value 0 for all the others.

The Internet uses mentioned in the questionnaire to the respondents covered both the Internet services essentially involving pictures (online videos and online games) and those involving sound and text, such as electronic mail, online live discussion and/or participation in a social networking site, search for information on national and international news, search for information on health matters, search for information related to one's job or studies, search for cultural/leisure/travel information, search for jobs, and downloading of music or films (Peer to Peer). Figures 1 and 2 present the most popular Internet services in this study's sample.

Figure 1: Main uses of the Internet in 2008 (% of users)

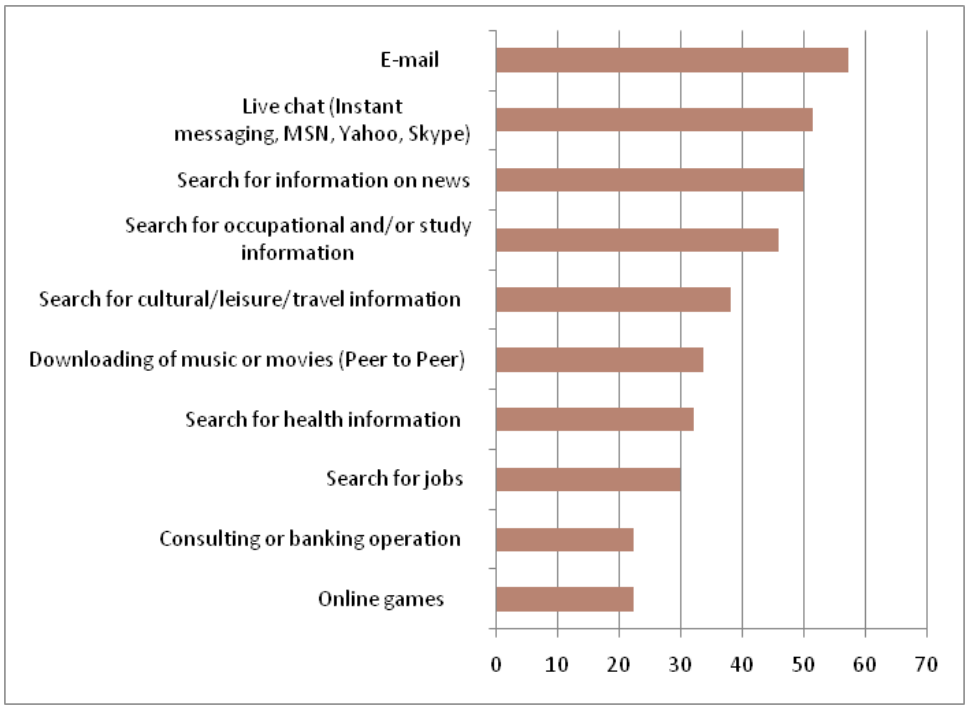


Source: Compiled by the authors

Electronic mail was the most popular Internet use: in the two surveys it was the most popular service, reported to be used by 55% of the respondents over the last 3 months. Overall, that interpersonal communication activities and those of search for information on news and that on studies/jobs were predominant ones,while searching for eGovernment services and consulting catalogues of products or services were the least frequent Internet uses (at rates of 8.01% and 16.25%, respectively, in 2008, and of 16.94% and 22.34% respectively in 2015). This suggests that the demand for Internet services in Cameroon is essentially oriented towards value-added services such as email and the search for news or information on jobs and studies.

Based on the observation that communication and information uses of the Internet are the most-searched services, they can be used as variables of Internet usage. This study therefore used two binary variables that take into account only the services used at a rate of at least 40% by Internet users. The first variable is "communication"; it takes the value 1 if the respondent has used an email and/or has participated in a live Internet chat in the last three months, and takes the value 0 if not. The second variable is "search"; it takes the value 1 if the respondent has done searches about news and/or about his/her job or his/her studies in the last three months, and takes the value 0 if not.

Figure 2: Main uses of the Internet in 2015 (% of users)



Source: Compiled by the authors

Explanatory variables

In this study, the explanatory variables were grouped into three categories: the Internet user's socio-economic characteristics; his/her lifestyle and his/her computer skills; and his/her locality and social environment.[12]

Internet user's socio-economic characteristics

The socio-economic variables were gender, age, income, employment status and education level. The study aimed to see whether the Internet user's profile in Cameroon in relation to these variables in 2015 was different from that in 2008.

Internet diffusion can reduce or increase certain forms of the digital divide in a lasting manner over time. However, it can also deepen certain others for a long time. In relation to the generation gap, one can safely predict that it will reduce gradually and almost naturally as the generations of people with good digital literacy get older. Moreover, while the disparities between men and women persist, they should reduce over time, as has happened in some European countries. However, the variables "employment status" and "education level" are expected to continue to influence Internet use. Specifically, current Internet users in Cameroon probably still belong to the category of human capital and income level that is above that of the average Cameroonian. Moreover, there seems to exist a quasi-linear and static relationship between education level and Internet use.

Regarding the linguistic variable, people with a mastery of English were expected to seek more opportunities for Internet use because of the ever-increasing amount of Internet content that is available in this language (Wunnava and Leite, 2008; Viard and Economides, 2011).

Lifestyle and computer skills

Lifestyle, as a variable in this study, essentially refers to the possession or not of ICT equipment (laptop, television, the "traditional" mobile phone, Smartphone and tablet). Computer skills are represented here by five binary indicators: the ability to use a word processor or a spreadsheet, the ability to install software, the ability to programme an application, having received formal computer training, and having received informal computer training. One expects a positive correlation between Internet adoption and use and the possession of electronic and computer equipment (laptop, the traditional mobile phone, smartphone and tablet). Research has shown that the more of this type of equipment a household has, the more technophile its members are likely to be (Hoffman et al, 1996; Le Guel et al, 2005). However, thanks to its diffusion, the Internet could compete with other forms of leisure such as television and video games. Regarding time constraints, households could strike a balance between logging on to the Internet and watching television. It is thus possible to test the hypothesis of substitutability between the various forms of leisure made available thanks to ICT equipment.

Furthermore, given that the computer remains the principal tool of Internet access, it can be assumed that good computer skills are useful for both access to the Internet and to all its other uses.

Internet user's locality and social environment

Locality here refers to the living standards of the neighbourhood where the user lives. From the simple fact that the residents of a "residential" neighbourhood are more likely to have family members living abroad, it would be reasonable to assume that living in such a neighbourhood is an asset for both Internet access and use, compared to living in a suburban area (Tamokwe, 2013).

The social environment was measured by four indicators: a) having a family member living abroad; b) being a member of a tontine; c) having family members who are Internet users; and d) having several friends who are Internet users. Le Guel et al (2005) have shown that the choice to use the Internet does not depend only on the intrinsic usefulness

of the services to which the Internet gives access, but also on the choices made by others in the user's social environment. Since all the services are affected by network externalities, the satisfaction an individual gets from them is an increasing function of the number of people who use them (Katz and Shapiro, 1985; Pénard, 2002). For example, the use of a tablet or a smartphone will bring more satisfaction at an individual level when a significant number of the users exist in the entire population, particularly in the user's social environment. After all, a person most of whose family members and friends use the Internet will also be encouraged to use it to communicate with them through email, exchanging files, etc. And he/she is likely to benefit from their advice and expertise on how to learn to use the Internet faster. Conversely, if a person's social environment has little access to the Internet, this is likely to continue being an obstacle to Internet use. It is thus expected that the influence of the two variables will be static overtime.

