# Adoption of Information and Communications Technology (ICT) in Industrial Firms in Cameroon

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# Adoption of Information and Communications Technology (ICT) in Industrial Firms in Cameroon

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# List of abbreviations and acronyms

| | |
|---|---|
| ADSL | Asymmetric Digital Subscriber Line |
| ANTIC | Agence Nationale des Technologies de l'information et de la Communication (National Authority for Information and Communications Technology) |
| ART | Agence de Régulation des Télécommunications (Telecommunications Regulatory Authority) |
| CAMTEL | Cameroon Telecommunications |
| DOI | Diffusion of Innovations |
| EDI | Electronic Data Interchange |
| EGDI | E-government Development Index |
| ENSPT | École Nationale Supérieure des Postes et Télécommunications (National Institute of Posts and Telecommunications) |
| ERP | Enterprise Resource Planning |
| FDI | Foreign Direct Investment |
| GCI | Global Cybersecurity Index |
| GNI | Gross National Income |
| HCI | Human Capacity Index |
| ICT | Information and Communications Technology |
| IDI | ICT Development Index |
| INS | Institut National de la Statistique (National Institute of Statistics) |
| INTELCAM | International Telecommunications of Cameroon |
| IS | Information Systems |
| ISIC | International Standard Industrial Classification |
| ISPs | Internet Service Providers |
| ITU | Union Internationale des Télécommunications (International Telecommunication Union) |
| IXP | Internet Exchange Point |
| LE | Large Enterprise |
| MAR | Missing-at-Random |
| ME | Medium-sized Enterprise |
| MI | Multiple Imputation |
| MICE | Multivariate Imputation by Chained Equations |
| MINPOSTEL | Ministry of Posts and Telecommunications |

| | |
|---|---|
| NACAM | Nomenclature d'activités du Cameroun (Cameroonian Nomenclature of Activities) |
| NAEMA | Nomenclature des Activités des États Membres d'AFRISTAT (Nomenclature of Activities of AFRISTAT Member States) |
| NRI | Networked Readiness Index |
| OSI | Online Service Index |
| RGE | Recensement Général des Entreprises (General Census of Enterprises) |
| SMEs | Small and Medium-sized Enterprises |
| TAM | Technology Acceptance Model |
| TII | Telecommunication Infrastructure Index |
| UNDESA | United Nations Department of Economic and Social Affairs |
| UTAUT | Unified Theory of Acceptance and Use of Technology |
| VSEs | Very Small Enterprises |

# Abstract

The ICT revolution is already a reality for firms in developed countries and in many developing ones, especially that there is now solid evidence of how it has improved productivity and growth. But at the same time, the ICT penetration rate is still low in African firms. Using data on industrial firms in Cameroon, the present study is an attempt to establish the determinants of ICT adoption in the country. It uses a negative binomial model and a probit model selection bias correction. It transpires from the study's econometric results that the size of the firm, the human capital of its employees, the proportion of its employees who are ICT-literate, its organizational practices, its manager's qualities and its regional location are the determinants of its ICT adoption rate. However, their discriminatory effect diminishes over time. From the study's results, lessons can be drawn that can guide the development of an ICT diffusion policy, not only for the firms in Cameroon, but also for those in other similar African countries with a slow rate of ICT diffusion.



**Key words**: ICT adoption; Firm; Cameroon.

# 1. Introduction

Information and Communications Technology (ICT) is at the heart of the "new" knowledge-based economy. There is evidence to suggest that ICT, innovation and technological change are important determinants of productivity, growth and countries' ability to benefit from globalization (Oliner and Sichel, 2000; Bassanini and Scarpetta, 2002; OECD, 2004; Timmer and van Ark, 2005; Holt and Jamison, 2009; Kretschmer, 2012; Biagi, 2013).

The impact of ICT investment on productivity and growth is greater for a firm than for the whole industry and the whole country (Brynjolfsson and Hitt, 2000, 2003; Lehr and Lichtenberg, 1999; Matteucci et al, 2005). At the firm-level, the use of ICT leads, not only to an improvement in product design, in marketing, in production, in financing and in the organization of firms (Hollenstein, 2004; Bloom et al, 2012), but also to the development of the export market (Machikita et al, 2010). In addition, ICT drives innovation by facilitating the creation of new products and services (Becchetti et al, 2003; Carlsson, 2004; Hollenstein, 2004).

It is, therefore, now evident that technological change is an important driver of productivity and firm performance in both developed and developing countries. This positive impact of ICT is even greater when it is accompanied by complementary investment such as in human capital formation and organizational change (Bloom et al, 2012; World Bank, 2016a). However, despite ICT's important role in business, the economy and society, the rate of its adoption continues to be significantly different across regions and enterprises. There is still some reluctance on the part of the latter, especially small and medium-sized enterprises (SMEs), to adopt a number of information and communications technologies, despite the fact that these are becoming more affordable (Giunta and Trivieri, 2007).

Despite the steady growth of ICT around the world, especially in mobile services and the Internet, its penetration rate remains low in developing countries, particularly in Africa. Indeed, while in 2016 the Internet penetration rate was 87% in developed countries, it was 40% in developing ones and only 25% in Africa in particular (International Telecommunication Union [ITU], 2016). In Africa, while telecommunications costs have fallen sharply in recent years, they remain higher than in other developing regions of the world. Mobile phone and Internet costs in Africa, for example, are about four times higher than they are in South Asia, and prices for international calls are more than twice as high. African countries' connectivity to international broadband networks is nearing completion, but costs are a key determinant of ICT adoption. In Africa, the cost of 1GB of data in 2016 represented

almost 18% of the monthly income of an average citizen, compared to only 3% in Asia (Alliance for Affordable Internet [A4AI], 2017). Mobile operators' uncompetitive pricing policies, such as increasing rates for calls made to rival networks, also make ICT relatively expensive in Africa. As the fastest growing mobile market in the world, mobile telephony has a positive influence on Africa's economic growth. Currently, the majority of mobile phones use versatile systems. On the other hand, smartphones are fast entering the market, as evidenced by the growing percentages of mobile users owning smartphones in several countries in 2015: Nigeria (25%), Egypt (22%), Ghana (18%), Cameroon (17%), Kenya (13%) and Senegal (11%) (Nyirenda-Jere and Biru, 2015). The ICT sector is expected to grow fast, with smartphones becoming more affordable for consumers.

An analysis of the ICT-related Development Index (IDI)[1] figures according to development level also reveal significant disparities between developed and developing countries. In 2014, the former had an average IDI of 7.20, while the latter had an average of only 3.84; that is, just about half (ITU, 2014). The regional IDI index for Africa was the lowest, with only two countries, Mauritius (5.22) and Seychelles (4.97), having an average higher than the world's average of 4.77. Three-quarters (29 out of 38) of African countries were considered to be among the least connected countries. The last 10 countries in the 2013 IDI ranking were all African, among them the Central African Republic – the only country with an IDI value of less than 1. Cameroon ranked 18th out of 38 African countries, behind Angola and ahead of Mali. In addition, in terms of numerical affordability[2], Cameroon occupied the penultimate place, with an index of 25.6, just ahead of Ethiopia which recorded a score of only 13.4 (A4AI, 2014). The policy makers' challenge is to identify the policy mix that will allow their economies to make the most of the benefits of an increasingly digitized global economy and, thus, to respond adequately to the attendant challenges. For that to happen, it is essential to ensure access to the digital economy for all. So, it would be interesting to determine the factors that slow down and those that accelerate the diffusion of ICT in Africa.

The present study is an attempt to determine those factors in relation to industrial firms in a sub-Saharan African country, Cameroon. In other words, it aims to highlight the determinants of ICT adoption in industrial firms in Cameroon. The country has been connected to the Internet since April 1997. However, its Internet penetration rate in the formal-sector firms was low, less than 50% in 2009 (Institut National de la Statistique [INS], 2009). Indeed, while 78% of those firms had at least one computer, barely one in two was connected to the Internet and an even lower proportion (23%) had an intranet network and thus had to use the Internet for its business operations. But the ICT penetration rate has increased significantly since 2006, when less than 7% of firms were equipped with a computer (Agence Nationale des Technologies de l'information et de la Communication [ANTIC], 2007). According to data from the World Bank Business Survey, a large number of firms in Cameroon were not connected to the Internet in 2016: only 22% of them had their own website, while 54% of them used e-mails to interact with their customers and/or suppliers (World Bank, 2016b). However, there were disparities depending on the firm's sector of activity and size. For

example, in the service sector, 24% of firms had their own website, compared to only 19% in the manufacturing sector. On the other hand, while 52% of enterprises in the service sector used e-mails to interact with their customers and/or suppliers, 60% of those in the manufacturing sector did. Furthermore, only 15% of small enterprises, 42% of medium-sized enterprises and 55% of large ones had their own websites. In terms of using emails to interact with their customers and/or suppliers, 46% of the small enterprises used them, 72% of the medium-sized enterprises did, and so did 92% of the large ones. All this goes to show that there was a considerable opportunity for growth in Cameroon, but one which was still not sufficiently used.

The present study's aim is to identify the factors that slow down ICT adoption in industrial firms in Cameroon. This is a microeconomic study aiming to complement existing research on the digital divide in Cameroon (Fambeu and Bakehe, 2015; Bakehe et al, 2016; etc.). Its findings are likely to serve as a foundation for an ICT development policy, not only in Cameroon, but also in countries with the same level of development and a similarly low rate of ICT penetration.

The rest of the paper is organized as follows: Section 2 is an overview of the state of ICT in Cameroon, Section 3 is a review of the literature on the determinants of ICT adoption in enterprises, Section 4 is the methodology, Section 5 discusses the results, while Section 6 is the conclusion where public policy recommendations are made.

# 2. The state of ICT in Cameroon

## Telecommunications legislation in Cameroon

From Cameroon's independence in 1960 to 1986, the telecommunications sector in the country was a government monopoly. The government body in charge of telecommunications performed both its regulatory and operational functions. It was during this period that the architecture of the national telecommunications network was put in place. In order to meet the sector's development needs, in 1969, the government created the National Institute of Posts and Telecommunications (*École Nationale Supérieure des Postes et Télécommunications, ENSPT*) and, in 1972, the INTELCAM (International Telecommunications of Cameroon) company which in 1998 became CAMTEL (Cameroon Telecommunications). CAMTEL offers telephone, fax, telegraphy, telex and data transmission services between fixed points. It is also responsible for the transmission of sound and television broadcasting signals as well as the rental of circuits. Despite all the investment made by the government in the company, its achievements have not been very satisfactory.

From 1986 to 1998, the government embarked on a vast project to render state corporations autonomous. By Law No. 87/021 of 17 December 1987, it gave financial autonomy to *MINPOSTEL* (Ministry of Posts and Telecommunications) by creating a budget specifically allocated to posts and telecommunications. This enabled *MINPOSTEL* to make the technological leap by the acquisition of digital exchanges in Yaoundé and Douala and, later, in the South West. The main transmission routes were also digitized. From 1993, the first GSM mobile telephony network in Africa was put into operation through the CAMTEL MOBILE project. It was in 1995 that the process of restructuring the communications sector was launched through the national operator. It is with the promulgation of Law No. 98/014 of 14 July 1998 governing the telecommunications sector that the government's disengagement came into effect through the separation of supervision and regulation operations. Implementation decrees were issued to govern the creation, organization and operation of new players in the national telecommunications environment, namely *ART* (*Agence de Régulation des Télécommunications* [Telecommunications Regulatory Authority]), specifically responsible for regulation, control and monitoring activities in the telecommunications sector, CAMTEL and CAMTEL MOBILE.

Since 1998, the country has embarked on the privatization and liberalization of the telecommunications sector. In 1999, a licence to operate mobile telephony was

awarded to the *SCM*, which in 2002 became Orange Cameroon (a subsidiary of the French company Orange). CAMTEL MOBILE was sold to MTN International, which set up MTN Cameroon (subsidiary of the South African group MTN) on 15 February 2000. The liberalization permitted by the 1998 law also led to the arrival of Internet access/service providers, value-added service providers (full liberalization), and many others. Unfortunately, it can be argued that all these changes took place without there being a real explicit and appropriate policy or strategy to govern the development of the sector. In 2002, the National Authority for Information and Communications Technology (*Agence Nationale des Technologies de l'Information et de la Communication, ANTIC*) was set up by a presidential decree, though it became operational in 2006. It was specifically mandated to promote and monitor government action in the field of information and communications technology. It is responsible for regulating electronic security activities, in collaboration with the Telecommunications Regulatory Authority (*ART*). Its primary mission is to design and implement the ICT policy. In 2010, three laws were enacted, one relating to cybercrime and cyber security, and the other two to electronic communications and commerce. The latter two laws enabled the setting-up of a legal and regulatory environment adapted to technological development, the emergence of new markets based on IP technology, competition and the promotion of public-private partnerships for the setting-up of new infrastructure. Additional laws governing electronic communications and related activities were passed in 2012 and 2013, which demonstrates the government's awareness of the need to develop the ICT sector and, hence, of the need to gradually integrate it into the daily activities of institutions and private individuals.

