



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

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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.

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 & Sichel, 2000; Bassanini & Scarpetta, 2002; OECD, 2004; Timmer & van Ark, 2005; Holt & 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 & Hitt, 2000, 2003; Lehr & 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 several information and communications technologies, even though these are becoming more affordable (Giunta & 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, many 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 & 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 among the least connected countries.

The last ten countries in the 2013 IDI ranking were all African, among which 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 affordability², 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

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- 1 The ICT Development Index (IDI) is a benchmark measure composed of eleven 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-indices 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.

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, many 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 & 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 state of ICT 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. 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 acquiring of digital exchanges in Yaoundé and Douala and, later, in the Southwest. 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.

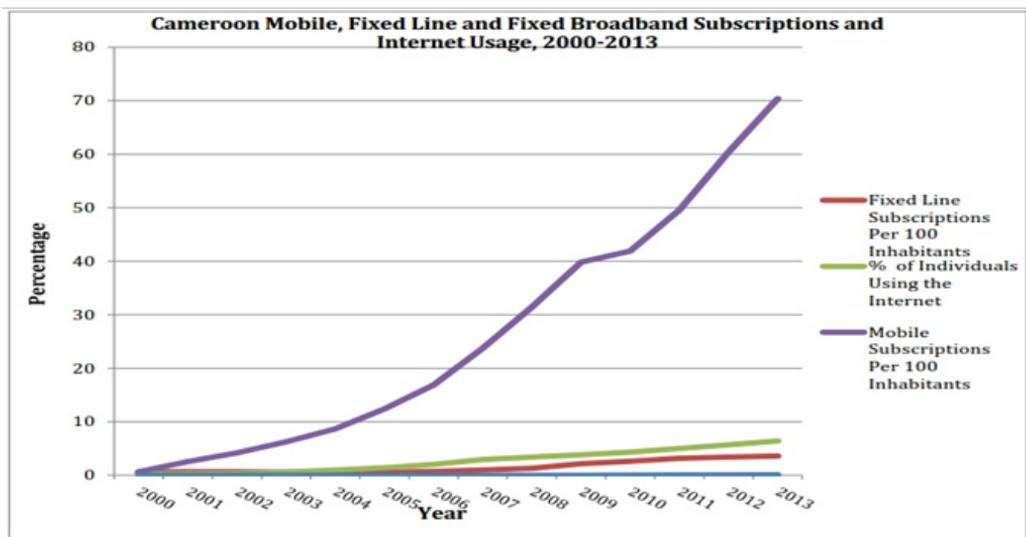
Trends in some ICT indicators at the national level

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 (Alliance for Affordable Internet [A4AI], 2014; Doing Business in Cameroon, 2017³). Despite this seemingly impressive progress in the development of modern infrastructure and the growing number of licenced 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 connected to the Internet in 2013 (ITU, 2014). Figure 1 shows that, except for 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 consider 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 indices 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 indices 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 indices 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 indices.

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 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 126th 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 indices: 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. About 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 must 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 most 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 2016.

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 must 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 & Bakehe, 2015; Bakehe et al., 2016; etc.).

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 considered 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 because during the process of cleaning up 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 analyzing 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).

Conclusion and policy recommendations

The present study analyzed 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, 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 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 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 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.

References

- Agence Nationale des Technologies de l'information et de la Communication (ANTIC). 2007. "Données statistiques au Cameroun de la téléphonie fixe, mobile et de l'internet de 1999 à 2006". At <http://www.antic.cm/images/stories/data/donnéesTICCameroon.pdf>
- Alliance for Affordable Internet (A4AI). 2014. Affordability Report 2014. Washington, D.C., USA.
- Alliance for Affordable Internet (A4AI). 2017. Affordability Report 2017. Washington, D.C., USA.
- Bakehe, N.P., A.H. Fambeu and G.B. Tamokwé Piaptié. 2016. "Adoption and usage of Internet in Cameroon: An analysis of the stability of determinants". AERC Research Paper No. 336. African Economic Research Consortium, Nairobi.
- Bassanini, A. and S. Scarpetta. 2002. "Growth, technological change and ICT diffusion: Recent evidence from OECD Countries". *Oxford Review of Economic Policy*, 18(3): 324–44.
- Becchetti, L., D.A. Londono Bedoya, and L. Paganetto. 2003. "ICT investment, productivity and efficiency: Evidence at firm level using a stochastic frontier approach". *Journal of Productivity Analysis*, 20(2): 143–67.
- Biagi, F. 2013. "ICT and productivity: A review of a literature". Working Paper, Institute for Prospective Technological Studies Digital Economy.
- Bloom, N., R. Sadun and J. van Reenen. 2012. "Americans do iT better: US multinationals and the productivity miracle". *American Economic Review*, 102(1): 167–201.
- Brynjolfsson, E. and L. Hitt. 2000. "Beyond computation: Information technology, organizational transformation and business performance". *Journal of Economic Perspectives*, 14: 23–48.
- Brynjolfsson, E. and L. Hitt. 2003. "Computing productivity: Firm level evidence". *The Review of Economics and Statistics*, 85(4): 793–808.
- Carlsson, B. 2004. "The digital economy: What is new and what is not?" *Structural Change and Economic Dynamics*, 15(3): 245–64.
- Cohen, J. and P. Cohen. 1983. *Applied Multiple Regression and Correlation Analysis for the Behavioral Sciences*, 2nd edn. Mahwah, NJ: Lawrence Erlbaum Associates.
- Fambeu, A.H. 2017. "L'Adoption des TIC dans un pays en développement". *Revue d'Economie Industrielle*, 157: 61–101.
- Fambeu, A.H. and N.P. Bakehe. 2015. "Interaction sociale et usages de l'internet au Cameroun". *L'Actualité Economique/Revue d'Analyse Economique*, 91(4): 421–60.
- Giunta, A. and F. Trivieri. 2007. "Understanding the determinants of information technology adoption: Evidence from Italian manufacturing firms". *Applied Economics*, 39: 1325–34.
- Hollenstein, H. 2004. "Determinants of the adoption of information and communication technologies: An empirical analysis based on firm-level data for the Swiss business sector". *Structural Change and Economic Dynamics*, 15(3): 315–42.