Modelling

This study sought to model the factors that affect Internet adoption and use in Cameroon. Given the binary nature of the explained variables, the use of linear regression models was inappropriate; instead, discrete choice models were used (Maddala, 1983; Gourieroux, 1986). Discrete choice models have already been used by others to analyse the determinants of Internet adoption and use (Le Guel et al, 2005; Tamokwe, 2013; Pénard et al, 2015).

Our study models the choices of Internet adoption by using a Probit model that assumes a normal distribution of error terms. The study assumes that r_i is a dichotomous variable which takes the value 1 if the person adopts the Internet and 0 otherwise. It then considers the following model:

$$r_i = \begin{cases} 1 \, if \, r_i^* = \alpha W_i + u_i > 0 \\ 0 \; if \; not \end{cases}$$

where u_i is the error term that follows a reduced centred normal distribution, W_i represents the explanatory variables, and α the coefficients that will be estimated by maximizing the log likelihood.

To analyse Internet use, two models were used. The first is a Probit model with selection bias correction. There is a link between the adoption of the Internet and the two uses of it, since these uses can only be observed if the individual concerned is indeed an Internet user. So, while the Internet adoption model concerned all the individuals surveyed, the Internet use model only concerned those who declared Internet use (whether by themselves or assisted by someone else). From this point of view, the Internet use model (concerning only "Internet users") could have presented some selection bias. To correct this, we used the two-step method used by Heckman (1976, 1979). At the first step, we applied Probit model to the choice to adopt the Internet (for the entire sample), and then computed, for each one of the households using the Internet, the inverse Mills ratio, which corresponds to the normal probability density function divided by the normal

distribution function. This ratio was then introduced into the Probit model of Internet use as an explanatory variable.[13] The estimated *rho* coefficient, which is associated with the Mills ratio, measures the error correlation between the Internet adoption model and the Internet use model (Maddala, 1983; Breen, 1996). When this coefficient is significantly different from zero, the conclusion is that selection bias exists.

Given that the decisions to adopt the two Internet uses can be linked, the second model is a bivariate Probit one, which enabled us to show a correlation between the error terms of the two equations for Internet use. In other words, it enabled us to show whether the unobserved characteristics which influence the probability to communicate through the Internet also influence the probability to do Internet searches.

In this connection, y_1 is assumed to be a dichotomous variable that takes the value 1 if the individual communicates through the Internet and the value 0 if not, while y_2 is a dichotomous variable which takes the value 1 if the individual does Internet searches and 0 if not, in the following equation:

$$y_1 = \begin{cases} 1 if\ y_1^* > 0 \\ 0\ if\ not \end{cases}$$

$$y_2 = \begin{cases} 1 if\ y_2^* > 0 \\ 0\ if\ not \end{cases}$$

The bivariate Probit model is thus written as follows:

$$\begin{cases} y_1^* = \beta_2 x_2 + \varepsilon_2 \\ y_2^* = \beta_1 x_1 + \varepsilon_1 \end{cases}$$

where y_1^* and y_2^* are two continuous latent variables for which y_1 is observed if and only if $y_1^* > 0$, and y_2 is observed if and only if $y_2^* > 0$. The β_i coefficients are those of the characteristics of individuals x_1 and x_2, while ε_1 and ε_2 are the error terms which are jointly distributed according to a normal law.

4. Results and estimations

Table 2 presents the results of the marginal effects of the Internet adoption model in Cameroon, while Table 3 presents those of the Internet use model. The two models offer an overview of the 2008 data and the 2015 data. Several results can be pointed out.

Impact on Internet adoption

Table 2 shows that, with a few exceptions, several factors that influenced Internet adoption in Cameroon in 2008 also did so in 2015. Indeed, the table shows that the probability of adopting the Internet reduces with age: in relation to the people over 45 years of age, the probability of adopting the Internet increased by 27.7 percentage points in 2015, compared with 16.5 points in 2008 for people below 30 years of age. For people aged between 30 and 44 years, this probability increased by 20.8 points in 2015, compared with 5.9 points in 2008. This result is not surprising because those aged between 15 to 29 years are the young Cameroonians born during a period of full diffusion of the Internet. Likewise, the marginal effects associated with the "education level" variable were higher in 2015 than in 2008. Thus, education level plays a positive role in Internet adoption by increasing the personal and professional benefits that one gets from this adoption (Pénard et al, 2012). In contrast, the gender-related first-level digital divide tends to disappear. Being male, which increased the probability of adopting the Internet by 5.1 percentage points in 2008, did not have a significant effect in 2015. With regard to budget constraints, the results show that the monthly income did not have a significant effect on Internet adoption, probably because of the possibility of accessing the technology through other people (Tamokwe, 2012).

The non-significance of English skills as a determinant of the digital divide related to Internet access can be explained by the specific nature of the Cameroonian context, which is characterized by the use of both English and French as official languages. Employment status had a significant effect on Internet adoption. Specifically, being an executive increased the probability of adopting the Internet by 25 percentage points in 2015, while being unemployed reduced this probability by 10.5 points in 2015. However, being self-employed was not found to have an effect on Internet adoption. These findings can be explained by the fact that executives increasingly have access to the Internet at

their workplace and occupy positions that require Internet use. As for the residential area, while it had a significant effect in 2008, it did not in 2015. The very limited home Internet access seems to have led the inhabitants of residential neighbourhoods to seek Internet access from public spaces (notably cybercafés) and from the residents of densely populated areas.

Table 2: Marginal effects of the simple probit model (the Internet adoption model)

Explanatory variables	Description	2008	2015
Gender	Being male	0.052**	0.061
		(2.38)	(1.20)
Age	15–29 years of age	0.162***	0.277***
Reference: 45 years of age and above		(4.37)	(4.54)
	30–44 years of age	0.059*	0.208***
		(1.67)	(3.72)
Education level			
Reference: primary school level	Lower secondary school	0.038	0.142**
		(0.88)	(2.35)
	Upper secondary school	0.105**	0.277***
		(2.10)	(4.29)
	Secondary school level/ Sec. school level +1 post-sec. school year	0.134*	0.251***
		(1.91)	(3.02)
	Secondary school level +2 post-sec. school years	0.179**	0.494***
		(2.03)	(6.81)
	Secondary school level +3 post-sec. school years or more	0.310***	0.452***
		(3.02)	(5.92)
Education level			
Reference: having a stable income	Middle income	-0.034	-0.031
		(1.15)	(0.40)
	High income	-0.027	-0.125
		(0.51)	(0.98)
Employment status	Self-employed	0.006	-0.080
		(0.18)	(1.32)
Employment status	Executive	0.139	0.250*
		(1.24)	(1.81)
Employment status	Unemployed	-0.040	-0.173**
		(1.26)	(2.67)
Having family members abroad	Having family members abroad	0.033	0.063
		(1.51)	(1.33)
The residential area's living standards	Medium living standards	0.077**	0.145
		(2.10)	(1.40)
Reference: low standards			
	High living standards	0.005	-0.120
		(0.07)	(0.64)
English	Competent user of English	0.034	0.062
		(1.53)	(1.27)
Laptop	Having a laptop	-0.036	-0.044