Following a call for tenders launched in May 2012, the third mobile phone licence was awarded to Viettel Cameroon company, which was later called Nexttel (a subsidiary of the Vietnamese group Viettel). Nexttel, the first holder of a 3G-licence in Cameroon, launched its activities in September 2014. Thus, the telecommunications services market in Cameroon comprises three mobile operators, namely MTN Cameroon, Orange Cameroon, and Viettel Cameroon, in addition to a fixed telecommunications operator, Camtel, which also serves as a transport operator. Many saw the arrival of this third operator (Nexttel) as the beginning of real competition on the mobile telephony and Internet market. It was hoped that this would lead to a considerable drop in communication and Internet costs. The drop in Internet costs was expected to be significant since there was a multitude of Internet access providers in the country.

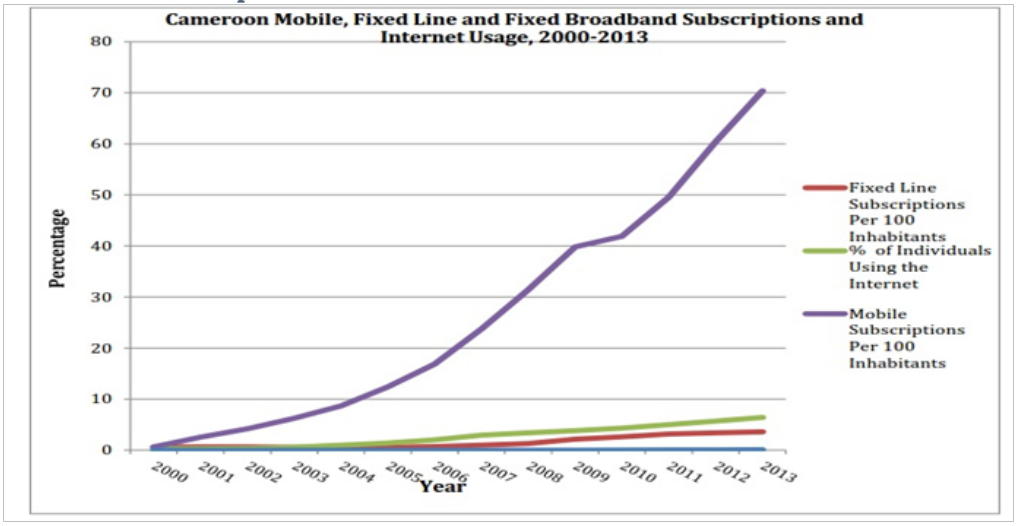
Today, after the government's implementation of measures aimed at developing the sector, in particular the setting up of legal and regulatory telecommunications frameworks (liberalization of the sector; separation of postal activities from telecommunications and ICT; new missions assigned to the Post and Telecommunications Ministry; and the setting-up of independent and autonomous monitoring development and regulation bodies), access to telecommunications services and ICT has slightly increased, as shown in the following subsection.

## Trends in some ICT indicators at the national level

Cameroon has enormous potential which could make it a major hub of ICT development in Central Africa. In fact, its education system, especially at the higher-education level, despite its many problems, is quite developed and could serve as a great starting point for ICT development in Central Africa. In addition, the country had access to a fibre optic backbone in 2005 along the Chad-Cameroon pipeline and a landing point for the SAT-3 (South African Telecommunication 3) submarine cable at the port of Douala, with a capacity of 2.5 gigabits per second (Gbps) (MINPOSTEL, 2006). CAMTEL, the exclusive supplier of broadband for SAT-3, operated (in 2008) eight Internet nodes (Lange, 2008) and offered access to two megabits per second (Mbps) to the ISPs. Cameroon had no Internet exchange point (IXP) (ANTIC, 2007). To improve Internet access in rural areas, the government embarked on a mission to equip more than 180 telecentres before 2008 (MINPOSTEL, 2006).

Cameroon has seen significant changes in Internet access, with an increasing penetration rate of 14% per year, on average, between 2007 and 2011 and of 19% between 2012 and 2017, which, however, was lower than the 32% penetration rate for the African continent as a whole (Alliance for Affordable Internet [A4AI], 2014; Doing Business in Cameroon, 2017[3]). Despite this seemingly impressive progress in the development of modern infrastructure and the growing number of licensed operators, various authors and institutions have reported that Cameroon has one of the lowest Internet usage rates in Africa, and that it was one of the least connected countries in the world with only 6% of its population being connected to the Internet in 2013 (ITU, 2014). Figure 1 shows that, with the exception of mobile phones, the other ICT indicators in Cameroon have a very low penetration and growth rate. While the fixed telephone penetration rate was 4.4%, that of mobile telephones was 71% in 2014 (ITU, 2014).

**Figure 1: Subscriptions to Internet use, fixed telephony and fixed and mobile broadband for the period 2000-2013 in Cameroon**




Source: ITU (2014).

Between 2014 and 2016, the Internet sector in Cameroon recorded remarkable progress, ranking it among the top 100 countries in the world where Internet access had improved, and among African countries which had recorded significant improvement (see Table 1).

**Table 1: Statistics on Internet use and penetration rate as a % of the population from 2014 to 2016**

| Year | Rank (out of 195 countries) | Internet users | Penetration (as a % of the population) | Population |
|---|---|---|---|---|
| **2014** | 93 | 2,505,032 | 11% | 22,773,014 |
| 2015 | 82 | 3,701,585 | 15.9% | 23,344,179 |
| 2016 | 78 | 4,311,178 | 18% | 23,924,407 |

Source: Ngang (2018).

The mobile phone penetration rate was around 80% in 2015 (MINPOSTEL, 2016). However, if we take into account the fact that this indicator refers more to the number of chips sold and estimate that 30% of the users own more than one chip, the real penetration rate could be around 50%. In addition, Internet connection through ADSL ("Asymmetric digital subscriber line") often poses challenges of use and exploitation to consumers.

## Cameroon ranking in the world in the digital domain

Several organizations at the international level have used various indexes and rankings to present the level of development of the digital economy or some of its essential components in countries, sub-regions, regions and the entire world. The best known

of those indexes are: the Networked Readiness Index (NRI) developed by the World Economic Forum, the e-government development index (EGDI) – produced each year by the Economic and Social Affairs Department of the United Nations general secretariat and the ITU's Global Cybersecurity Index (GCI). The different indexes reflect the absolute situation of world economies in the different strands of the digital economy. The cost of Internet access can be added to those indexes.

**The Networked Readiness Index (NRI)** measures a government's capacity (factors, policies, institutions) to be ready to use and take advantage of the opportunities offered by ICT in order to increase the competitiveness of its economy and the well-being of its people. With a score of 3 on a scale of 1 to 7, Cameroon ranked 126$^{th}$ in the world out of the 143 countries assessed in 2015 (World Economic Forum, 2015). Thus, it is considered a lower middle country. This low ranking is due to the low level (with a value of just 1.2) of the country's infrastructure development, to the low level (with a value of 1.9) of use of ICT by its inhabitants and to the high costs of ICT.

The **E-Government Development Index** (EGDI) measures a government's use of ICT to make public information and services available to users. It is an average of three indexes: the Online Service Index (OSI), the Telecommunication Infrastructure Index (TII), and the Human Capacity Index (HCI). This index, for which Cameroon scored a value of 0.2782 on a scale of 0 to 1, comprises three pillars: infrastructure, human capital, and online services (United Nations Department of Economic and Social Affairs [UNDESA], 2014). Regarding these pillars, Cameroon scored 0.0958 (OSI), 0.5421 (TII) and 0.1968 (HCI) on a scale of 0 to 1. Clearly, while the score for human capital is acceptable, those for infrastructure and online services are not at all. Cameroon thus ranked second in the Central Africa sub-region, behind Gabon, whose index value was 0.3294. In Africa, Tunisia ranked first, with a score of 0.5390. At the world level, the Republic of Korea ranked first, with a score of 0.9462.

The **Global Cybersecurity Index (GCI)** measures the level of development in each country in terms of cyber security. It presents a country's commitment to or readiness for cyber security. With regard to this indicator, Cameroon was ranked 5th in Africa and joint 15th in the world in 2014 (ITU, 2014). This indicator shows that access to ICT enjoyed an acceptable security level.

The level of those indicators in Cameroon is enough evidence that the country has to redouble its efforts, especially in the development of telecommunications infrastructure, which is a prerequisite for improving the other components of those indicators. In this respect, the government has shown considerable interest and commitment in stimulating the development of the digital economy in the country, as evidenced by some key policies it has taken (World Bank, 2016c).

Concerning the **Cost of Internet Access**, the toxic cocktail of limited access to the international bandwidth, the monopoly in the fixed-line sector and the extremely limited competition in the mobile telephony sector has contributed to a lack of access to the Internet by the majority of Cameroonians, except for the wealthiest. A 2013 ITU report ranked Cameroon 152nd out of 169 countries in terms of fixed broadband costs. A fixed broadband connection cost 61% of the gross national income (GNI) per capita

in 2013. In 2017, it cost 23% of the GNI per capita. In fact, only six African economies devised fixed-broadband plans representing no more than 5% of their GNI per capita: Mauritius, Seychelles, Gabon, South Africa, Cape Verde and Botswana. Thus, in terms of fixed broadband Internet costs, Cameroon ranked 165th out of 195 countries in 2017 (ITU, 2017a). But in terms of mobile broadband connection, the country recorded a significant reduction in costs, of more than 50% between 2015 and 2016, due to the availability of tariff schemes responding better than before in terms of monthly data volumes. In relation to affordability of mobile broadband connection, Cameroon ranked 134th out of 192 countries, as the cost of it represented 3% of its GNI per capita in 2016. The monthly quality-price ratio corresponded to 500GB per month for US$3 (ITU, 2017b). The best African country was Mauritius (ranked 51st in the world) with a cost representing less than 1% of its GNI per capita.

The value of the mobile telephony sub-basket in Cameroon was among the values that experienced the greatest fluctuation over the period 2013-2016, with significant increases and decreases in costs. This type of fluctuation is not uncommon in markets that have not yet reached maturity. Against a backdrop of 68 mobile subscriptions per 100 inhabitants in 2016 (compared to 33 in 2008), of an increase in the number of SIM holders (Media Intelligence, 2016), a newcomer on the mobile telephony market (Nexttel) and the imminent launch of the mobile number portability (TeleGeography, 2017), the dynamics of the market in Cameroon is changing, which could cause dominant mobile operators to abandon existing tariff schemes and introduce new ones at a faster rate. The price baskets in Cameroon in recent years have been based on different offers, which suggest a greater fluctuation. Table 2 presents some ICT indicators for Cameroon in 2006.

**Table 2: Key ICT indicators for Cameroon (2016)**

| | Cameroon | Africa | World |
|---|---|---|---|
| Landline telephone per 100 inhabitants | 4.4 | 1.0 | 13.6 |
| Mobile phone per 100 inhabitants | 68.1 | 74.6 | 101.5 |
| Fixed broadband per 100 inhabitants | 0.2 | 0.4 | 12.4 |
| Mobile broadband per 100 inhabitants | 9.6 | 22.9 | 52.2 |
| 3G coverage (% of the population) | 65.0 | 59.3 | 85.0 |
| LTE/WiMAX coverage (% of the population) | 64.1 | 25.7 | 66.5 |
| Mobile phone cost (% of the GNI per capita) | 12.2 | 14.2 | 5.2 |
| Fixed broadband cost (% of the GNI per capita) | 22.8 | 39.4 | 13.9 |
| Cost of 500MB mobile broadband (% of the GNI per capita) | 3.1 | 9.3 | 3.7 |
| 1GB mobile broadband cost (% of the GNI per capita) | 6.1 | 17.7 | 6.8 |
| Percentage of households with a computer | 13.7 | 9.6 | 46.6 |
| Percentage of households with Internet access | 10.5 | 16.3 | 51.5 |
| Percentage of people using the Internet | 25.0 | 19.9 | 45.9 |
| International Internet bandwidth per user (KBps) | 2.5 | 51.0 | 74.5 |

Source: ITU (2017b).

It is evident from Table 2 that the ICT penetration rate in Cameroon is still low. Therefore, understanding the factors responsible for this digital divide is essential if the country has to adopt the appropriate policies to remedy the situation. The present study, carried out at the firm level, complements the earlier research conducted at household level (Tamokwe, 2013; Fambeu and Bakehe, 2015; and Bakehe et al, 2016).