- Hollenstein, H. and M. Woerter. 2008. "Inter- and intra-firm diffusion of technology: The example of E-commerce. An analysis based on Swiss firm-level data". *Research Policy*, 37: 545-64.
- Holt, L. and M. Jamison. 2009. "Broadband and contributions to economic growth: Lessons from the US experience". *Telecommunications Policy*, 33: 575-81.
- International Telecommunication Union (ITU). 2013. "Measuring the information society". At http://www.itu.int/en/ITU/Statistics/Documents/publications/mis2013/MIS2013_without_Annex_4.pdf
- International Telecommunication Union (ITU). 2014. Rapport: Mesurer la société de l'information 2014: Résumé analytique. Geneva, Switzerland.
- International Telecommunication Union (ITU). 2014. Global Cybersecurity Index (GCI) 2014.
- International Telecommunication Union (ITU). 2016. *ICT Facts and Figures 2016*. Geneva: Switzerland.
- International Telecommunication Union (ITU). 2017a. ICT Prices 2017. At https://www.itu.int/pub/D-IND-ICT_PRICES.01-2017/en
- International Telecommunication Union (ITU). 2017b. Measuring the Information Society Report 2017. Volume 2. ICT Country Profiles. Geneva: ITU. At www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2017/MISR2017_Volume2.pdf
- Jones, M.P. 1996. "Indicator and stratification methods for missing explanatory variables in multiple linear regression". *Journal of the American Statistical Association*, 91: 222-30.
- Kretschmer, T. 2012. "Information and communication technologies and productivity growth: A survey of the literature". *OECD Digital Economy Papers*, 195. Paris, France.
- Lehr, B., and F. Lichtenberg. 1999. "Information technology and its impact on productivity: Firm level evidence from government and private data sources, 1977-1993". *Canadian Journal of Economics*, 32: 335-62.
- Machikita, T., M. Tsuji, and Y. Ueki. 2010. "How ICTs raise manufacturing performance: Firm-level evidence in Southeast Asia". Papers DP-2010-07. Economic Research Institute for ASEAN and East Asia.
- Matteucci, N., M. O'Mahony, C. Robinson and T. Zwick. 2005. "Productivity, workplace performance and ICT: Industry and firm-level evidence for Europe and the US". *Scottish Journal of Political Economy*, 52(3): 359-86.
- Media Intelligence. 2016., The Telecommunications Market in Cameroon in 2015: Analysis of Key Figures and Findings. At <https://www.mediaintelligence.fr/publications/etudes/25-telco-market-2015>
- MINPOSTEL (Ministry of Posts and Telecommunications). 2006. Cameroon Scan-ICT Report: National Survey on the Level of Penetration and Usage of ICT in Cameroon. Yaoundé: African Information Society Initiative, 2006. At www.uneca.org/aisi/scanict.htm
- MINPOSTEL (Ministry of Posts and Telecommunications). 2016. *Plan Stratégique Cameroun Numérique 2020* [Strategic Plan for Digital Cameroon 2020].
- Nyirenda-Jere, T. and T. Biru. 2015. "Internet development and Internet governance in Africa". *Internet Society*.
- OECD. 2004. *The Economic Impact of ICT, Measurement, Evidence, and Implications*. Paris: OECD.
- Rubin, D.B. 1978. "Multiple imputations in sample surveys: A phenomenological Bayesian approach to non-response". The Proceedings of the Survey Research Methods Section of The American Statistical Association, pp. 20-34.

- Rubin, D.B. 1987. *Multiple Imputation for Nonresponse in Surveys*. New York: John Wiley & Sons, Inc.
- Ssewanyana, J. and M. Busler. 2007. "Adoption and usage of ICT in developing countries: Case of Ugandan firms". *International Journal of Education and Development using ICT*, 3(3) 49–59.
- TeleGeography. 2017. "Cameroon set for MNP launch next month". At <https://www.telegeography.com/products/commsupdate/articles/2017/08/24/cameroon-set-for-mnp-launch-next-month>
- Timmer, M. and B. van Ark. 2005. "Does information and communication technology drive EU-US productivity growth differentials?" *Oxford Economic Papers*, 57: 693–716.
- United Nations Department of Economic and Social Affairs (UNDESA). 2014. *United Nations E-Government Surveys: 2014, E-Government for the Future We Want*. New York: UNDESA.
- World Bank. 2016a. *World Development Report 2016: Digital Dividends*. Washington, D.C.: The World Bank.
- World Bank. 2016b. Enterprise Surveys: What Businesses Experience. <http://www.enterprisesurveys.org>.
- World Bank. 2016c. Cameroon - ICT Sector Reform Project (P161219).
- World Economic Forum. 2015. Global Information Technology Report 2015.



Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

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