		(1.00)	(0.71)

continued next page

Table 2 Continued

Explanatory variables	Description	2008	2015
Internet	Having access to the Internet	0.358** (2.16)	0.121** (2.06)
Television	Having a television set	0.071 (0.71)	-0.015 (0.17)
Telephone	Having a traditional mobile phone	0.113*** (5.53)	0.145 (0.77)
Tablet	Having a tablet	……	0.296*** (3.99)
Smartphone	Having a smartphone	……	-0.006 (0.09)
Computer training	Formal training	0.090** (2.43)	0.072 (0.95)
Computer training	Informal training	0.338*** (6.74)	0.393*** (8.24)
Computer skills	Spreadsheet	0.196*** (5.13)	0.207** (2.55)
Computer skills	Software	0.071 (1.37)	0.380*** (2.83)
Computer skills	Programming	-0.005 (0.11)	0.084 (0.66)
Internet use by family members	Family members use the Internet	0.394*** (17.71)	0.51***1 (12.93)
Internet use by friends	Several friends use the Internet	0.200*** (6.53)	0.298*** (6.71)
Membership of a tontine	Being a member of tontines	-0.057** (2.30)	-0.176*** (3.66)
Number of observations		2187	1244

…: the variable is not used in the econometric model CHANGE THIS SYMBOL FOR CLARITY?
(.): Wald test; ***: significant at less than 1%; **: significant at less than 5%; *: significant at less than 10%

Concerning the ICT-related variables, the results show that behaviour that is technophile from the start is a strong motivation for Internet adoption: several studies (e.g., Le Guel et al, 2005; Pénard et al, 2012) have reported a link between the decision to have Internet access and the possession of ICT equipment such as traditional mobile phones and tablets. However, with the arrival of equipment that is more compatible with Internet technology, the possession of a traditional mobile phone, which had a significant effect in 2008, did not have any in 2015.

The study also found that the probability of using the Internet rose when people had computer skills: Table 2 shows that the ability to use desktop application software (for word processing or spreadsheet) increased the likelihood of adopting the Internet by 20.7

points in 2015, against 19.6 points in 2008. The same was observed about the ability to install software: this influenced Internet adoption by 38 points in 2015. However, having programming skills did not have any significant effect on Internet adoption.

Regarding the effect of social environment on the probability of someone adopting the Internet, this probability rose by 50 points in 2015, against 39.4 points in 2008, for the people who declared having family members who used the Internet; it rose by 29.8 points in 2015, against 20 points in 2008, for those who had many friends using the Internet. These results indicate that there are network externalities between friends (Goolsbee and Zittrain, 1999; Coneus and Schleife, 2010). However, being a member of a tontine reduced the probability of adopting the Internet by 17.6 points in 2015, against 5.7 points in 2008, while having a family member abroad did not have any effect on the decision to adopt the Internet.

Impact on Internet use

In relation to the determinants of Internet use, the results analysed in this study are those of the bivariate Probit model. The rho coefficient (associated with the inverse Mills ratio) was not significant for information search (in 2008) and for the two categories of Internet use (in 2015), a finding which rejects the hypothesis of the existence of selection bias (see Annex 4). However, the correlation coefficient (ρ) for the errors of the bivariate probit was significantly different from zero for the two dates under study, confirming the interdependence between communication and Internet search. The positive sign for this coefficient means that the unobserved characteristics that positively influence the probability of communicating through the Internet also positively influence the probability of doing Internet searches.

As in the case of the Internet adoption model, several factors that influenced Internet use in Cameroon in 2008 did so in 2015 as well. Whether it is for 2008 or for 2015, the bivariate Probit model shows that Internet use increased for the variables gender, age, education level, computer skills, and computer training (whether formal or informal). Specifically, respondents with a lower education level, older respondents, and female respondents were less likely to engage in Internet communication and search for information. This finding confirms those reported in other studies (e.g.,Tamokwe, 2013; Fambeu and Bakehe, 2015; Pénard et al, 2015), according to which age was negatively correlated, while education level was positively correlated, with activities of Internet communication and search.

However, some big changes were recorded between the two dates. For example, being male increased the probability of adopting Internet communication by 7.4 points in 2015, against only 1.1 points in 2008. Similarly, compared to the respondents with just a primary-school education level, the probability of adopting Internet communication for those with an upper-secondary school level rose by 7.9 points in 2015, against only 4.1 points in 2008; for the respondents with a secondary school level plus two years of post-secondary education, the probability rose by 24 points in 2015, against only 8.5 in 2008; for those with at least a Bachelor's degree, it rose by 19.7 points in 2015, against only 14.8 points in 2008. The same probability increased by 12.6 points in 2015, against 5.4 points in 2008, for the respondents below 30 years of age; for those aged between 30 and 44, it rose by 5.3 points in 2015, against 2.2 points in 2008. A possible explanation

for this latter discrepancy is that the majority of the respondents aged between 15 and 29 years were students, either at secondary school or post-secondary school level.

Table 3: Marginal effects of the bivariate Probit model (the Internet use model)

Explanatory variables	Description	2008		2015	
		Communication	Internet search	Communication	Internet search
Gender	Being male	0.011*	0.018**	0.074***	0.069***
		(1.78)	(2.75)	(3.38)	(3.13)
Age	15–29 years of age	0.054***	0.042***	0.126***	0.081**
Reference: 45 years of age and above		(3.01)	(2.83)	(3.03)	(2.34)
	30–44 years of age	0.022*	0.019*	0.053*	0.034
		(1.75)	(1.79)	(1.77)	(1.44)
Education level	Lower secondary school	0.009	0.014	0.019	0.005
Reference variable: primary school level		(0.56)	(0.81)	(0.55)	(0.21)
	Upper secondary school	0.041*	0.047*	0.079*	0.026
		(1.73)	(1.68)	(1.65)	(0.80)
	Secondary school / Sec. school +1 post-sec. sch. year	0.083*	0.113*	0.086	0.047
		(1.87)	(1.89)	(1.49)	(1.07)
	Secondary school +2 post-sec. sch. years	0.085*	0.139*	0.240**	0.146*
		(1.72)	(1.91)	(2.40)	(1.75)
	Secondary school +3 post-sec. sch. years or more	0.148**	0.177**	0.197**	0.010
		(2.24)	(2.18)	(2.29)	(1.52)
Education level	Middle income	-0.002	-0.004	-0.004	-0.004
Reference: having a stable income		(0.21)	(0.66)	(0.14)	(0.18)
	High income	0.012	-0.002	-0.032	-0.011
		(0.60)	(0.28)	(0.99)	(0.42)
Employment status	Self-employed	-0.002	-0.006	0.031	0.019