# 3. Literature review

Several theories can be used to analyse technological adoption at the firm level. One of them is Davis' (1989) Technology Acceptance Model (TAM) which explains that technology adoption results from the perception of the usefulness of the technology in question and the perception of the ease of use of it. Drawn from social psychology theories (the Theory of Reasoned Action and the Theory of Planned Behaviour), the TAM model was developed for application specifically to Information Systems (IS) and is no longer part of the general theories of human behaviour. This model has undergone several modifications and extensions aimed at improving its explanatory power and at identifying as many variables as possible which influence user behaviour in relation to technologies. Inspired by the TAM model, Venkatesh et al (2003) synthesized the main models of ICT acceptance from which they derived a Unified Theory of Acceptance and Use of Technology (UTAUT). Rogers' (1995) Diffusion of Innovations (DOI) theory identifies five factors responsible for adoption of innovation: relative advantage, compatibility, complexity, testability and observability. Rogers (1995) also puts emphasis on the "snowball effect" in neighbourhood networks when it comes to adopting innovation.

In addition, two main approaches are generally used in the economic literature to explain the adoption (or not) of ICT in firms. The first comprises factors that directly affect the costs and benefits of adopting a new technology. In this approach, four effects are usually highlighted: rank effects, stock effects, order effects and epidemic effects (Karshenas and Stoneman, 1993; Geroski, 2000). The second approach emphasises the complementarity between ICT and certain organizational practices and the associated efficiency gains (Milgrom and Roberts, 1990). In the present study, the business manager's profile is also stressed as a determinant of ICT investment. It plays a particularly important role in African countries characterized by a predominance of family VSEs and SMEs, whose managers are very often their founders as well.

## Review of theoretical literature and hypotheses to be tested

The *rank effects* are associated with the heterogeneity of firms which generates differences in the benefits linked to technology adoption. Adoption decisions are primarily determined by a trade-off between the additional profits expected from the adoption and the costs of technological change. Yet the costs and benefits of

technological change are specific to each firm and, therefore, depend on key variables that differentiate between firms in terms of their size, their pricing and service provider policies, their legal status and their financial position, the nature of the competitive environment around them and their ability to acquire new skills and to innovate.

Hypothesis 1: *ICT adoption by a firm depends on the firm's structural characteristics (among which its size, its age, its ownership of capital, the human capital of its employees and its export capacity).*

The *stock-order models* express the ambiguous influence of competition on the technology diffusion process. They were inspired by the game theory developed by Reinganum (1981), Fudenberg and Tirole (1985) and Quirmbach (1986). Game theorists suggest that the interaction of the profitability of new technologies for the user, combined with the relentless pressure from their rivals to reduce costs, will determine the adoption time for a given firm and who will be the leader firm and the follower firm. The order models are based on the idea that the order in which firms adopt new technology determines the profit they can get from it. The benefits of adoption are greater for the firms that are the first to adopt the new technology (the first movers). This may be due to the fact that they are then in a position to pre-empt excess profits (Fudenberg and Tirole, 1985), to occupy the most advantageous geographical sites, or to be the first to have access to qualified workforce available only in limited quantities at the time (Ireland and Stoneman, 1985). The *stock models* are based on the idea that the profit generated by the adoption of innovation is a function of the total number of firms that have already adopted the same innovation. The benefits of adoption for the marginal adopter decrease as the number of firms that have already adopted it increases (Karshenas and Stoneman, 1993). The two models imply that the lower the number of adopters and/or the stock of new technology already installed, the higher the probability of adoption. However, when there is great uncertainty about the future benefits of the new technology, or when faced with network-effect technologies, these predictions can be completely reversed (Bocquet and Brossard, 2008).

Hypothesis 2: *ICT adoption by a firm is inversely related to the adoption of it by the other firms belonging to the same sector of activity*.

The *epidemic information dissemination models*, inspired by the work of Mansfield (1961), consider that information relating to an innovation is decisive for its adoption and that it is costly. Each adopter of it thus generates a positive externality by transferring information to other potential adopters. While their validity has been recognized by numerous empirical studies, those models have been criticized in particular because of their uniform treatment of firms which are assumed to have an identical probability of being contaminated.

Those models are mainly concerned with firms' aggregate behaviour, thus practically ignoring the decision making process at the level of each individual firm (Grolleau, 2001). Yet, not all the firms get the same information, in identical quantity

and at the same time. The general idea of this geographical proximity[4] is that the environment in which the firm is located influences its ability to innovate and, above all, its ability to adopt new technologies (Galliano and Roux, 2006).

Hypothesis 3: *ICT adoption by a firm is positively related to the adoption of it by the other firms in the same region.*

In their *supermodularity theory*, Milgrom and Roberts (1990, 1995) link ICT diffusion to the emergence of new modes of business organization characterized by more decentralized decision making processes, strong incentives to improve quality and close relationships with customers and suppliers. This suggests that ICT diffusion is stimulated by the adoption of new complementary organizational practices. Formally, the *supermodularity theory* is based on a reformulation of the production function of the firm integrating, besides traditional factors (capital and labour), input in the form of organizational and strategic practices. When this extended production function is supermodular, an exogenous shock that has a positive influence on the adoption of a practice will lead to the adoption of all the other complementary practices, even if this shock has no direct influence on them. As a result, supermodularity results in a correlation between the practices and techniques adopted. It is, therefore, possible to adopt an empirical strategy based on the revelation of preferences: if firms choose their technologies and practices by optimization and if there are complementarities between the latter, ICT adoption should be positively influenced by the adoption of complementary organizational and strategic practices.

Hypothesis 4: *Adoption of organizational practices positively affects ICT adoption by a firm.*

The *role of the business manager* is important in ICT adoption in African countries, where small businesses are predominant. In the SMEs, managers make ICT adoption decisions from the planning phase through to the implementation and system-upgrading stages (Bruque and Moyano, 2007; Nguyen, 2009). This is because the SMEs are generally simple and highly centralized structures under a business manager, and in which most often the owner of the business is at the same time its manager (Ghobakhloo et al, 2011). A number of studies have revealed that in the SMEs, the manager's/owner's decisions influence the strategic orientation and organization of the enterprise's various activities, both now and in the future (Fuller-Love, 2006; Smith, 2007).

Hypothesis 5: *The manager's profile (gender, age, education level, technological savvy) influences the level of ICT adoption by a firm*.

## Review of the empirical literature

The literature on ICT adoption has documented empirical evidence of various factors that are inherent in a firm's ICT adoption in both developed[5] and developing[6] countries. The literature below focuses on Africa as it is the most relevant literature for this study.

Lal (2007), in a study of 67 Nigerian manufacturing SMEs, showed that their

employees' absorptive capacity (number of technical employees) played an important role in their ICT adoption. The multivariate approach used by the author also allowed the study to observe that the SMEs adopted ICT to obtain more appropriate and specific commercial information, which was related to market trends in terms of product specifications, information on new production technologies and exchange of business information. Employees' absorptive capacity was also found by Ssewanyana and Busler (2007) in their study of 110 companies in Uganda. Using statistical tools, the authors concluded that there was a need to expand employee training on the use of ICT, especially on Internet services. Using a different methodology, Ben Youssef et al (2015) arrived at the same results. They applied bivariate and ordered probit models to data from 350 Tunisian companies and found that the human capital of a firm's employees and its manager determined the firm's adoption of cloud computing. A similar methodology had already been used by Kossai et al (2010), who showed that the employees and managers (human capital) were explanatory variables for the intensity of ICT use. On the other hand, using a logit model, Nkouka (2014) showed that the education level of a firm's employees had no effect on the firm's ICT adoption in the case of Congolese SMEs; instead, it was the presence of senior managers that played a determining role. A study by Appiah et al (2016), in the case of Ghana, and another by Thuo et al (2017), in the case of Kenya, confirmed the role of the manager's human capital mainly for the adoption of e-commerce in 250 Ghanaian SMEs and 153 Kenyan SMEs, respectively. Furthermore, while some studies (Gnansounou, 2010; Ochola, 2015) found that the manager's age had no effect on a firm's ICT adoption. A study by Adebimpe (2014), which applied a Tobit model to 100 Nigerian SMEs, did find a positive relationship between the manager's age and the firm's ICT use. This use was attributed to experience and better exposure related to the manager's education level (Adebimpe, 2014).

In a study carried out in Benin on 440 firms using an ordered probit, Gnansounou (2010) found that in addition to the manager's characteristics, the firm age and size and its export capacity were positively related to ICT adoption. Large firms were found to be more likely to adopt ICT since they had more resources and knowledge to invest in new technology. However, a study by Olise et al (2014), using a simple probit on 40 Nigerian SMEs, concluded that there was no link between a firm size and its Internet use. Further, using the same methodology (a simple probit), Benabderrahmen et al (2016) found that the impact of firm size depended on the technology used: conducted on 110 textile companies in Tunisia, the study confirmed that a firm size had no impact on the firm's Internet use but rather on its adoption of software, such as the electronic data interchange (EDI) and the enterprise resource planning (ERP) systems.

Very few studies have highlighted the role of organizational practices. Based on data from 175 Tunisian companies, Ben Youssef et al (2014) showed that new organizational practices had a positive impact on ICT adoption and use. This finding was confirmed by a study by Ben Khalifa (2014), which applied the same model (ordered logit) to 145 companies in Tunisia: it is the companies with the highest number of innovative organizational practices that had the highest probability of increasing their Internet

use. The study further found that sectoral and regional effects were significant on the intensity of Internet use. The positive effects of the environment were also observed in other studies (Ochola, 2015; Agyire-Tettey, 2015; Cirera et al, 2016).

Cirera et al (2016), in a study of 2,938 companies from six countries of sub-Saharan Africa, using a Poisson regression model complemented by meta-analysis, found that imports, foreign participation in capital, organizational practices and competition had a positive effect on the adoption of ICT and, in particular, e-commerce. The same study also reported that Kenya had a very high ICT penetration rate, while the DRC and Tanzania had the lowest rates, which were related to their low level of per capita income. However, Agyire-Tettey (2015) found that the impact of factors was different in different countries. It was conducted on 3,996 SMEs from 12 countries in sub-Saharan Africa.[7] The study's use of a bivariate probit model and, more importantly, a meta-analysis technique enabled it to identify the sectoral effect and the perception of competition as the factors common to all countries in their use of computers and the Internet. It further found that the size of the firm had a positive effect on its use of computers but zero effect on its use of the Internet in Botswana, Ghana and Kenya, while this effect was zero for computer use and negative for Internet use in Cameroon. It also found that the human capital of a firm's employees had a positive impact on its use of computers and the Internet in Cameroon, Ethiopia, Mozambique and Rwanda, while it had no effect on ICT adoption in Ghana, Kenya and Nigeria. In the final analysis, it transpires from the preceding literature review that hardly has existing research integrated the role of organizational practices (mentioned in Milgrom and Robert's [1990, 1995] theory of supermodularity) and of proximity effects (regional and sectoral). Therefore, using data from industrial firms in Cameroon, the present study is an attempt to fill this gap and complement existing research by integrating the latter variables.The following sections present the methodology the present study used to test its five hypotheses and then discuss the results.

# 4. Methodology

## The data

The data used in the present study were obtained from two databases: one containing data from a 2009 survey and the other containing data from a 2012 survey. Both surveys were carried out by the Cameroon National Institute of Statistics (*INS*). The first used a sample of 1,008 firms, and the second a sample of 183 firms in the industrial sector. The sampling frame for the two samples was the national directory of companies set up based on the 2009 General Census of Enterprises (*Recensement Général des Entreprises, RGE*, 2009). In accordance with the Cameroonian Nomenclature of Activities (*Nomenclature d'activités du Cameroun*, *NACAM*), each sample was constituted by subdividing the industrial sector into five sub-sectors: extraction (with two branches), food industries (seven branches), other manufacturing industries (14 branches), electricity-water-gas (one branch) and construction (one branch). The Cameroonian nomenclature is an adaptation of the Nomenclature of Activities of AFRISTAT Member States (*Nomenclature des Activités des États Membres d'AFRISTAT, NAEMA*) based on the International Standard Industrial Classification of All Economic Activities (ISIC, rev. 3.1). However, since some sub-sectors would have been very poorly represented in those samples, they were not considered in the present study which, in the end, only focused on three sub-sectors: food industries, other manufacturing industries and construction. Moreover, while the 2009 survey covered the entire country, the 2012 one was conducted only in the two largest cities and the West Region of Cameroon (the three regions represent more than 75% of firms in the country). So, for ease of comparison in the analysis, from the 2009 database only the three regions data from which were also available in the 2012 database were taken into account in the present study. In a nutshell, the two samples used in the present study comprise data from three regions and three sectors of activity, some characteristics of which are presented in Table 3.

