



## Deregulation and Universal Service for Telecommunications in Central Africa: *an Empirical Analysis*

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**Abstract:** *The telecommunications sector was at the centre of structural reforms in the 1990s in the countries of the Economic and Monetary Community of Central African States (CEMAC). Two decades later, the issue of access to universal service is still very much on the agenda. Drawing on panel data between 2000 and 2018, and based on the adapted Koski (2002) model, we illustrate that liberalisation and privatisation have had a significant impact on the availability of mobile and Internet telecommunications services. The effects of deregulation on affordability, however, do not appear to be significant. The direction of subsidies towards a previously designated operator responsible for universal service obligations is suggested.*

**Keywords:** *Telecommunications, deregulation, regulation, liberalisation, privatisation, universal service, affordability, availability.*

### 1. INTRODUCTION

The telecommunications industries, which had developed in the United States from 1876 onwards<sup>1</sup>, within a strictly regulated framework and a monopolistic context for the most part (Leroy-Therville, 1980), underwent upheavals from the 1960s onwards, due in particular to technological advances and institutional changes.

In Africa, the deregulation of the telecommunications sector was initially a requirement of the International Monetary Fund (IMF) and the World Bank within the framework of the Structural Adjustment Programmes (SAPs) (Sagna, 2010); before being integrated into the commitments of States at the multilateral level with the World Trade Organisation (WTO) Agreement on Basic Telecommunications, signed in 1997. It is characterised, as highlighted in (Do-Nascimento, 2005), by the separation of postal services from those of telecommunications, the opening of the mobile telephony market to competition through the sale of one or more licences to private stakeholders and the partial opening of the capital of the incumbent operator to national or foreign private capital, with the concept of universal service, the scope of which has been tested before in developed countries.

The economics of regulation and the economics of networks will thus support and justify several empirical works on the deregulation of telecommunications services and the scope of the concepts of natural monopoly and universal service related to it. While studies on comparative analyses between developed and developing countries (DCs) reveal that the availability of telecommunication service has increased in DCs due to the introduction of mobile telephony (Garbacz et al, 2007), the findings of work on the effects of telecommunication deregulation on affordability in developing countries are contradictory.

1. Date of filing of the first two patents for the invention of the telephone in the United States by Alexander Graham BELL.

Hardy (1980) and Roeller and Waverman (2001) show that investment in telecommunications generates a growth dividend, as network expansion reduces transaction costs, increases market boundaries and greatly increases information flows. Nevertheless, in developing countries, the lack or low level of network access increases the cost and reduces the possibilities of financing infrastructure.

Gasmi *et al* (2000) empirically assess the effects of deregulation on universal service, with particular attention to the values of the relevant parameters for developing countries. This analysis highlights the conditions under which cross-subsidies between urban and rural areas can still be a powerful tool for financing universal service in developing countries despite liberalisation. These authors assess the value of cross-subsidies as a means of financing universal service, when asymmetric information is taken into account. Assuming that a monopolistic operator under a regulated tariff structure traditionally provides local telecommunications services, they show that technological change and the increasing benefits of competition in traditional natural monopolistic industries have generated forces that threaten the sustainability of this traditional method of financing universal service.

Founanou's (2015) article, which is part of the new economics of regulation, raises the problem of information asymmetry between the regulator and the incumbent operator in charge of universal service after the privatisation and liberalisation of the telecommunications sector in sub-Saharan Africa in the late 1990s. This problem is equally acute in the CEMAC countries, where, despite the efforts made to develop telecommunications services, the number of fixed telephone subscribers, the privileged perimeter of the universal service, did not exceed 1% of the population in 1996.

This article analyses the effects of deregulation on the universal telecommunications service in the six CEMAC countries, namely Cameroon, Gabon, Congo, Equatorial Guinea, Chad and the Central African Republic (CAR), using panel data between 2000 and 2018 and based on the adapted Koski (2002) model.