		(0.20)	(0.90)	(1.11)	(0.95)

continued next page

Table 3 Continued

Explanatory variables	Description	2008		2015	
		Communication	Internet search	Communication	Internet search
Employment status	Executive	0.065 (1.51)	0.066 (1.64)	0.099 (1.35)	0.058 (1.11)
Employment status	Unemployed	-0.014 (1.55)	-0.008 (1.15)	-0.071*** (2.93)	-0.054** (2.67)
Having family members abroad	Having family members abroad	0.009 (1.48)	0.006 (1.20)	0.000 (0.00)	-0.006 (0.40)
The residential area's living standards: *Reference: low standards*	Medium living standards	0.019* (1.74)	0.007 (1.07)	-0.010 (0.31)	0.014 (0.49)
	High living standards	-0.020** (2.06)	-0.013 (1.43)	-0.036 (0.89)	-0.026 (1.06)
English	Competent user of English	0.014** (2.00)	0.002 (0.47)	0.005 (0.24)	0.005 (0.35)
Laptop	Having a laptop	0.011 (0.85)	0.017 (1.31)	0.064** (2.31)	0.053** (2.28)
Internet	Having access to the Internet	-0.000 (0.00)	0.010 (0.45)	0.057** (2.21)	0.039** (1.94)
Television	Having a television set	-0.003 (0.16)	-0.007 (0.73)	0.025 (0.91)	-0.003 (0.14)
Telephone	Having a traditional mobile phone	0.021*** (2.80)	0.014** (2.37)	-0.015 (0.12)	-0.033 (0.30)
Tablet	Having a tablet	.....	.....	0.067*	0.047

		(1.72)	(1.58)

continued next page

Table 3 Continued

Explanatory variables	Description	2008		2015	
		Communication	Internet search	Communication	Internet search
Smartphone	Having a smartphone	.....	.....	-0.009 (0.41)	-0.002 (0.15)
Computer training	Formal training	0.005 (0.66)	0.016* (1.86)	0.106*** (3.05)	0.083** (2.72)
Computer training	Informal training	0.032** (2.48)	0.025** (2.35)	0.127*** (4.25)	0.110*** (3.44)
Computer skills	Spreadsheet	0.038** (2.77)	0.028** (2.56)	0.095** (2.69)	0.078** (2.59)
Computer skills	Software	-0.003 (0.41)	0.006 (0.69)	-0.010 (0.36)	0.003 (0.13)
Computer skills	Programming	0.040* (1.85)	0.022 (1.52)	0.040 (1.05)	0.031 (1.06)
Internet use by family members	Family members use the Internet	0.140*** (9.16)	0.094*** (6.90)	0.182*** (8.68)	0.142*** (7.46)
Internet use by friends	Several friends use the Internet	0.052*** (3.42)	0.029*** (2.86)	0.088*** (3.62)	0.063** (3.00)
Membership of a tontine	Being a member of tontines	0.001 (0.22)	-0.002 (0.37)	-0.056** (2.73)	-0.029* (1.82)
Number of observations		2206	1244		

…: the variable is not used in the econometric model
(.): Wald test; ***: significant at less than 1 %; **: significant at less than 5 %; *: significant at less than 10 %.

This means that they were most certainly urged by their teachers to have access to the Internet to search for information or to be able to communicate with others. As for the older respondents, while some of them found the Internet difficult to understand and use, others were not informed of the opportunities offered by this innovation.

Furthermore, while the probability of communicating through the Internet and that of doing Internet searches were not significant in 2008, they increased by 6.4 and 5.3 points, respectively, in 2015, for the respondents possessing a laptop. Possessing a tablet was also found to have a positive effect on Internet communication. The study further found that possessing a traditional mobile phone had a positive effect only for the first period (2008), while having access to the Internet had a ripple effect only for the second period (2015). However, no difference in behaviour was observed between the respondents possessing a television or a smartphone and those who did not.

With regard to the impact of the user's social environment on Internet behaviour, the study found that irrespective of the period of study, the respondents "surrounded" by Internet users (that is those most of whose family members and friends used the Internet) had a higher probability of engaging in both Internet communication and search activities. Regarding Internet communication, this probability increased by 18.2 points in 2015, against 14 points in 2008, for the respondents whose family members used the Internet, and by 8.8 points in 2015, against 5.2 points in 2008, for those who reported having several friends who used the Internet. It thus seems that Internet use follows a diffusion logic, from family member to family member and friend to friend, by social contagion effects. However, whether it was in 2008 or in 2015, having a family member living abroad had no effect on the decision to use the Internet. This suggests that when one has a family member living abroad, the telephone seems to be a more practical tool than the Internet for maintaining relationships.

Moreover, budgetary constraints were not found to be a determinant of Internet adoption or use (irrespective of the year studied). It can be deduced from this finding that in Cameroon the benefits which the well-to-do get from using the Internet are not significantly more important than those of the less well-to-do. Tamokwe (2013) has explained this finding by the fact that, despite the existence of income inequality, although the purchasing power in Cameroon remains low overall, many information goods can only be obtained more effectively through the Internet. So, Internet use in the country is necessary if, for example, one wants to get some international information quickly, whether one is well of for not.

The non-significance of competence in English in 2015 shows once Internet access is possible, each user communicates and conducts Internet searches first in his/her first working language. Regarding the residential area variable, in 2015 there was no longer any significant difference between the people living in popular neighbourhoods and those living in the affluent ones. This finding can be explained by the very low number of people who had Internet access from their homes, which led to the residents of affluent neighbourhoods using public spaces (cybercafés), just like residents of popular neighbourhoods.

Table 4 summarizes all the results obtained from both the Internet adoption and

Internet use models, highlighting the changes observed in the explanatory factors between 2008 and 2015. The direction of the variation in the coefficients of the marginal effects determines whether the digital divide decreased or increased.