As Table 3 shows, the study's sample is not perfectly representative of the industrial firms in Cameroon. This is due to the fact that during the process of cleaning up[8] the database, about 95% of very small enterprises (VSEs) were eliminated, and yet they were the most represented (82%) in the population. As a result, due to the over-representation of the VSEs in "other manufacturing industries", elimination of some of them automatically led to a reduction in the weight of this sector and increased the weight of other types of enterprises and other sectors. Despite all that, the VSEs and the "other manufacturing industries" remained strongly represented in the samples, as was the case in the study population.

Since the samples used were not fully representative of industrial firms in Cameroon, it is advisable to remain cautious about the results obtained from them. Still, from those results useful lessons can be drawn regarding the conditions of ICT adoption at firm-level in the country.

**Table 3: Distribution of firms by size, sub-sector and region in Cameroon**

| | Population | | Samples | | | |
|---|---|---|---|---|---|---|
| | 2009 | | 2009 | | 2012 | |
| | N | % | N | % | N | % |
| Firm size | | | | | | |
| VSE (Very Small Enterprise) | 6,726 | 82.64 | 401 | 51.74 | 95 | 53.37 |
| SE (Small-sized Enterprise) | 638 | 7.84 | 156 | 20.13 | 36 | 20.22 |
| ME (Medium-sized Enterprise) | 599 | 7.36 | 147 | 18.97 | 29 | 16.29 |
| LE (Large Enterprise) | 176 | 2.16 | 71 | 9.16 | 18 | 10.11 |
| Sub-sector of activity | | | | | | |
| Food industries | 420 | 5.16 | 154 | 19.87 | 35 | 19.66 |
| Other manufacturing industries | 7,206 | 88.54 | 375 | 48.39 | 112 | 62.92 |
| Construction | 513 | 6.30 | 246 | 31.74 | 31 | 17.42 |
| Region | | | | | | |
| Douala | 3,694 | 45.39 | 500 | 64.52 | 103 | 57.87 |
| Yaoundé | 3,139 | 38.57 | 223 | 28.77 | 50 | 28.09 |
| West Region | 1,306 | 16.05 | 52 | 6.71 | 25 | 14.04 |
| | | | | | | |
| Total | **8,139** | **100** | **775** | **100** | **178** | **100** |

Source: Author's compilation based on data from the 2009 *RGE* census and the 2009 and 2012 surveys by the *INS.*

Before analysing the data from the samples, it is essential to look at the incomplete or missing data. Failure to take account of the missing data would lead to a loss in efficiency, since a significant part of the information would be ignored. There are many approaches to dealing with missing data. One of them is to use dummy variables to identify the missing observations. First, a dummy variable is constructed for each variable with missing data. Then the imputed variables and their corresponding dummy variables are entered into an econometric estimation. This approach was popularized by Cohen and Cohen (1983) in estimations. However, this technique produces biased estimators (Jones, 1996).

The present study uses a multiple imputation (MI) procedure. This consists in creating several possible values for a missing value. The multiple imputation principle and techniques were developed by Rubin (1978, 1987). In addition to simultaneously taking into account all the individuals and all the variables (with and without missing data), this method makes it possible to deal with the uncertainty around the prediction of a substitution value. The main idea behind multiple imputation (MI) is to produce *m* imputed databases. In each imputed base, each missing value is substituted at the end of an iterative process by an estimation. The goal in this technique is not to predict missing values as best as possible, but rather to take account of and reflect

the uncertainty associated with the missing data. Another advantage of the MI method is that it has a high degree of efficiency even when the number of imputations (*m*) is small. Rubin (1987) has shown that with only three to five imputations, excellent results can be obtained; so, it is not necessary for *m* to be very large in order to gain efficiency (in this work, *m* = 10).

Several formulations of the MI method exist which differ according to the specified models, their assumptions and their way of generating imputations. Assuming a situation of Missing-at-Random (MAR) data, the present study has used the Multivariate Imputation by Chained Equations (MICE)[9] procedure. Going by this assumption, the missing value depends on one or more other observed variables (for example, very small enterprises and small enterprises are less likely to answer questions related to the environment). This procedure makes it possible to estimate the parameters on each of the *m* samples imputed in this way, and then to estimate the final model through a combination of these *m* estimations (Rubin, 1987). The user of this method specifies the conditional distribution for the missing data of each variable containing these data (Royston, 2004). This method has the advantage of combining the imputations of variables of all kinds (continuous, binary and categorical, with more than two modalities). In the present study, the imputed variables are the average salary of permanent employees (*SALAIRE*) and ISO certification (*ISO*), with the non-response rates of 57.3% and 21.03%, respectively (the descriptive statistics in Table A3 in the Appendix show the observations for these two imputed variables).

## Measuring the variables

The present study analyses the determinants of ICT adoption in industrial firms. The data used in it enable a distinction between three types of ICT: the number of functional computers (*ORDI*), Internet connection (*INTERNET*) and the practice of online business operations (*E_AFFAIRE*). All the variables are defined and coded in detail in Table A1 (in the Appendix). The table of descriptive statistics (Table A2 in the Appendix) highlights the existence of a digital divide among industrial firms in Cameroon. And it would seem that this divide got worse over time. For example, 53% of firms had at least one working computer in 2009, compared to only 45% in 2012. Moreover, 43% had an Internet connection in 2009, compared to only 39% in 2012. Regarding business operations done via the Internet, 31% of firms did business this way in 2009 and 30% did in 2012. These surprising trends in adoption can be explained by the selection of the sample: indeed, the 2012 sample contains a higher proportion of firms from Cameroon's West Region, a region with the lowest ICT infrastructure and adoption rates. The most widespread technology is the mobile phone, with a penetration rate of 80% in 2012. This strong democratization of the mobile telephony can be explained mainly by the spectacular fall in the cost of this technology in developing countries in recent years. In addition, more than 43% of business managers adopted this technology because it would have a positive impact on their businesses.

Table 4 details the different ICT adoption rates by firm size, its sector of activity and the region in which the firm is located. In terms of analysis according to firm size, it is the VSEs (despite them being predominant in the economic environment) which are least equipped with ICT infrastructure, with only 39% of them having at least one computer, only 28% having Internet connection and only 20% doing their business operations online. These figures suggest that ICT is relatively expensive, and, thus, many VSEs, with limited financial resources, cannot afford it. The difference in ICT adoption by sector of activity is not large, although it can be noted that it is the food industries that use it least. Finally, the firms located in Douala (Cameroon's economic capital) are the most familiar with ICT, compared to those in Yaoundé and the West Region. It is the latter region that has the lowest rates: 39% for computer ownership and 17% or less for Internet connection and e-business. One explanation for this is that the region has a relatively low level of infrastructure development.

**Table 4: ICT penetration rate (in %) in the industrial firms in Cameroon**

| | *ORDI* | *INTERNET* | *E_AFFAIRE* |
|---|---|---|---|
| **Firm size** | | | |
| VSE (Very Small Enterprise) | 39.76 | 28.31 | 20.48 |
| SE (Small-sized Enterprise) | 61.46 | 52.60 | 40.63 |
| ME (Medium-sized Enterprise) | 64.20 | 57.39 | 46.59 |
| LE (Large Enterprise) | 77.53 | 75.28 | 58.43 |
| Sub-sector of activity | | | |
| Food industries | 48.68 | 32.80 | 25.40 |
| Other manufacturing industries | 51.75 | 45.80 | 34.91 |
| Construction | 55.20 | 44.80 | 34.41 |
| Region | | | |
| Douala | 57.05 | 49.09 | 37.15 |
| Yaoundé | 45.05 | 36.63 | 27.84 |
| West | 38.96 | 16.88 | 15.88 |

Source: Author's compilation.

In relation to explanatory variables, there are five types of them in the present study (they are defined and coded in detail in Table A1 in the Appendix). First, there are the *rank effects* (see Hypothesis 1), which comprise the firm age and size, the human capital of its employees, its research and development, ownership of capital (FDI) and trade openness (exports). Second, there is the *stock-and-order effect* (see Hypothesis 2) and, third, the *epidemic effect* (see Hypothesis 3), both of which will be captured through "dummy" variables representing the firm's sector of activity and the region where it is located, respectively. Fourth, there is the *organizational-practices effect* (see Hypothesis 4), which will be measured by a few organizational systems relating to the new flexible production system implemented by the firm. From the data collected emerged three organizational systems used: technology-related staff training, ISO certification and social benefits (other than transport and housing allowances and NSSF contributions) aimed at motivating employees. Fifth, there are the *manager's characteristics* (see Hypothesis 5), which are measured by his/her gender, age, education level and perceived effect of ICT.

## Estimating the empirical model

Based on the theoretical and empirical literature reviewed above, the empirical model for ICT adoption can be formulated as follows:

$$TIC_{ijr} = \alpha + \beta_R X_i^R + \beta_{SO} X_j^{SO} + \beta_E X_r^E + \beta_{PO} X_i^{PO} + \beta_D X_i^D + \varepsilon_{ijr}$$

Where, *i, j* and *r* are the indexes for type of firm, sector of activity and location of the region, respectively. β is the vector of the parameters to be estimated, $X^R$ represents the rank effects, $X^{SO}$ the stock-order effect, $X^E$ the epidemic effect, $X^{PO}$ the organizational-practices effect and $X^D$ the manager's individual characteristics. $\varepsilon$ $\varepsilon$ is the error term considered to be normally distributed. As previously specified, the ICT variable is represented by the number of functional computers (*ORDI*), by Internet connection (*INTERNET*) and by e-business (*E_AFFAIRE*).

Given the cross-sectional nature of the data and the two different types of dependent variables (quantitative and qualitative) used in the present study, two econometric techniques were used to estimate the determinants of ICT adoption by the industrial firms in Cameroon. First, the Poisson regression model was used to estimate the model with the number of computers as the explained variable, because the OLSs would not guarantee that the predicted values were non-negative. In fact, to present appropriate regression analyses when the dependent variable takes only non-negative integer values (0, 1, 2,…) and the large values represent rare events, the Poisson regression model is the natural model to choose (Cameron and Trivedi, 1986; Gurmu, 1991; Hausman et al, 1984; Lee, 1986). Typically, the distribution of such a variable tends to be skewed to the right, often including a large proportion of zeros and a long, straight tail. However, this Poisson model poses certain restrictive assumptions, the violation of which can have significant effects on the reliability and efficiency of the model's coefficients. The most notable criticism of the Poisson model concerns its assumption that the variance of the dependent variable is equal to its mean. Research has addressed some of the model's limitations by developing over-dispersion tests. Over-dispersion occurs if the variance of the distribution is greater than its mean. One approach to dealing with over-dispersed data is to use a less constraining model, such as the negative binomial model (Cameron and Trivedi, 1986; Gurmu, 1991; Lee, 1986). One of the more general counting models is the negative binomial model. In fact, the Poisson model is a special type of the negative binomial model (Cameron and Trivedi, 1986). Second, for the explained qualitative variables (Internet connection and e-business), the study used the probit model with correction of the selection bias. This is because, on the one hand, Internet connection is conditional on the availability of a computer and, on the other, e-business is conditional on Internet connection. To correct this bias, the study used the two-step estimation procedure proposed by Heckman (1979) and later refined by Van De Ven and Van Praag (1981).[10] As a first step, the study estimated a computer choice model,

and, as a second step, it calculated, for each of the firms, the Inverse Mills Ratio (IMR), which corresponds to the standard normal density function divided by the standard normal distribution function. This IMR was then introduced into the probit model of an Internet connection as an explanatory variable. The estimated $\rho$ coefficient, associated with the IMR, was then used to measure the correlation of errors between the computer-adoption model and the Internet-connection-adoption one. When this coefficient is significantly different from zero, it can be concluded that there is selection bias.[11] This method thus makes it possible to obtain consistent and asymptotically efficient estimators, unlike the simple probit. The same method was used to measure the e-business model which hinges on Internet connection.

# 5. Results

It can be affirmed that multi-collinearity between variables poses no problem in the present study. In fact, as Table A3 (in the Appendix) shows, the values of the variance inflation factor (VIF) of all the independent variables are lower than 10. Thus, the estimated models do not suffer from the problem of multi-collinearity for values of the VIF < 10 (Marquardt, 1970; Theil, 1971; Mason et al, 1989).

The results (in Tables 5a and 5b) show that the coefficient associated with the Inverse Mills Ratio is negative and significant over the two periods, thus confirming the existence of selection bias. The negative sign can be interpreted as follows: the unobserved characteristics, which positively influence the probability of having at least one computer, negatively affect the probability of having Internet connection. Likewise, the unobserved characteristics which positively influence the probability of having Internet connection negatively affect the probability of doing business transactions online. So, in order to control for the endogeneity of certain variables, the study estimated the models with and without these variables. The results show that the problem of endogeneity of the suspected variables can be minimized, since their presence (or absence) does not significantly and overall change the behaviour of the other variables.