## **2. UNIVERSAL TELECOMMUNICATION SERVICE IN CENTRAL AFRICA**

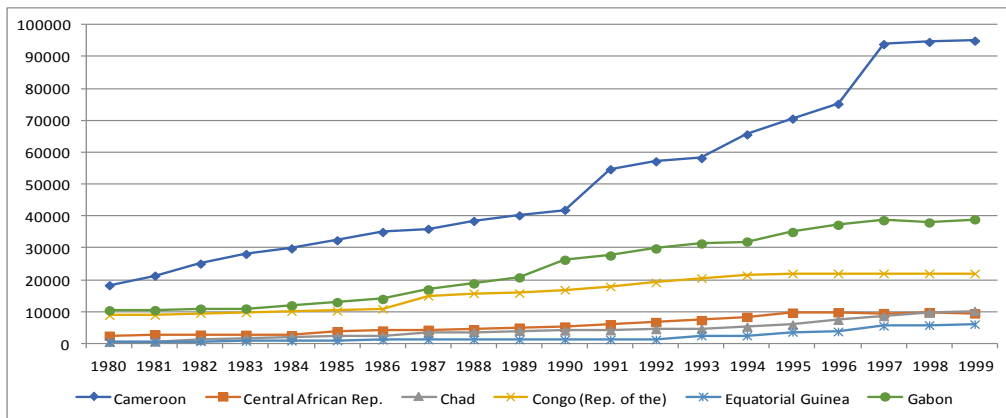
The Central African countries have chosen to continue the models established by the colonial powers in the management of telecommunications networks after independence (Kouahou, 2010). The beginnings of a federating framework for the harmonious development of telecommunications appeared in 1975 with the establishment of the Conférence Administrative des Postes et Télécommunications d'Afrique Centrale (CAPTAC). They were taken up in the Convention governing the UEAC<sup>2</sup>, which in Article 2 refers to telecommunications as one of the areas in which the Economic Union intends to establish coordination of national sectoral policies, adopt common policies and implement them.

In each country, the public monopoly (Administrations or Telecommunications Office) is responsible for ensuring the obligations related to universal service. These monopolies will rely more on the fixed telephony service made available through community access. Price regulation and cross-subsidisation ensure that the service is affordable.

At the time of the assessment in 1996, no CEMAC country had crossed the threshold of 100,000 subscribers to fixed telephony, as shown in the graph below.

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2. The Treaty establishing CEMAC was signed on 16 March 1996 between Cameroon, Congo Brazzaville, Gabon, Equatorial Guinea and Chad. One of the four institutions established through this Treaty is the Central African Economic Union (UEAC)