Table 4: Summary of the key determinants of Internet adoption and use and of the signs of their coefficients between 2008 and 2015

Factors	Internet adoption			Internet use		
	2008	2015	Direction of the variation in the coefficient of marginal effects	2008	2015	Direction of the variation in the coefficient of marginal effects
Motivating factors	Being male		+	Being male	Being male	+
	Aged below 45	Aged below 45	+	Aged below 45	Aged below 45	+
	Education level higher than primary school	Education level higher than primary school	+	Education level higher than primary school	Education level higher than primary school	+
	Having formal computer training	Having formal computer training	+	Having formal computer training	Having formal computer training	+
	Family members use the Internet	Family members use the Internet	+	Family members use the Internet	Family members use the Internet	+
	Several friends use the Internet	Several friends use the Internet	+	Several friends use the Internet	Several friends use the Internet	+
	Having computer skills (word processing / spreadsheet)	Having computer skills (word processing / spreadsheet)	-	Having computer skills (word processing / spreadsheet)	Having computer skills (word processing / spreadsheet)	+
	Possession of a traditional mobile		-	Possession of traditional mobile		-

	phone			phone		

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Table 4 Continued

Factors	Internet adoption			Internet use		
	2008	**2015**	**Direction of the variation in the coefficient of marginal effects**	**2008**	**2015**	**Direction of the variation in the coefficient of marginal effects**
Motivating factors		Possession of a tablet			Possession of a tablet	
	Having access to the Internet	Having access to the Internet	-		Having access to the Internet	+
Impeding factors	Being a member of a tontine	Being a member of a tontine	-			
Neutral factors	Income level	Income level		Income level	Income level	
	Having a family member	Having a family member		Having a family member	Having a family member	

	living abroad	living abroad
living abroad	living abroad	

The predominance of positive signs in the variation in the coefficients of marginal effects of the factors that motivate Internet adoption and use shows that the first-level and second-level digital divides continue to worsen and that there is a risk that they will last for a long time. This risk is all the more worrying because the Internet plays an ever increasing role in daily life.

5. Conclusion and policy recommendations

The aim of this study was to analyse the stability, over time, of the factors that motivate or impede Internet adoption and use in Cameroon. The study found the following: except for factors such as the possession of a traditional mobile phone or being unemployed, most of the determinants of Internet adoption and use in 2008 had a significant effect even in 2015. So, whether it was in 2008 or 2015, the key determinants were gender (being male), education level, age (being below 45 years of age), computer skills, and social environment (having Internet users among one's social network). Moreover, the coefficients associated with marginal effects for most of these factors increased over time in the two models (of Internet adoption and the Internet use). This shows that in the future the digital divides will occur more in terms of Internet use than of Internet adoption.

The main reasons given by the respondents who reported not having used the Internet in 2015 were: no interest/little interest/no interesting content (34.21%, which is a big decline from 2008, when the rate was 47.81%); too expensive (7.61%, which is a big decline from 2008, when the rate was 12.37%), and lack of support (11.47%, which is an increase from 2008, when the rate was 10.30%).

To give to each Cameroonian the possibility of creating, using and sharing information so that he/she can achieve his/her full potential, this study made two types of recommendations. The first aims to act to change the slow pace of the development of Internet use in Cameroon by fostering competition. The second proposes a plan aimed at mass Internet use in Cameroon.

Fostering competition

The lack of basic broadband infrastructure is an impediment to the development of Internet use in Cameroon and constitutes an entry barrier for Internet service providers who are thus faced with severe technical constraints. For investment in this sector to increase, the country must attract potential operators. To this effect, a conducive environment must be created to attract investors and guarantee them a market.

In view of the challenge of attracting the big investments to be made and to their long-term profitability, a public–private partnership approach is recommended. Such partnership could take the form of a consortium of basic infrastructure development bringing together public and institutional stakeholders and private ones. These

stakeholders would pool their technical and financial resources and their expertise to quickly develop basic infrastructure in Cameroon. This quick development would in turn have a triple effect: it would provide broadband telecommunication services to a large majority of the population; it would increase the amount of service provision; and it would enable a change from competition based on infrastructure to that based on services. An expected consequence of this increased competition would be a faster reduction in the rates charged to the end users, as these users would benefit from the resultant lower prices for broadband connection leasing. To stimulate demand, it would be necessary to also stimulate the creation of services that are adapted to the local needs. There will indeed be no mass Internet use as long as services tailored to the needs of the Cameroonian people have not been created. It can be envisaged that a national plan for the development of local content can be devised under the coordination of the National Agency for Information and Communication Technology. This would be a plan that covered all the areas where ICT is key, namely agriculture, health, education, culture, trade and public administration.

Developing and implementing a plan for mass Internet use

For Cameroon to avoid being obliged to develop "Internet literacy" programmes for its population in the near future, this study recommends that "a reverse funnel" scheme, similar to the "Reverse Funnel" system proposed[14] by the UIT [ITU] (2013), should be launched. This would enable the country, in a few years to come (10 years at the maximum), to have more than 70% of its population using the Internet.

The reverse funnel system we are recommending for Cameroon should comprise setting up an ICT teaching programme throughout the educational system. An ICT ratio (the number of computers for X students) would have to be defined for each teaching institution.

The scheme could start at the higher-education level. A two-to-three-year timeline would be required for all the higher education institutions (whether public or private) to have started the programme. After the three years, the scheme would be launched at the secondary school level. Secondary schools would be given a three-to-four-year deadline to have embarked on implementing the scheme. Finally, the scheme would reach the primary school level; schools would be given three to five years to have implemented it.

At the same time, a special programme should be designed for women, the elderly and school dropouts. Such a programme would be implemented at adult learning centres and at cooperatives and other similar forums. In the same vein, trade associations should have a multimedia centre in each region or big town to enable their members to have access to ICT.

The Cameroonian reverse funnel system could be financed through a partnership between all the interested stakeholders: the government, which is the guarantor of the collective well-being, and its partners, namely the telecommunication services operators and providers and the national electricity company. The government is expected to be the principal stakeholder, as it would intervene through several ministries: Education (Higher Education, Secondary Education, Basic Education), Finance, and Posts and Telecommunications.

The Ministry of Education would be responsible for the supervision of the scheme. In consultation with the Ministry of Posts and Telecommunications, they would develop the criteria for choosing the educational institutions that would benefit from the scheme. They would also coordinate scheme-launching activities.

The Ministry of Posts and Telecommunications would intervene in the scheme through a universal service fund that would finance the connection of certain localities and, to a lesser extent, the terminal equipment connection.

The ministry of Finance would take part in the scheme by passing laws of partial or total tax exemption on the equipment bought by operators and users joining the scheme. The Ministry could also exempt from value-added tax, and for a fixed period, the income from the business generated by the scheme.

The telecommunication services operators and providers would play an essential role in the running of this scheme. A feasibility study would clearly indicate their respective interests in their participation in the scheme. Incentives should be given to these operators and service providers to encourage them to participate in it. These operators and service providers would in turn install Internet connections and could contribute to the financing of Internet use equipment depending on which economic aspect of the programme they were interested in.

Even though the measures recommended above can considerably reduce the digital divide, they require certain preconditions, such as access to energy and the existence of basic infrastructure. However, in Cameroon, as in many other developing countries, urban populations have greater access to electricity than those in rural areas. The private monopoly in the electricity sector, obsolete equipment, technical failures and fraud, are all factors that limit access to electricity in the towns and, even more so, in the rural areas of Cameroon. This state of affairs is evidence of the difficulties the country's population have in getting connected to the information society, hence the need for the national company in charge of electricity production and distribution to also take part in the scheme. All in all, the Cameroon government should consider all these infrastructural requirements, as they are crucial to effective implementation of all its future policies aimed at reducing the digital divide.