However, the coefficients obtained from the probit model must be interpreted with caution. The absolute value taken by the estimated coefficients cannot be directly interpreted in terms of partial derivatives, or elasticities, of the explained variable compared to the explanatory variables (Greene and Hensher, 2010). What is important in these results is less the absolute value of the coefficients than their sign and degree of significance. The marginal effects (see Table A5 in the Appendix) enable an estimation of the magnitude (or differences) of the digital divide among the industrial firms in Cameroon.

**Table 5a: Estimation of ICT adoption (for the year 2009)**

| Variables | ORDI | | INTERNET | | E_AFFAIRE | |
|---|---|---|---|---|---|---|
| | | | | | | |
| ***TXUORDI*** [Computer use rate] | 1.863 | | 0.834*** | | 0.759*** | |
| | (0.376) | | (0.2547) | | (0.233) | |
| AGE1 | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| AGE2 | 0.074 | 0.199 | -0.0026 | -0.154 | 0.0468 | 0.0929 |
| | (0.208) | (0.217) | (0.141) | (0.162) | (0.139) | (0.152) |
| AGE3 | 0.665 | 0.248 | 0.217* | 0.143 | 0.186 | 0.0616 |
| | (.196) | (0.202) | (0.129) | (0.149) | (0.124) | (0.141) |

| | | | | | | |
|---|---|---|---|---|---|---|
| ***TAILLE***[Firm size] | 1.844*** | 1.432*** | 0.552*** | 0.309** | 0.359*** | 0.0235** |
| | (0.201) | (0.322) | (0.126) | (0.157) | (0.121) | (0.164) |
| ***SAL***[Salary] | 1.201*** | | 0.043 | | -0.00025 | |
| | (0.417) | | (0.062) | | (0.049) | |
| ***CADRE***[Executive] | - 0.001 | | 0.012 | | 0.0175 | |
| | (0.011) | | (0.013) | | (0.011) | |
| ***IDE*** [FDI] | 2.015*** | 2.061*** | 0.292 | 0.0709 | -0.195 | -0.283 |
| | (0.238) | (0.257) | (0.337) | (0.347) | (0.262) | (0.264) |
| EXPORT | 0.241 | - 0.116 | 0.308 | 0.0815 | 0.044 | 0.268 |
| | (0.417) | (0.429) | (0.264) | (0.312) | (0.240) | (0.267) |
| ISO9000 | - 0.432 | | 0.0010 | | 0.1675 | |
| | (0.285) | | (0.157) | | (0.150) | |
| MOTIVATION | - 0.301 | | 0.3814*** | | 0.314** | |
| | (0.244) | | (0.139) | | (0.131) | |
| ***FORMATIONTIC***[ICT training] | 0.182 | | 0.778** | | 0.448** | |
| | (0.303) | | (0.321) | | (0.247) | |
| ***HOMME***[Male] | 0.305 | 0.422 | 0.592*** | 0.0534** | 0.614*** | 0.0803* |
| | (0.269) | (1.002) | (0.163) | (0.320) | (0.167) | (0.232) |
| ***AGEDIRI1***[Manager's age] | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| AGEDIRI2 | 0.206 | 0.444 | 0.780*** | 0.166 | 0.416*** | 0.472 |
| | (0.400) | (0.420) | (0.194) | (0.494) | (0.195) | (0.389) |
| AGEDIRI3 | 0.486 | 0.567 | 0.973*** | 0.0695** | 0.622*** | 0.407** |
| | (0.386) | (0.405) | (0.191) | (0.537) | (0.189) | (0.385) |
| AGEDIRI4 | 0.105 | 0.128 | 1.109*** | 0.260* | 0.681*** | 0.507* |
| | (0.376) | (0.394) | (0.165) | (0.525) | (0.165) | (0.400) |
| ***PRIMAIRE***[Primary educ.] | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| ***SECONDAIRE***[Secondary] | - 0.759 | - 0.760 | 0.124 | -0.112 | 0.1614 | 0.0122 |
| | (0.290) | (0.304) | (0.1820) | (0.232) | (0.185) | (0.207) |
| ***BAC***[High school certificate] | 0.740 | 0.689 | 0.454** | 0.111* | 0.468** | 0.0290* |
| | (0.285) | (0.298) | (0.193) | (0.334) | (0.193) | (0.254) |
| ***BACPLUS***[Post-secondary educ.] | 0.369 | 0.575* | 0.745*** | 0.294* | 0.674*** | 0.0249** |
| | (0.209) | (0.215) | (0.140) | (0.325) | (0.138) | (0.235) |
| ***OUEST***[West Region] | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| DOUALA | 0.260 | -.357 | 0.591*** | 0.747** | 0.432*** | 0.0962 |
| | (0.405) | (0.417) | (0.141) | (0.348) | (0.141) | (0.420) |
| YAOUNDÉ | 0.137 | -0.1722 | 0.279* | 0.716** | 0.167 | 0.0794 |
| | (0.415) | (.433) | (0.159) | (0.301) | (0.162) | (0.391) |
| CONSTRUCTION | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| ***ALIMENTAIRE*** [Food industries] | - 0.195 | -1.179 | -0.611** | -0.300 | -0.431*** | -0.0945* |
| | (0.294) | (0.281) | (0.154) | (0.218) | (0.153) | (0.214) |
| ***MANUFACTURES*** [Manufacturing] | 0.148 | -0.0686 | -0.131 | 0.0269 | -0.088 | -0.0438 |
| | (0.167) | (0.177) | (0.121) | (0.150) | (0.116) | (0.131) |
| Cons. | -1.247** | -0.0700 | -3.019*** | -0.382* | -2.529*** | -1.280* |
| | (0.609) | (0.593) | (0.487) | (1.391) | (0.455) | (1.163) |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Alpha | 0.386*** | 0.826*** | | | | |
| | (0.072) | (0.108) | | | | |
| Inverse Mills Ratio | | | -0.228* | -1.188** | -0.183* | -1.481*** |
| | | | (0.125) | (0.310) | (0.094) | (0.372) |
| Pseudo R2 | 0.284 | 0.143 | | | | |
| Obs. | 775 | | 417 | | 340 | |

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Ref.: Reference variable.

## Table 5b: Estimation ICT adoption (for the year 2012)

| Variables | ORDI | | INTERNET | | E_AFFAIRE | |
|---|---|---|---|---|---|---|
| | | | | | | |
| ***TXUORDI***[Computer use rate] | 0.995 | | 2.215** | | 0.951 | |
| | (0.455) | | (0.899) | | (0.734) | |
| ***EFFETPERCU*** [Perception-of-use effect] | 1.733 | | 2.763*** | | 1.869* | |
| | (0.366) | | (0.890) | | (1.049) | |
| AGE1 | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| AGE2 | 0.072 | 1.156 | 0.684 | 1.183 | -0.533 | -1.228** |
| | (0.346) | (0.424) | (0.598) | (0.736) | (0.5007) | (0.608) |
| AGE3 | 0.230 | 1.939 | -0.232 | 0.287 | 0.033 | -0.180 |
| | (0.310) | (.374) | (0.491) | (0.563) | (0.432) | (0.486) |
| ***TAILLE***[Size] | 0.999*** | 9.68*** | 1.411** | 0.519** | 0.654 | 0.797 |
| | (0.292) | (1.032) | (0.577) | (0.610) | (0.476) | (0.494) |
| ***SAL***[Salary] | 0.854** | | 0.216** | | 0.043 | |
| | (0.497) | | (0.105) | | (0.0767) | |
| ***CADRE*** [Executive] | - 0.0009 | | -0.0172 | | -0.0099 | |
| | (0.018) | | (0.0141) | | (0.026) | |
| ***IDE***[FDI] | 0.292* | 0.346* | 0.386 | | -0.014 | |
| | (0.276) | (0.466) | (0.723) | | (0.461) | |
| EXPORT | 0.382 | 0.182 | -0.0412 | -0.0192 | -0.326 | -0.511 |
| | (0.275) | (0.354) | (0.456) | (0.502) | (0.378) | (0.426) |
| ISO9000 | - 0.209 | | | | 0.985 | |
| | (0.352) | | | | (0.661) | |
| MOTIVATION | 0.123 | | 0.771* | | 0.032* | |
| | (0.313) | | (0.605) | | (0.434) | |
| ***FORMATIONTIC*** [ICT training] | - 1.922 | | 1.0178* | | 1.199* | |
| | (0.640) | | (1.243) | | (1.151) | |
| INNOVORG | 1.824 | | 0.323 | | 0.106 | |
| | (0.175) | | (0.529) | | (0.411) | |
| ***FORMEL***[Formal] | 1.706 | | -0.157 | | 0.3670 | |
| | (5.563) | | (0.966) | | (0.605) | |
| ***HOMME***[Male] | 0.102 | 0.677 | 0.318** | 0.414* | 0.472* | 0.517* |
| | (0.411) | (0.512) | (0.149) | (0.881) | (0.118) | (0.662) |
| ***AGEDIRI1*** [Manager's age] | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| AGEDIRI2 | -0.058 | 0.643 | -0.227 | -0.148 | 0.202 | 0.127 |
| | (0.365) | (0.463) | (0.596) | (0.678) | (0.506) | (0.575) |
| AGEDIRI3 | 0.025 | 0.732 | 0.101 | -0.155 | 0.635 | 0.798 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (0.374) | (0.484) | (0.596) | (0.701) | (0.508) | (0.605) |
| AGEDIRI4 | 0.728** | 1.764*** | -0.0190 | 0.00135 | 1.260*** | 1.328** |
| | (0.310) | (0.414) | (0.568) | (0.598) | (0.482) | (0.542) |
| ***PRIMAIRE***[Primary educ.] | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| ***SECONDAIRE***[Secondary] | 0.404 | 0.414 | -0.6305 | -0.760 | 1.028 | 1.783** |
| | (0.451) | (0.524) | (0.7102) | (0.813) | (0.646) | (0.808) |
| ***BAC***[High school cert.] | 0.600 | 0.313 | 1.351** | 1.103* | 0.331 | -0.194 |
| | (.452) | (.576) | (0.684) | (0.771) | (0.682) | (0.777) |
| ***BACPLUS***[Post-sec. educ.] | 0.285 | 1.211* | 0.329 | 0.769 | 1.140** | 1.004** |
| | (0.328) | (0.363) | (0.5103) | (0.595) | (0.462) | (0.488) |
| ***OUEST***[WEST] | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| DOUALA | 0.743 | 0.084* | 1.371** | 1.206* | 1.059* | 1.861*** |
| | (0.340) | (0.498) | (0.669) | (0.709) | (0.551) | (0.691) |
| YAOUNDÉ | 0.208 | 0.101 | 0.9202 | 0.689 | -0.423 | -0.931 |
| | (0.356) | (0.541) | (0.588) | (0.609) | (0.523) | (0.652) |
| CONSTRUCTION | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| ***ALIMENTAIRE*** [Food industries] | 0.034 | 0.392 | -0.242 | -0.0122 | 0.086 | 0.171 |
| | (0.359) | (0.506) | (0.629) | (0.699) | (0.571) | (0.648) |
| ***MANUFACTURES*** [Manufacturing] | 0.032 | 0.345 | 0.874 | 0.911 | 0.256 | 0.241 |
| | (0.315) | (0.464) | (0.604) | (0.619) | (0.472) | (0.544) |
| Cons | - 1.555* | - 0.909 | -6.697*** | -0.812 | -3.141** | 0.774 |
| | (0.811) | (0.675) | (2.107) | (1.235) | (1.562) | (1.154) |
| | | | | | | |
| Alpha | 0.455*** | 1.952*** | | | | |
| | (0.098) | (0.343) | | | | |
| Inverse Mills Ratio | | | -0.859*** | -1.435*** | -0.431** | -0.961*** |
| | | | (0.316) | (0.419) | (0.186) | (0.260) |
| Pseudo R2 | 0.285 | 0.113 | | | | |
| Obs. | 178 | | 80 | | 69 | |

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Ref.: Reference variable.

In relation to the *rank effects*, the size of a firm and the presence of foreign capital in it were found to significantly influence ICT adoption, especially the use of computers. Despite the fall in the prices of computer hardware and components, as well as in the cost of information and communications processing, in recent years, ICT adoption is still low in small enterprises with limited financial resources. It can, therefore, be concluded that the financial factor is still a determinant of ICT adoption by firms in in Cameroon. Furthermore, according to Mansfield (1961), SME managers tend to have a risk aversion. Yet, investing in new technologies necessarily involves some risk. This explains the positive relationship that was observed between the size of a firm and its adoption of ICT. Another explanation could be that small and very small enterprises have not adopted organizational strategies and practices capable of enabling them to adopt new technologies. This influence of firm size was previously established by Machikita et al (2010), Agyire-Tettey (2015) and Benabderrahmen et al (2016). On the other hand, Kontolaimou and Skintzi (2018) found a negative relationship between the

size of a firm and its adoption of e-commerce. A possible explanation could be sought from the greater flexibility of small enterprises (than of larger ones) and the need to gain a competitive advantage over large enterprises in order to survive. The same negative relationship was also observed by Bayo-Moriones and Lera-López (2007). The influence of a firm's employees' human capital (measured by *SAL*) was found to have a positive and significant effect on the use of computers and the Internet. This means that a workforce with a high-level human capital is often required to facilitate the adoption of new technologies. In connection with this, Kossai et al (2010) found that the human capital of a firm's salaried employees was the most significant explanatory variable for ICT adoption in Tunisia. The present study's results confirm that the contribution of the employees who are computer-literate is a determinant of a firm's ICT option. Ssewanyana and Busler (2007) recommended extended training on ICT for employees, notably in how to use computers and the Internet. Taking into account the significance of several variables related to the rank effects, it can be concluded that the present study's Hypothesis 1 has been confirmed, overall.

Like the employees' human capital, that of the manager was also found to be positively and significantly related to the adoption of the Internet and online business operations. Since investment in ICT is a source of productivity gains, the use of digital tools requires qualified managers, that is, those with a high level of human capital. In addition, given the uncertainty accompanying the introduction of new products and processes, it is the managers with the highest human capital – the most knowledgeable and qualified managers – who can handle them and thus make the most of the new technologies. Further, the managers' positive perception of the Internet on their businesses was also found to have a positive impact on ICT adoption. Knowing that in Cameroon more than 90% of firms are SMEs and VSEs, a manager's human capital is essential. Under a business manager, the VSEs and SMEs are mainly simple and highly centralized structures where, in most cases, the owner and the manager are one and the same person. The study also found that the manager's gender and age influenced ICT adoption, with men and older people having a greater influence. A number of studies in Africa have revealed the significance of a business manager's education level (Kossai et al, 2010; Appiah et al, 2016; Thuo et al, 2017; Ben Youssef et al, 2015), his/her perception and his/her gender (Ochola, 2015; Adebimpe, 2014) on ICT adoption. It can therefore be concluded that the present study's Hypothesis 5 stating that the *manager's profile* will influence the level of ICT adoption by a firm has been confirmed.

In relation to the *stock-order effect* and the *epidemic effect*, the study found that the chances of a firm adopting the Internet and doing business online were higher for firms in the construction industry (for the stock-order effect) and those in the city of Douala (for the epidemic effect). These results suggest that a firm is more likely to adopt ICT than not if it belongs to a sector or is located in a region where the level of adoption of ICT is already high. They corroborate the results obtained by studies by Karshenas and Stoneman (1993) and Bocquet and Brossard (2008), which did not observe the expected effect (a negative sign). This positive effect of the *stock-order*

*effect*, which was also observed by Ben Khalifa (2014), can be attributed to behaviour characterized by social conformism, transmission of information between firms, or even to market behaviour which encourages those who had not adopted ICT to do so if they want to remain competitive. Indeed, the firms that face strong competition are more inclined to innovate and adopt new technologies, such as ICT, in order to improve their performance and increase their chances of survival (Porter, 1990). This will therefore result in greater intra-sectoral and intra-regional homogeneity in terms of ICT adoption behaviour than between the different sectors. In some sectors, several businesses adopt ICT and encourage the others to do so, while in other sectors the majority of establishments do not adopt it and encourage others not to as well. This type of adoption behaviour was also found among firms that were geographical neighbours (the *epidemic effect*). The epidemic effects affecting the adoption of new technologies have to do with the characteristics of the environment in which the firms operate, such as the density of these firms, information and knowledge spillovers and network externalities. Technology diffusion is geographically localized while information spillover decreases as the geographical distance between firms increases (Jaffe et al, 1993; Keller, 2002). In addition, being part of a network makes it possible to make the new technology better known and to reduce the risks associated with its adoption (Gourlay and Pentecost, 2002). Furthermore, network externalities are positively related to the number of users of the new technology (Oulton, 2002).

It was therefore observed that in terms of ICT adoption, firms behaved in the same way as their peers, regardless of type of proximity (sectoral or geographical). In addition, the sectoral effect was found to disappear over time: it was no longer significant in 2012. To be competitive, firms must have adopted similar technologies as their competitors in the same sector. These technologies enabled them to build or maintain entry barriers (Robertson and Gatignon, 1986). So, while Hypothesis 3 was confirmed, Hypothesis 2 was not. It can, therefore, be concluded that the present study's proximity hypotheses show that today ICT adoption by firms in Cameroon is a consequence of a geographical (or spatial) effect, which in turn may be an infrastructural problem.

Regarding the impact of *organizational practices*, the study found that employee training and motivation influenced ICT adoption (mainly the Internet and e-business). This finding, which confirmed its Hypothesis 4, also corroborates those made by several other studies which found that ICT adoption was preceded by organizational changes in the firm in order to make the most of the new technology in terms of productivity and growth (Ben Youssef et al, 2014; World Bank, 2016a, Cirera et al, 2016; Benabderrahmen et al, 2016).

The results of the Chow (1960) test[12] suggest that the behaviour of the firms considered in the present study was the same irrespective of the year considered (Table A4 in the Appendix). In other words, there was no significant break between the two groups of firms (those of 2009 and those of 2012). But it would also be appropriate to group them into a single series, since the theoretical coefficients of the study's model were stable over time; that is, the coefficients of the two linear series were equal (Prob>

chi2> 1% or Prob> F> 1 %). Disruption of behaviour from one group to the other (from one year to the next) could be caused by public policy or by a random shock.

Table A5 (in the Appendix, on the marginal effects) shows that the gap in ICT adoption narrowed over time. Several factors that determined the differences in ICT adoption in 2009 (firm size, its age, its location, etc.) were no longer relevant in 2012. On the other hand, employee motivation was found to increase the probability of the firms adopting the Internet and doing e-business by 10 points in 2009, compared to only 1 point in 2012. Being a manager with a university education level increased the probability of adopting the Internet and e-business by 26 points in 2009, compared to less than 10 points in 2012. These results show that, over time, those factors became less and less important with reference to ICT adoption. The manager's perception was found to be the most important factor in explaining the digital divide in 2012: a manager who had a positive perception of the Internet use had a 34% probability of adopting it and doing e-business in 2009 and a 41% probability in 2012. However, as the Chow test showed these differences between 2009 and 2012 were not statistically significant and can, therefore, be ignored.

The present study's findings are robust with regard to comparisons of the estimations of the model with imputations (Table 5) and that without imputations (Table A6 in the Appendix). Indeed, with the exception of a few differences in figures, the variables determining ICT adoption were practically the same with the same effects regardless of the model estimated (whether it was the model with correction of non-response or the one without correction of non-response). Table A6 (in the Appendix) presents the results of the ICT adoption model without correction of non-response. An additional robustness test (see Table A7 in the Appendix) shows that ICT adoption did not vary by sector of activity for firms of the same size. In other words, the interaction variables (size-sector of activity) were not significant, which means that there was no specificity of ICT adoption linked to the size of the firms being compared, notably by sector of activity.

# 6. Conclusion

The present study analysed the determinants of the digital divide in Cameroon. Its research hypotheses were empirically tested on two samples of industrial firms (from the year 2009 and the year 2012). It used a negative binomial model and a probit model with correction of the selection bias. Its findings highlight the significant role of firm size, employees' absorptive capacity (human capital and proportion of employees capable of using ICT), organizational practices, regional effect and managerial effect on ICT adoption. However, the discriminatory effect of these variables diminished over time.

Some lessons for the development of an ICT diffusion policy can be drawn from this study. In terms of industrial policy, in order to be able to accelerate the diffusion of ICT in the Cameroonian economic environment and, thus, to enhance competitiveness, it is essential to promote organizational changes in firms. But it is worth making it clear here that it is the quality of skills and the ability to use ICT, and not the presence of qualified employees (or executives), that determine the level of ICT use in firms in Cameroon. It is, therefore, important to rethink the education and training systems in order to improve the quality of graduates and employees in general. But, above all, specific training for the promoters or managers with a low education level should be promoted. In this regard, it will be a question of opening a window for them on the possibilities offered by ICT in order to make them realize the full potential of this technology in their firms. The government should also offer incentives on the tax exemption of computer equipment to enable ICT adoption to spread to all firms, including the very small and the small enterprises with limited financial resources.

By making the most of the benefits of ICT, the Internet could be used to facilitate the diversification of the activities of the SMEs, thereby increasing their productivity. In this regard, Hollenstein (2004) points out that the development of the Internet leads to an explosion of new functions and new professions, as well as a transformation of existing ones, and to creation of new businesses and a reorganization of existing ones. In addition, the impact of ICT on the SMEs will be more significant if other conditions are met, such as improving the business climate. Finally, the provision of equipment and infrastructure (electricity, broadband Internet connection, etc.) that facilitate ICT adoption in remote geographical areas, coupled with the promotion of ICT use in the sectors of activity that do not use ICT a great deal, would not only reduce the digital divide among firms, but would also enable the industrial firms in Cameroon and the country itself to catch up, in terms of technology use, with more developed regions and countries.

Considering the important contribution of ICT to business and society, African governments should refrain from ordering Internet disruptions. These have occurred mostly in the run-up to elections (in Chad, Gabon, Gambia, Republic of Congo and Uganda), during public protests (in Burundi, Cameroon, Democratic Republic of Congo, Ethiopia, Mali, Niger and Togo) and during the national examinations (in Ethiopia). Far from promoting stability, as the governments hope they do, such disruptions instead harm economic activity and disrupt normal order. In fact, Internet shutdowns cost sub-Saharan African countries around US$237 million between 2015 and 2017 (CIPESA, 2017). The longest shutdown was recorded in Cameroon, lasting 93 days from 16 January 2017 in its English-speaking regions. It cost the country's economy US$38.8 million (CIPESA, 2017). It should be noted that the negative effects of Internet disruptions persist long after the Internet has been restored: they disrupt supply chains and affect investor confidence, among other things. Future research could more accurately assess the impact of Internet disruptions at both the micro- and the macro-level.

# Notes

1 The ICT Development Index (IDI) is a benchmark measure composed of 11 indicators; it was designed to monitor and compare progress made in information and communications technologies (ICT) in different countries. The IDI ranks countries based on their performance in terms of ICT infrastructure and use and related skills.

2 The affordability index is a composite index, composed of two sub-indexes that measure the impact of two affordability drivers: the infrastructure sub-index (measuring the availability and quality of infrastructure and the policies that encourage its development) and the access sub-index (measuring broadband adoption rates and policies that facilitate broadband adoption). This index ranges between 0 and 100. An index close to 100 indicates high Internet penetration rates, accompanied by strong policies promoting Internet penetration.

3 Doing Business in Cameroon, No. 51, May 2017; www.businessincameroon.com

4 Boschma (2005) distinguishes five types of proximity that can affect innovation: cognitive, organizational, social, institutional and geographical. As specified, it is geographical proximity that is at issue here; it is defined as the spatial distance between the actors (i.e., businesses).

5 Fabiani et al (2005); Hollenstein and Woerter (2008); Haller and Siedschlag (2011).

6 Indjikian and Siegel (2005); Gallego et al (2015); Adnan and Rakibul (2017).

7 Botswana, Cameroon, Ethiopia, Ghana, Kenya, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, Zambia and Zimbabwe.

8 The cleaning-up carried out by the INS consisted in identifying unusual cases in the data and, as far as possible, in correcting them. They were corrected for each survey questionnaire. In addition, certain data essential for the analysis were not always provided during the surveys. An adjustment for not obtaining these essential data will thus have to be made in the present study for the comparability of the results.

9 The results are to be taken with caution because although this assumption is realistic, it remains strong (not testable) (Royston, 2004). In addition, a comparison will be made of the results with and those without imputation in order to verify their robustness. This technique has already been used by Fambeu (2017).

10 Van De Ven and Van Praag (1981) note that this two-step approach is approximately accurate.

11 Correcting selection bias can, however, lead to heteroscedasticity. To correct this problem, the STATA software enables one to use the Huber-White sandwich estimator.

12 The Chow test is simply a test done to determine if the coefficients estimated on one group of data are equal to the coefficients estimated on another.