Notes

1. See ANTIC (2007) for more details concerning these laws.
2. Created by the presidential decree No. 98/198 of 8 September 1998, CAMTEL is a publicly owned company, a legal entity with financial autonomy.
3. Nexttel is the commercial name of Viettel Cameroun S.A. [Viettel Cameroon, plc], the holder of the third licence for mobile telephony in the country.
4. This demand does not cover that for access to mobile Internet.
5. According to the ART, the most profitable ISPs are those that have specialized in offers for business customers, while those that have specialized in residential offers have recorded the worst performance.
6. However, the same survey suffered from significant bias because the respondents were all Internet users who had volunteered to fill in an online questionnaire (Le Guel et al, 2005).
7. Tontines are associations of people who contribute money to a common fund to be used for savings or loans. They are very popular in Cameroon. Belonging to a tontine is a marker of social capital.
8. The 2008 survey was conducted with the financial support of the Agence Universitaire de la Francophonie (AUF) [the French-speaking countries' University Agency] while the 2015 survey was conducted with the financial support of the African Economic Research Consortium (AERC).
9. In 2008 smartphones and tablets were uncommon in Cameroon.
10. For consistency in the comparative analysis, data collected from only Douala, Limbe and Buea are included in this study.
11. In the research on the digital divide in Africa, some authors have represented the notion of Internet adoption with the fact of "having used the Internet in the last three months" (see, e.g.,Mukoko, 2012; Tamokwe, 2013; Pénard et al, 2015).
12. The descriptive statistics for the explanatory variables are presented in Annex 1.
13. See Van De Ven and Van Praag (1981) for a detailed presentation.
14. The "reverse funnel" system was proposed by the International Communication Union (see IUT, 2013) as part of an educational system containing a course on introduction to computer science at all levels of education. The system is designed to start with the university level and spread downwards to primary school level, hence its name "reverse funnel".

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Annexes

Annex 1: Descriptive statistics for the explanatory variables

Variable	Definition	2008					2015				
		Obser-vations	Mean	SD	Min	Max	Obser-vations	Mean	SD	Min	Max
Male	Being male	2,595	0.5433	0.4982	0	1	2,262	0.5221	0.4996	0	1
Age: 15–29 years	Aged 15–29 years	2,616	0.4392	0.49638	0	1	2,266	0.3923	0.4883	0	1
Age: 30–44 years	Aged 30–44 years	2,616	0.3161	0.4650	0	1	2,266	0.3654	0.4816	0	1
Age: 45+	Aged 45 years and more	2,616	0.2446	0.4299	0	1	2,266	0.2352	0.4242	0	1
Primary school	Primary school education level	2,563	0.1814	0.3854	0	1	2,266	0.1946	0.3959	0	1
Lower-secondary school	Lower-secondary school education level	2,563	0.3472	0.4761	0	1	2,266	0.2581	0.4377	0	1
Upper-secondary school	Upper-secondary school education level	2,563	0.2532	0.4349	0	1	2,266	0.1941	0.3956	0	1
Sec. school/Sec. school + 1 year of post-sec. school	Secondary school/Sec. school + 1 year of post-sec. school	2,563	0.0823	0.2749	0	1	2,266	0.1235	0.3291	0	1
Sec. school + 2 years of post-sec. school	Secondary school + 2 years of post-sec. school	2,563	0.0542	0.2265	0	1	2,266	0.0586	0.2351	0	1
Sec. school + 3 years of post-sec. school or more	Bachelor's degree or more	2,563	0.0815	0.2737	0	1	2,266	0.1244	0.3301	0	1
Low income	A respondent's income is low if it is lower than or equal to CFAF 100,000 per month.	2,579	0.8162	0.3873	0	1	2,266	0.5926	0.4914	0	1

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Annex 1 Continued

Variable	Definition	2008					2015				
		Observations	Mean	SD	Min	Max	Observations	Mean	SD	Min	Max
Middle income	A respondent's income is middle if it is between CFAF 101,000 and 200,000.	2,579	0.1469	0.3541	0	1	2,266	0.1363	0.3432	0	1
High income	A respondent's income is high if it is higher than CFAF 200,000.	2,579	0.0368	0.1883	0	1	2,266	0.0679	0.2517	0	1
Self-employed	A respondent is considered self-employed if he/she is an entrepreneur, an artisan, a business man/woman, or practices a liberal profession.	2,650	0.3467	0.4760	0	1	2,266	0.2400	0.4272	0	1
Executive	A respondent is considered executive if he/she is in (middle or senior) management in the private sector	2,650	0.0286	0.1669	0	1	2,266	0.0423	0.2014	0	1
Unemployed	A respondent is considered inactive if he/she is unemployed.	2,600	0.4138	0.492	0	1	2,266	0.4479	0.4973	0	1
Has got family members abroad	At least one member of his/her family lives abroad.	2,551	0.5695	0.4952	0	1	2,266	0.5679	0.4954	0	1
Low income	Low income means that the respondent lives in a "popular" neighbourhood.	2,588	0.8508	0.3563	0	1	2,266	0.8040	0.3970	0	1
Middle income	Middle income means that the respondent lives in a "residential" neighbourhood.	2,588	0.1402	0.3473	0	1	2266	0.1751	0.3802	0	1
High income	High income means that the respondent lives in an "affluent" neighbourhood.	2,588	0.0088	0.0938	0	1	2266	0.0207	0.1425	0	1
Competent user of English	Competent user of English means that the respondent has a mastery of only English.	2,624	0.560	0.4963	0	1	2266	0.4510	0.4977	0	1
Laptop	Laptop means that the respondent possesses a laptop.	2,650	0.0584	0.2347	0	1	2266	0.3111	0.4630	0	1
Internet	Internet means that the respondent has	2,584	0.0135	0.1156	0	1	2266	0.2978	0.4574	0	1

access to the Internet.

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Annex 1 Continued

Variable	Definition	2008					2015				
		Obser-vations	Mean	SD	Min	Max	Obser-vations	Mean	SD	Min	Max
Television	Television means that the respondent possesses at least one TV set.	2,613	0.0164	0.12724	0	1	2266	0.9165	0.2765	0	1
Telephone	Telephone means that the respondent possesses at least one traditional mobile phone.	2,608	0.7952	0.4035	0	1	2266	0.9660	0.1812	0	1
Tablet	Tablet means that the respondent possesses at least one tablet.				0	1	2266	0.1469	0.3541	0	1
Smartphone	Smartphone means that the respondent possesses at least one smartphone.				0	1	2266	0.2819	0.4500	0	1
Formal training	Formal training means that the respondent has had formal computer training.	2,614	0.2302	0.4211	0	1	2266	0.2947	0.4560	0	1
Informal training	Informal training means that the respondent has had informal computer training.	2,613	0.1664	0.3725	0	1	2266	0.3654	0.4816	0	1
Text/Spreadsheet	Text/spreadsheet means that the respondent is able to use a word processor or spreadsheet.	2,614	0.3075	0.4615	0	1	2266	0.2705	0.4443	0	1
Software	Software means that the respondent is able to install software.	2,610	0.1386	0.3456	0	1	2266	0.1615	0.3680	0	1
Programming	Programming means that the respondent is able to programme an application.	2,608	0.0962	0.2949	0	1	2266	0.1156	0.3198	0	1
Use by family members	Use by family friends means that most of the respondent's family members use the Internet.	2,650	0.5498	0.4976	0	1	2266	0.7109	0.4534	0	1
Use by friends	Use by friends means that most of the respondent's friends use the Internet.	2,650	0.3181	0.4658	0	1	2266	0.4708	0.4992	0	1
Tontine	Tontine takes the value 1 if the respondent belongs to at least one tontine.	2,650	0.5086	0.5000	0	1	2266	0.4660	0.4989	0	1