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# Appendix

### Table A1: Description of the variables

| VARIABLES | DEFINITION |
|---|---|
| **Dependent variables** | |
| **ORDI** | Number of functional computers |
| **ORDI1** | = 1 if the firm has at least one functional computer and 0 if not |
| **INTERNET** | = 1 if the firm has Internet connection and 0 if not |
| **E_AFFAIRE** | = 1 if the firm does business operations online and 0 if not |
| **Rank variables** | |
| **TXUORDI** | Proportion of permanent employees who are computer-literate |
| **AGE** | *AGE1*=1 if the age of the firm is < 5 years and 0 if not (ref. group.)<br>*AGE2*=1 if 5-9 years and 0 if not<br>*AGE3*= 1 if 10 years and more and 0 if not |
| **TAILLE [Size]** | Log of the number of permanent employees |
| **SALAIRE [Salary]** | Log of the permanent employees' average salary |
| **CADRE [Executive]** | = 1 if there is at least one executive in the firm and 0 if not |
| **IDE [FDI]** | = 1 if the firm is a subsidiary of foreign company and 0 if not |
| **EXPORT** | = 1 if the firm's production is mainly intended for export and 0 if not |
| **FORMEL [Formal]** | = 1 if the firm has a taxpayer number and 0 if not |
| **Stock-order variables** | |
| **Sector of activity** | *ALIMENTAIRE*= 1 if the firm is a food-industry one and 0 if not<br>*MANUFACTURES*= 1 if the firm is one of the other manufacturing industries and 0 if not<br>*CONSTRUCTION*= 1 if the firm is in the construction industry and 0 if not |
| **Epidemic variables** | |
| **Region (of Cameroon)** | *DOUALA*= 1 if the firm is located in Douala; *YAOUNDÉ*= 1 if the firm is located in Yaoundé; *OUEST*=1 if the firm is located in the West Region |
| **Organizational variables** | |
| **MOTIVATION** | = 1 if the firm pays social benefits other than transport and housing allowances and NSSF contributions with the aim of motivating its employees and 0 if does not |
| **FORMATIC** | = 1 if the firm has trained its employees on ICT and 0 if it has not |
| **INNOVORG** | 1 if the firm has effected organizational innovation and 0 if not |
| **ISO** | = 1 if the firm has received an ISO certification and 0 if has not |
| **Manager's characteristics** | |
| **HOMME [Man]** | = 1 if the manager is male and 0 if not |

| | |
|---|---|
| **AGEDIRI** | *AGEDIRI1*= 1 if he/she is 21-31 years old and 0 if not (ref. group)<br>*AGEDIRI2*= 1 if he/she is 32-42 years old and 0 if not<br>*AGEDIRI3*=1 if he/she is 43-53 years old and 0 if not<br>*AGEDIRI4*= 1 if he/she is 54 years and above and 0 if not |
| **EDUCATION** | *PRIMAIRE*= 1 if the manager did not go beyond primary school and 0 if he/she did (ref. group); *SECONDAIRE*= 1 if the manager's education level is just secondary school and 0 if otherwise; *BAC*= 1 if his/her highest level is the high school certificate and 0 if otherwise; *BACPLUS*= 1 if his/her highest education level is at least *Bac + 2* [2 years of post-secondary school] and 0 if otherwise |
| **EFFETPERCU** | = 1 if the manager thinks that the Internet has a positive effect on his/her firm |

## Table A2: Descriptive statistics

| | 2009 | | | | | 2012 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **Obs.** | **Mean** | **Std. Dev.** | **Min** | **Max** | **Obs.** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| **ORDI** | 775 | 0.8203321 | 5.814077 | 0 | 120 | 178 | 7.453901 | 17.53709 | 0 | 150 |
| **ORDI1** | 775 | 0.5380645 | 0.4988709 | 0 | 1 | 178 | 0.4494382 | 0.4988401 | 0 | 1 |
| **INTERNET** | 775 | 0.4387097 | 0.4965497 | 0 | 1 | 178 | 0.3876404 | 0.4885862 | 0 | 1 |
| **E_AFFAIRE** | 775 | 0.3341935 | 0.4720124 | 0 | 1 | 178 | 0.3033708 | 0.4610108 | 0 | 1 |
| **MOBILE** | | | | | | 178 | 0.7977528 | 0.4028087 | 0 | 1 |
| **TXUORDI** | 775 | 0.4541622 | 0.229132 | 0 | 1 | 178 | 0.5213067 | 0.3510656 | 0 | 1 |
| **EFFETPERCU** | | | | | | 178 | 0.4382022 | 0.497566 | 0 | 1 |
| **AGE1** | 775 | 0.2696774 | 0.4440788 | 0 | 1 | 178 | 0.3202247 | 0.4678789 | 0 | 1 |
| **AGE2** | 775 | 0.2735484 | 0.4460677 | 0 | 1 | 178 | 0.2191011 | 0.4148041 | 0 | 1 |
| **AGE3** | 775 | 0.396129 | 0.4894077 | 0 | 1 | 178 | 0.3707865 | 0.4843779 | 0 | 1 |
| **LNTAILLE** | 775 | 0.4749082 | 0.5258548 | 0 | 1.386 | 178 | 0.4593615 | 0.5279217 | 0 | 1.386 |
| **CADRE** | 775 | 1.753658 | 5.607137 | 0 | 119 | 178 | 4.089888 | 19.36923 | 0 | 253 |
| **LNSAL** | 331 | 7.052832 | 1.047874 | 3.113 | 11.988 | 110 | 8.396741 | 3.496723 | 0 | 16.585 |
| **IDE** | 775 | 0.0374194 | 0.1899097 | 0 | 1 | 178 | 0.1235955 | 0.3300479 | 0 | 1 |
| **EXPORT** | 775 | 0.0425806 | 0.2020401 | 0 | 1 | 178 | 0.4775281 | 0.5009038 | 0 | 1 |
| **ISO9000** | 612 | 0.1187097 | 0.3236555 | 0 | 1 | 93 | 0.0561798 | 0.2309181 | 0 | 1 |
| **MOTIVATION** | 775 | 0.1909677 | 0.3933175 | 0 | 1 | 178 | 0.6516854 | 0.4777803 | 0 | 1 |
| **FORMATIONTIC** | 775 | 0.04 | 0.1960857 | 0 | 1 | 178 | 0.8764045 | 0.3300479 | 0 | 1 |
| **INNOVORG** | | | | | | 178 | 0.5617978 | 0.497566 | 0 | 1 |
| **FORMEL** | | | | | | 178 | 0.3932584 | 0.4898513 | 0 | 1 |
| **HOMME** | 775 | 0.7367742 | 0.4406683 | 0 | 1 | 178 | 0.7865169 | 0.4109218 | 0 | 1 |
| **AGEDIRI1** | 775 | 0.0258065 | 0.1586599 | 0 | 1 | 178 | 0.3314607 | 0.4720661 | 0 | 1 |
| **AGEDIRI2** | 775 | 0.1535484 | 0.3607481 | 0 | 1 | 178 | 0.2303371 | 0.4222363 | 0 | 1 |
| **AGEDIRI3** | 775 | 0.163871 | 0.3703975 | 0 | 1 | 178 | 0.1629213 | 0.3703356 | 0 | 1 |
| **AGEDIRI4** | 775 | 0.3509677 | 0.4775811 | 0 | 1 | 178 | 0.241573 | 0.4292442 | 0 | 1 |
| **PRIMAIRE** | 775 | 0.0348387 | 0.1834896 | 0 | 1 | 178 | 0.2134831 | 0.4109218 | 0 | 1 |
| **SECONDAIRE** | 775 | 0.116129 | 0.3205865 | 0 | 1 | 178 | 0.247191 | 0.4325956 | 0 | 1 |
| **BAC** | 775 | 0.0941935 | 0.2922864 | 0 | 1 | 178 | 0.0955056 | 0.2947411 | 0 | 1 |
| **BACPLUS** | 775 | 0.3819355 | 0.4861746 | 0 | 1 | 178 | 0.3707865 | 0.4843779 | 0 | 1 |
| **DOUALA** | 775 | 0.6451613 | 0.4787734 | 0 | 1 | 178 | 0.5786517 | 0.495168 | 0 | 1 |
| **YAOUNDÉ** | 775 | 0.2877419 | 0.4530025 | 0 | 1 | 178 | 0.2808989 | 0.450706 | 0 | 1 |
| **OUEST** | 775 | 0.670968 | 0.2503511 | 0 | 1 | 178 | 0.1404494 | 0.3484328 | 0 | 1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **ALIMENTAIRE** | 775 | 0.1987097 | 0.3992867 | 0 | 1 | 178 | 0.1966292 | 0.3985707 | 0 | 1 |
| **MANUFACTURES** | 775 | 0.483871 | 0.5000625 | 0 | 1 | 178 | 0.6292135 | 0.4843779 | 0 | 1 |
| **CONSTRUCTION** | 775 | 0.3174194 | 0.4657727 | 0 | 1 | 178 | 0.1741573 | 0.3803145 | 0 | 1 |

### Table A3: Values of the variance inflation factor (VIF)

| 2009 | | | 2012 | | |
|---|---|---|---|---|---|
| **Variable** | **VIF** | **1/VIF** | **Variable** | **VIF** | **1/VIF** |
| **AGEDIRI4** | 4.14 | 0.241419 | FORMEL | 4.54 | 0.220272 |
| **AGEDIRI3** | 3.43 | 0.291880 | DOUALA | 3.17 | 0.315341 |
| **AGEDIRI2** | 3.24 | 0.308709 | YAOUNDÉ | 3.13 | 0.319973 |
| **BACPLUS** | 2.16 | 0.462135 | TAILLE | 2.90 | 0.344296 |
| **DOUALA** | 1.84 | 0.542009 | EFFETPERCU | 2.54 | 0.393630 |
| **SECONDAIRE** | 1.82 | 0.550528 | BACPLUS | 2.28 | 0.437732 |
| **BAC** | 1.74 | 0.574296 | MANUFACTURES | 2.27 | 0.441065 |
| **YAOUNDÉ** | 1.73 | 0.578073 | ALIMENTAIRE | 2.13 | 0.468746 |
| **ALIMENTAIRE** | 1.69 | 0.590433 | AGE3 | 2.06 | 0.486252 |
| **AGE3** | 1.67 | 0.598809 | AGEDIRI4 | 1.98 | 0.505789 |
| **AGE2** | 1.60 | 0.624448 | TXUORDI | 1.79 | 0.557313 |
| **TAILLE** | 1.53 | 0.651599 | SECONDAIRE | 1.63 | 0.611955 |
| **MANUFACTURES** | 1.49 | 0.671256 | AGEDIRI3 | 1.59 | 0.628791 |
| **TXUORDI** | 1.39 | 0.720030 | MOTIVATION | 1.54 | 0.648288 |
| **CADRE** | 1.27 | 0.786373 | AGEDIRI2 | 1.52 | 0.658739 |
| **MOTIVATION** | 1.19 | 0.839145 | IDE | 1.49 | 0.671623 |
| **IDE** | 1.19 | 0.840716 | BAC | 1.46 | 0.685122 |
| **FORMATIONTIC** | 1.16 | 0.859792 | AGE2 | 1.44 | 0.693880 |
| **ISO9000** | 1.11 | 0.896891 | EXPORT | 1.43 | 0.698440 |
| **EXPORT** | 1.05 | 0.948495 | CADRE | 1.43 | 0.701661 |
| | | | FORMATION | 1.22 | 0.817324 |
| | | | ISO9000 | 1.19 | 0.837634 |
| | | | | | |
| **Mean VIF** | 1.82 | | Mean VIF | 2.03 | |

### Table A4: Chow test results (combined data for 2009 and 2012)

| | **ORDI** | **INTERNET** | **E-AFFAIRE** |
|---|---|---|---|
| **F (21.545) or chi2 (21)** | 5.96 | 13.60 | 15.55 |
| **Prob > F or Prob > chi2** | 0.2376 | 0.8863 | 0.7945 |
| **Obs.** | 953 (775+178) | | |