Annex 2: The determinants of Internet adoption: the Probit model

Explanatory variables	Description	2008	2015
Gender	Being male	0.241**	0.154
		(2.36)	(1.20)
Age	15–29 years of age	0.702***	0.709***
Reference: 45 years of		(4.66)	(4.34)
age and above	30–44 years of age	0.254*	0.527***
		(1.77)	(3.65)
Education level	Lower secondary school	0.169	0.358**
Reference: primary		(0.90)	(2.33)
school level	Upper secondary school	0.427**	0.714***
		(2.26)	(4.01)
	Secondary school / Sec. school +1 post-sec. sch. year	0.496**	0.646***
		(2.22)	(2.82)
	Secondary school +2 post-sec. sch. years	0.626**	1.577***
		(2.44)	(3.61)
	Secondary school +3 post-sec. sch. years or more	0.994***	1.313***
		(3.66)	(4.12)
Education level	Middle income	-0.163	-0.078
Reference: having a		(1.08)	(-0.40)
stable income	High income	-0.132	-0.324
		(0.47)	(-0.93)
Employment status	Self-employed	0.025	-0.204
		(0.18)	(-1.31)
Employment status	Executive	0.503	0.648*
		(1.48)	(1.65)
Employment status	Unemployed	-0.187	-0.443**
		(1.24)	(-2.62)
Having family members abroad	Having family members abroad	0.151	0.160
		(1.49)	(1.33)
The residential area's living standards:	Medium living standards	0.313**	0.366
Reference: low standards		(2.35)	(1.37)
	High living standards	0.027	-0.313
		(0.07)	(-0.61)
English	Competent user of English	0.159	0.156
		(1.51)	(1.27)
Laptop	Having a laptop	-0.181	-0.112
		(0.91)	(-0.70)
Internet	Having access to the Internet	1.087***	0.305**
		(2.59)	(2.05)
Television	Having a television set	0.279	-0.038
		(0.80)	(-0.17)

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Annex 2 Continued

Explanatory variables	Description	2008	2015
Telephone	Having a traditional mobile phone	0.638 *** (4.62)	0.382 (0.72)
Tablet	Having a tablet	……	0.774*** (3.59)
Smartphone	Having a smartphone	……	-0.015 (-0.09)
Computer training	Formal training	0.369*** (2.68)	0.180 (0.95)
Computer training	Informal training	1.118*** (8.21)	1.039*** (7.29)
Computer skills	Spreadsheet	0.767*** (5.94)	0.524** (2.47)
Computer skills	Software	0.289 (1.52)	1.037** (2.24)
Computer skills	Programming	-0.024 (0.11)	0.211 (0.66)
Internet use by family members	Family members use the Internet	1.916*** (13.17)	1.489*** (9.83)
Internet use by friends	Several friends use the Internet	0.784*** (7.91)	0.767*** (6.41)
Membership of a tontine	Being a member of tontines	-0.261** (2.34)	-0.448*** (-3.59)
Constant		-4.289*** (13.29)	-3.219*** (-5.27)
Number of observations		2,187	1,244
Likelihood log	Log (L)	-458.87602	-574.0293

….: the variable is not used in the econometric modelWHY NOT USE "-"?

(.): Wald test; ***: significant at less than 1 %; **: significant at less than 5 %; *: significant at less than 10 %.

Annex 3: The determinants of Internet use: the bivariate Probit model

Explanatory variables	Description	2008		2015	
		Internet communication	Internet search	Internet communication	Internet search
Gender	Being male	0.189* (1.94)	0.389*** (3.87)	0.467*** (3.73)	0.624*** (4.84)
Age *Reference: 45 years of age and above*	15–29 years of age	0.774*** (4.70)	0.770*** (4.46)	0.685*** (3.62)	0.630*** (3.05)
	30–44 years of age	0.319** (2.14)	0.345** (2.25)	0.329* (1.87)	0.302 (1.57)
Education level *Reference: primary school level*	Lower secondary school	0.140 (0.58)	0.264 (0.87)	0.120 (0.57)	0.047 (0.21)
	Upper secondary school	0.526** (2.23)	0.682** (2.28)	0.422* (1.92)	0.220 (0.91)
	Secondary school/secondary school +1 post-sec school year	0.753*** (2.97)	1.022*** (3.24)	0.441* (1.80)	0.354 (1.34)
	Secondary school +2 post-sec. sch. years	0.751*** (2.76)	1.118*** (3.40)	0.950*** (3.28)	0.808** (2.68)
	Secondary school +3 post-sec. school years or more	1.067*** (3.96)	1.299*** (3.99)	0.841*** (3.06)	0.630** (2.17)
Education level *Reference: having a stable income*	Middle income	-0.031 (0.21)	-0.096 (0.63)	-0.027 (-0.14)	-0.034 (-0.18)
	High income	0.168 (0.70)	-0.062 (0.27)	-0.239 (-0.84)	-0.111 (-0.39)
Employment status	Self-employed	-0.027 (0.20)	-0.125 (0.91)	0.189 (1.16)	0.174 (1.02)

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Annex 3 Continued

Explanatory variables	Description	2008		2015	
		Internet communication	Internet search	Internet communication	Internet search
Employment status	Executive	0.621** (2.44)	0.717*** (2.89)	0.483* (1.72)	0.413 (1.47)
Employment status	Unemployed	-0.241 (1.62)	-0.182 (1.18)	-0.484*** (-2.93)	-0.548*** (-3.18)
Having family members abroad	Having family members abroad	0.154 (1.54)	0.125 (1.22)	0.000 (0.00)	-0.053 (-0.40)
The residential area's living standards: *Reference: low standards*	Medium living standards	0.259** (2.28)	0.144 (1.25)	-0.068 (-0.30)	0.123 (0.54)
	High living standards	-0.562 (1.28)	-0.403 (0.97)	-0.286 (-0.72)	-0.321 (-0.82)
English	Competent user of English	0.239** (2.18)	0.053 (0.46)	0.031 (0.24)	0.048 (0.36)
Laptop	Having a laptop	0.161 (0.99)	0.280* (1.76)	0.361** (2.70)	0.419*** (3.11)
Internet	Having access to the Internet	-0.001 (0.00)	0.181 (0.53)	0.331** (2.54)	0.327** (2.47)
Television	Having a television set	-0.044 (0.15)	-0.184 (0.61)	0.180 (0.81)	-0.032 (-0.14)
Telephone	Having a traditional mobile phone	0.443*** (3.05)	0.364** (2.43)	-0.090 (-0.13)	-0.259 (-0.36)
Tablet	Having a tablet	.....	.....	0.359** (2.08)	0.361** (2.06)

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Annex 3 Continued

Explanatory variables	Description	2008		2015	
		Internet communication	Internet search	Internet communication	Internet search
Smartphone	Having a smartphone	……	……	-0.057 (-0.40)	-0.022 (-0.15)
Computer training	Formal training	0.085 (0.69)	0.296** (2.39)	0.548*** (3.87)	0.587*** (4.12)
Computer training	Informal training	0.409*** (3.66)	0.398*** (3.50)	0.664*** (5.43)	0.771*** (5.87)
Computer skills	Spreadsheet	0.514*** (4.32)	0.482*** (3.97)	0.494*** (3.32)	0.564*** (3.79)
Computer skills	Software	-0.060 (0.39)	0.115 (0.76)	-0.067 (-0.35)	0.026 (0.13)
Computer skills	Programming	0.460*** (2.79)	0.347** (2.15)	0.227 (1.19)	0.249 (1.28)
Internet use by family members	Family members use the Internet	1.937*** (7.07)	1.697*** (6.52)	1.564*** (5.49)	1.808*** (3.87)
Internet use by friends	Several friends use the Internet	0.653*** (6.78)	0.496*** (5.00)	0.534*** (4.09)	0.551*** (4.12)
Membership of a tontine	Being a member of tontines	0.025 (0.22)	-0.043 (0.37)	-0.367*** (-2.81)	-0.277** (-2.00)
Constant		-4.939*** (11.46)	-4.944*** (10.69)	-3.902*** (-4.90)	-4.015*** (-4.44)
Number of observations		2206		1244	
Likelihood log	Log (L)	-726.0262		-396.39581	
rho		0.9797036***		16.40e-10*	

…: the variable is not used in the econometric model
(.): Wald test; ***: significant at less than 1 %; **: significant at less than 5 %; *: significant at less than 10 %.

Annex 4: The determinants of Internet use: the bias correction model

Explanatory variables	Description	2008		2015	
		Internet communication	Internet search	Internet communication	Internet search
Gender	Being male	0.089**	0.153***	0.119***	0.168***
		(2.29)	(4.03)	(3.02)	(4.37)
Age	15–29 years of age	0.227***	0.194***	0.138**	0.097
Reference: 45 years of age and above		(3.23)	(2.82)	(2.14)	(1.54)
	30–44 years of age	0.083	0.073	0.049	0.023
		(1.42)	(1.27)	(0.83)	(0.41)
Education level	Lower secondary school	0.061	0.040	-0.074	-0.067
Reference: primary school level		(0.58)	(0.37)	(-0.90)	(-0.84)
	Upper secondary school	0.225**	0.208*	-0.002	-0.035
		(2.11)	(1.94)	(-0.03)	(-0.40)
	Secondary school/sec. school level +1 post-sec school year	0.326***	0.337***	0.005	0.014
		(2.86)	(2.95)	(0.06)	(0.15)
	Secondary school +2 post-secondary school years	0.320***	0.372***	0.128	0.122
		(2.70)	(3.14)	(1.22)	(1.20)
	Secondary school +3 post-secondary school years or more	0.366***	0.377***	0.083	0.077
		(3.10)	(3.20)	(0.84)	(0.80)
Education level	Middle income	0.001	-0.029	-0.019	-0.014
Reference: having a stable income		(0.03)	(0.53)	(-0.35)	(-0.25)
	High income	0.038	-0.053	-0.038	-0.012
		(0.46)	(0.65)	(-0.47)	(-0.16)
Employment status	Self-employed	-0.024	-0.092*	0.105**	0.056

		(0.47)	(1.83)	(1.96)	(1.07)

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Annex 4 Continued

Explanatory variables	Description	2008		2015	
		Internet communication	Internet search	Internet communication	Internet search
Employment status	Executive	0.159**	0.140*	0.070	0.055
		(2.00)	(1.85)	(0.95)	(0.76)
Employment status	Unemployed	-0.062	-0.060	-0.112**	-0.128**
		(1.10)	(1.08)	(-2.16)	(-2.51)
Having family members abroad	Having family members abroad	0.039	0.019	0.004	-0.020
		(0.99)	(0.48)	(0.10)	(-0.51)
The neighbourhood's living standards: *Reference: low standards*	Medium living standards	0.075*	0.028	-0.034	0.049
		(1.76)	(0.68)	(-0.50)	(0.75)
	High living standards	-0.185	-0.063	-0.039	-0.084
		(1.27)	(0.45)	(-0.34)	(-0.77)
English	Competent user of English	0.089**	0.001	-0.024	-0.001
		(1.99)	(0.03)	(-0.60)	(-0.03)
Laptop	Having a laptop	0.037	0.106**	0.147***	0.157***
		(0.67)	(2.00)	(3.41)	(3.76)
Internet	Having access to the Internet	0.036	0.067	0.063	0.072*
		(0.35)	(0.70)	(1.47)	(1.72)
Television	Having a television set	-0.059	-0.092	0.054	-0.014
		(0.55)	(0.88)	(0.82)	(-0.21)
Telephone	Having a traditional mobile phone	0.149**	0.086	-0.164	-0.191
		(2.25)	(1.31)	(-0.68)	(-0.81)
Tablet	Having a tablet	.....	.....	0.027	0.043

		(0.55)	(0.91)

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Annex 4 Continued

Explanatory variables	Description	2008		2015	
		Internet communication	Internet search	Internet communication	Internet search
Smartphone	Having a smartphone	.....	.....	-0.025 (-0.60)	-0.006 (-0.13)
Computer training	Formal training	-0.019 (0.38)	0.045 (0.93)	0.148*** (3.51)	0.158*** (3.86)
Computer training	Formal training	0.092 (1.61)	0.031 (0.55)	0.121** (2.69)	0.155*** (3.54)
Computer skills	Spreadsheet	0.177*** (3.08)	0.118** (2.10)	0.129** (2.73)	0.141*** (3.07)
Computer skills	Software	-0.035 (0.64)	0.017 (0.33)	-0.054 (-1.00)	-0.017 (-0.33)
Computer skills	Programming	0.150*** (2.66)	0.128** (2.37)	0.039 (0.75)	0.055 (1.07)
Internet use by family members	Family members use the Internet	0.632*** (3.97)	0.261 (1.60)	0.228** (2.05)	0.293** (2.69)
Internet use by friends	Several friends use the Internet	0.230*** (4.66)	0.104** (2.14)	0.086* (1.83)	0.093** (2.03)
Membership of a tontine	Being a member of tontines	0.033 (0.76)	0.047 (1.11)	-0.091* (-2.20)	-0.068* (-1.69)
Constant		-1.141*** (3.27)	-0.533 (1.53)	0.110 (0.32)	0.009 (0.03)
Number of observations		2,187	2,187	1,244	1,244
Likelihood log	Log (L)	0.262*** (2.61)	0.048 (0.47)	-0.089 (-0.99)	-0.022 (-0.25)