### Table A5: Marginal effects

| | **2009** | | **2012** | |
|---|---|---|---|---|
| **Variables** | **INTERNET** | **E_AFFAIRES** | **INTERNET** | **E_AFFAIRES** |
| | | | | |
| **TXUORDI** | 0.317*** | 0.246*** | 0.295 | 0.137 |
| | (0.0948) | (0.0750) | (0.232) | (0.0958) |
| **EFFETPERCU** | | | 0.628*** | 0.411*** |

| | | | | |
|---|---|---|---|---|
| | | | (0.210) | (0.116) |
| **AGE1** | Ref. | Ref. | Ref. | Ref. |
| **AGE2** | -0.0142 | 0.00455 | 0.236 | -0.0130 |
| | (0.0519) | (0.0442) | (0.225) | (0.0621) |
| **AGE3** | 0.0785* | 0.0624 | 0.00284 | 0.0332 |
| | (0.0476) | (0.0400) | (0.0961) | (0.0725) |
| **TAILLE** | 0.218*** | 0.136*** | 0.0439 | 0.00360 |
| | (0.0465) | (0.0382) | (0.119) | (0.0711) |
| **SAL** | | | 0.0296 | 0.0109 |
| | | | (0.0265) | (0.0108) |
| **CADRE** | 0.00440 | 0.00526 | -0.00135 | -0.000443 |
| | (0.00473) | (0.00346) | (0.00220) | (0.00219) |
| **IDE** | 0.121 | -0.0565 | | |
| | (0.129) | (0.0731) | | |
| **EXPORT** | 0.120 | 0.0174 | 0.0848 | -0.0261 |
| | (0.100) | (0.0778) | (0.124) | (0.0490) |
| **ISO9000** | 0.0188 | 0.0672 | | |
| | (0.0592) | (0.0518) | | |
| **MOTIVATION** | 0.140*** | 0.106** | 0.0816 | 0.0138* |
| | (0.0531) | (0.0456) | (0.104) | (0.0559) |
| **FORMATIONTIC** | 0.279** | 0.131 | | |
| | (0.119) | (0.0917) | | |
| **INNOVORG** | | | 0.0488 | 0.0309 |
| | | | (0.0854) | (0.0511) |
| **FORMEL** | | | 0.0782 | 0.0207 |
| | | | (0.164) | (0.0709) |
| **HOMME** | 0.0154 | (0.088) | (0.0114) | (0.1004) |
| | (0.0887) | (0.088) | (0.088) | (0.0777) |
| **AGEDIRI1** | Ref. | Ref. | Ref. | Ref. |
| **AGEDIRI2** | 0.381*** | 0.233*** | -0.0722 | 0.00869 |
| | (0.0648) | (0.0700) | (0.0867) | (0.0674) |
| **AGEDIRI3** | 0.453*** | 0.316*** | 0.0756 | 0.128 |
| | (0.0594) | (0.0672) | (0.166) | (0.126) |
| **AGEDIRI4** | 0.503*** | 0.325*** | -0.0164 | 0.236 |
| | (0.0497) | (0.0535) | (0.0965) | (0.146) |
| **PRIMAIRE** | Ref. | Ref. | Ref. | Ref. |
| **SECONDAIRE** | 0.0840 | 0.0907 | -0.0845 | 0.0648 |
| | (0.0697) | (0.0654) | (0.111) | (0.119) |
| **BAC** | 0.219*** | 0.209*** | 0.455 | 0.0606 |
| | (0.0744) | (0.0734) | (0.326) | (0.140) |
| **BACPLUS** | 0.322*** | 0.260*** | 0.0514 | 0.110* |
| | (0.0500) | (0.0466) | (0.121) | (0.0991) |
| **OUEST** | Ref. | Ref. | Ref. | Ref. |
| **DOUALA** | 0.216*** | 0.143*** | 0.226 | -0.111 |
| | (0.0490) | (0.0432) | (0.187) | (0.0987) |
| **YAOUNDÉ** | 0.109* | 0.0626 | 0.200 | -0.0375 |
| | (0.0612) | (0.0546) | (0.215) | (0.0604) |
| **CONSTRUCTION** | Ref. | Ref. | Ref. | Ref. |

| | | | | |
|---|---|---|---|---|
| **ALIMENTAIRE** | -0.220*** | -0.134*** | -0.102 | 0.140 |
| | (0.0467) | (0.0402) | (0.211) | (0.144) |
| **MANUFACTURES** | -0.0576 | -0.0352 | 0.0335 | 0.0307 |
| | (0.0442) | (0.0368) | (0.103) | (0.0599) |
| **Inverse Mills Ratio** | -0.0517 | -0.0507 | -0.126 | 0.0570* |
| | (0.120) | (0.0724) | (0.445) | (0.0313) |
| | | | | |
| **Obs.** | 946 | 340 | 178 | 70 |

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Ref.: Reference variable.

## Table A6: ICT adoption estimation (without imputation)

| | 2009 | | | 2012 | | |
|---|---|---|---|---|---|---|
| **Variables** | **ORDI** | **INTERNET** | **E_AFFAIRE** | **ORDI** | **INTERNET** | **E_AFFAIRE** |
| **TXUORDI** | 1.157 | 0.856*** | 0.413*** | -0.463 | 1.128* | 0.592 |
| | (1.208) | (0.300) | (0.338) | (4.953) | (1.191) | (0.936) |
| **AGE2** | -0.0307 | -0.119 | 0.0827 | -0.0392 | 1.170 | -0.747 |
| | (0.741) | (0.172) | (0.153) | (3.640) | (0.897) | (0.679) |
| **AGE3** | 1.107 | 0.181 | 0.112 | 4.710 | 0.205 | -0.0766 |
| | (0.703) | (0.151) | (0.149) | (3.723) | (0.666) | (0.493) |
| **TAILLE** | 1.729*** | 0.055* | 0.012 | 11.20*** | 0.494** | 0.692 |
| | (0.629) | (0.169) | (0.227) | (4.120) | (0.718) | (0.534) |
| **SAL** | 1.502** | 0.763 | 1.175** | 0.807** | 0.301* | 0.158 |
| | (0.923) | (0.694) | (0.512) | (1.274) | (0.385) | (0.527) |
| **CADRE** | -0.0261 | -0.00385 | 0.00658 | 0.242 | 0.0698 | -0.0122 |
| | (0.0450) | (0.0233) | (0.0137) | (0.355) | (0.0747) | (0.0396) |
| **IDE** | 6.162*** | 0.0825 | -0.311 | 7.979* | 0.816 | -0.0655 |
| | (1.264) | (0.362) | (0.273) | (4.524) | (1.162) | (0.494) |
| **EXPORT** | 0.365 | 0.116 | -0.231 | 0.294 | 0.368 | -0.376 |
| | (1.415) | (0.315) | (0.275) | (3.039) | (0.701) | (0.439) |
| **ISO** | -0.674 | 0.0299 | 0.109 | -2.264 | | 1.086* |
| | (0.843) | (0.185) | (0.168) | (5.986) | | (0.652) |
| **MOTIVATION** | -0.857 | 0.0132** | 0.100** | -1.645 | 0.226** | 0.0399* |
| | (0.734) | (0.170) | (0.153) | (3.493) | (0.811) | (0.480) |
| **FORMATIONTIC** | -0.326 | 0.354* | 0.146** | -5.211 | 0.553* | 0.205** |
| | (1.139) | (1.003) | (0.297) | (7.680) | (1.639) | (1.099) |
| **HOMME** | 0.438 | 0.113** | 0.272** | -0.631 | 0.161* | 0.538* |
| | (1.100) | (0.400) | (0.285) | (3.826) | (0.763) | (0.629) |
| **AGEDIRI2** | 0.149 | 0.233* | -0.0621 | -0.533 | -0.567 | 0.0541 |
| | (1.298) | (0.621) | (0.506) | (3.700) | (0.723) | (0.550) |
| **AGEDIRI3** | 0.265 | 0.169** | 0.0108** | -0.647 | 0.326 | 0.664 |
| | (1.244) | (0.684) | (0.508) | (4.156) | (0.857) | (0.563) |
| **AGEDIRI4** | 0.0985 | 0.379** | 0.0324* | 9.516** | -0.114 | 1.362*** |
| | (1.178) | (0.674) | (0.550) | (4.105) | (0.672) | (0.524) |
| **SECONDAIRE** | -1.888 | -0.0558 | 0.0671 | 0.698 | -0.745 | 1.629* |
| | (1.022) | (0.254) | (0.211) | (3.831) | (0.914) | (0.883) |
| **BAC** | -1.896 | 0.139* | 0.169** | 1.258 | 1.245** | 0.334 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (1.025) | (0.399) | (0.298) | (4.822) | (0.976) | (0.963) |
| **BACPLUS** | -1.748 | 0.317** | 0.202** | 1.502 | 0.763 | 1.175** |
| | (0.785) | (0.398) | (0.301) | (3.923) | (0.694) | (0.512) |
| **DOUALA** | 0.601 | 0.807** | 0.258* | 8.663* | 1.282 | 1.393* |
| | (1.274) | (0.385) | (0.527) | (4.584) | (0.849) | (0.821) |
| **YAOUNDÉ** | 0.268 | 0.724** | 0.178 | 3.293 | 0.879 | -0.793 |
| | (1.328) | (0.307) | (0.456) | (4.774) | (0.765) | (0.792) |
| **ALIMENTAIRE** | 0.354 | -0.213* | -0.0327** | 2.990 | 0.0547 | 0.0430 |
| | (0.878) | (0.235) | (0.235) | (4.557) | (0.827) | (0.652) |
| **MANUFACTURES** | 0.489 | -0.0410 | 0.0108 | 2.343 | 0.434 | 0.157 |
| | (0.653) | (0.159) | (0.133) | (3.913) | (0.777) | (0.541) |
| **EFFETPERCU** | | | | 2.561 | 2.825** | 1.105* |
| | | | | (4.036) | (1.165) | (1.510) |
| **FORMEL** | | | | 2.690 | -0.196 | 0.141 |
| | | | | (5.458) | (1.121) | (0.665) |
| | | | | | | |
| **Inverse Mills Ratio** | | -1.088* | -1.000** | | -0.340* | -0.428** |
| | | (0.717) | (0.540) | | (0.666) | (0.670) |
| **Constant** | 0.939 | -1.135 | -0.393 | -6.123 | -4.628 | -1.575 |
| | (2.150) | (1.820) | (1.796) | (9.836) | (3.254) | (3.186) |
| | | | | | | |
| **R-squared** | 0.189 | | | 0.386 | | |
| **Observations** | 612 | 612 | 340 | 93 | 93 | 69 |

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

## Table A7: Determinants of ICT adoption with interaction variables (2009-2012)

| | (1) | (2) | (3) |
|---|---|---|---|
| **Variables** | **ORDI** | **INTERNET** | **E_AFFAIRE** |
| | | | |
| **TXUORDI** | 0.787*** | 0.765*** | 0.873 |
| | (0.220) | (0.253) | (0.843) |
| **AGE1** | Ref. | Ref. | Ref. |
| **AGE2** | 0.173 | 0.0538 | -0.318 |
| | (0.134) | (0.138) | (0.514) |
| **AGE3** | 0.157 | 0.116 | 0.0650 |
| | (0.128) | (0.130) | (0.444) |
| **TAILLE** | 0.475** | 0.502** | 0.170 |
| | (0.211) | (0.226) | (0.953) |
| **SAL** | 0.372** | 0.033 | -0.0192 |
| | (0.518) | (0.056) | (0.037) |
| **CADRE** | -0.0085 | -0.00825 | 0.00136 |
| | (0.00506) | (0.00520) | (0.0324) |
| **EXPORT** | 0.122 | 0.0130 | -0.337 |
| | (0.172) | (0.186) | (0.390) |
| **MOTIVATION** | 0.0924 | 0.0779* | 0.205* |
| | (0.127) | (0.131) | (0.489) |

| | | | |
|---|---|---|---|
| **AGEDIRI1** | Ref. | Ref. | Ref. |
| **AGEDIRI2** | 1.228*** | 0.471* | -0.0716 |
| | (0.164) | (0.273) | (0.532) |
| **AGEDIRI3** | 1.464*** | 0.632** | 0.376 |
| | (0.168) | (0.271) | (0.513) |
| **AGEDIRI4** | 1.591*** | 0.817*** | 0.837* |
| | (0.140) | (0.273) | (0.508) |
| **PRIMAIRE** | Ref. | Ref. | Ref. |
| **SECONDAIRE** | 0.283* | -0.0246 | 0.667 |
| | (0.160) | (0.178) | (0.651) |
| **BAC** | 0.944*** | 0.542** | 0.239 |
| | (0.184) | (0.212) | (0.711) |
| **BACPLUS** | 1.078*** | 0.643*** | 1.068** |
| | (0.130) | (0.175) | (0.476) |
| **OUEST** | Ref. | Ref. | Ref. |
| **DOUALA** | 0.572*** | 0.667** | 0.857* |
| | (0.189) | (0.272) | (0.589) |
| **YAOUNDÉ** | 0.307 | 0.517* | -0.427 |
| | (0.200) | (0.265) | (0.552) |
| **CONSTRUCTION** | Ref. | Ref. | Ref. |
| **ALIMENTAIRE** | -0.475 | -0.398* | -1.486* |
| | (0.319) | (0.345) | (1.597) |
| **MANUFACTURES** | -0.528** | -0.190 | 0.342 |
| | (0.242) | (0.239) | (1.216) |
| **TAILLE*ALIMENTAIRE** | 0.0834 | 0.0714 | 0.578 |
| | (0.151) | (0.151) | (0.572) |
| **TAILLE*MANUFACTURES** | 0.158 | 0.0906 | 0.0890 |
| | (0.129) | (0.124) | (0.483) |
| **Inverse Mills Ratio** | | -0.630*** | -0.922** |
| | | (0.223) | (0.384) |
| **Constant** | -2.47*** | -1.542** | -0.771 |
| | (0.281) | (0.736) | (1.395) |
| | | | |
| **Pseudo R2** | 0.409 | 0.404 | 0.5607 |
| **Observations** | 953 | 497 | 409 |

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Ref.: Reference variable.


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