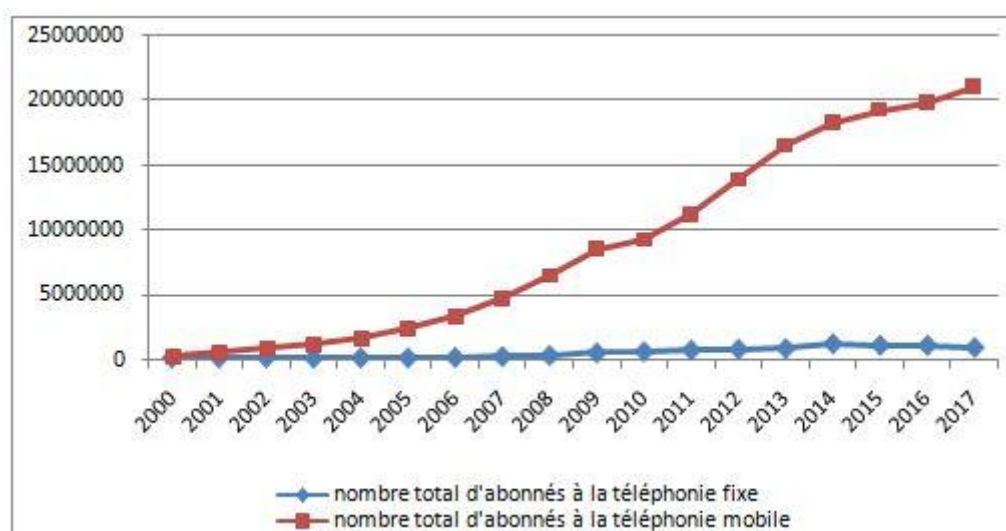


**Graph1.** Evolution of the number of fixed-line subscribers in CEMAC countries before deregulation

**Source:** Based on ITU data (ITU ICT-Eyes).

Deregulation of the telecommunications sector began in 1996, with the enactment by CAR of the law liberalising the telecommunications sector in that country. Between 1997 and 2005, Congo, Cameroon, Chad, Gabon and Equatorial Guinea in turn enacted laws deregulating their telecommunications sectors. All these reforms were consolidated in 2008 with the adoption of Community Regulation No. 21/08-UEAC-133-CM-18 of 19 December 2008 on the harmonisation of regulations and policies for the regulation of electronic communications within the CEMAC Member States (Matschinga, 2014). This directive defines universal service as “a minimum set of defined services of good quality which is accessible to the whole population under affordable tariff conditions, regardless of geographical location”. Universal service is now, according to this Community Directive, “a dynamic concept whose content is subject to periodic review by the telecommunications administration”.

The opening up of mobile telephony to competition has made it possible to satisfy a significant number of the population and to eliminate the phenomenon of queues that were at the origin of the “black market in telephony” before deregulation, as shown in the graph below.



**Graph2.** Comparative evolution of the number of fixed and mobile telephone subscribers in the CEMAC zone

**Source:** Based on ITU data (ITU ICT-Eyes).

In 2017, more than 20 million people had access to mobile phone services in the CEMAC zone. There is a part of the population that lives in areas not covered by the operators' networks, or that has little purchasing power to afford the service. As illustrated in the table below, mobile services (broadband and dial-up) are less affordable in CAR and Chad, compared to other CEMAC countries. Gabon is the country where these services are more affordable.

**Table1.** Price of a basket of mobile services as a percentage of gross national income per capita

Service Country	Years	Broadband mobile data (1.5Gbps)	Low-speed cellular mobile	Low speed mobile data and voice	Broadband mobile data and voice
Cameroon	2018	4.67	4.5	7.5	22.49
	2019	4.67	8.67	7.5	22.49
	2020	3.9	8.1	5.98	11.95
CAR	2018	44.99	24.35	31.49	33.74
	2019	26.99	28.5	48.14	62.98
	2020	24.44	25.81	43.58	57.08
Chad	2018	32.23	31.56	43.37	75
	2019	32.23	31.56	38.68	58.01
	2020	17.59	20.08	35.59	56.99
Congo	2018	13.17	NA	NA	NA
	2019	13.17	NA	NA	NA
	2020	8	10.25	13.17	28.49
Gabon	2018	1.91	2.91	3.81	4.76
	2019	1.91	3.71	3.81	4.45
	2020	1.92	3.37	2.87	5.47

**Source:** International Telecommunication Union data, ITU\_ICT Price Basket 2018-2020.

As regards internet service in the CEMAC countries, in 2018, one in four inhabitants (25.75%) used the internet, compared with 0.29% in 2000 and 3.88% in 2009. The rise in internet service from 2010 is linked to the introduction of third generation mobile technologies and the deployment of optical fibre infrastructure. Panzar (2000), argues that internet service is more worthy of being part of the universal service obligation, than basic telephone service. The author shows that universal service increases the sustainability of existing networks through network externality.

### 3. MODEL FOR ANALYSING THE EFFECTS OF DEREGULATION ON UNIVERSAL TELECOMMUNICATION SERVICE IN CENTRAL AFRICA

The empirical literature analysing the effects of deregulation on universal telecommunications service involves both developed countries (Ahn and Lee, 1999; Rossten and Wimmer, 2000; Koski, 2002) and developing countries (Duffy-Deno, 2001; Lim and Chen, 2012; Founanou, 2015).

The model selected to assess the effects of deregulation on universal telecommunications service in Central Africa is based on the article by Koski (2002); using data on the penetration rate and prices of telecommunications services between 2000 and 2018.

#### 3.1. Model Variables and Data Sources

Based on the empirical literature and data availability, eighteen variables are selected, including six dependent and twelve independent variables. The dependent variables in our study describe the level of universal service provision in terms of penetration rates and service prices. Universal telecommunications service is captured through the variables of availability and affordability.

The availability of universal service refers to the number of people who have access to a given telecommunications service. In the empirical literature, notably the work of Koski (2002); Garbacz et al (2005), it is measured by the penetration rate of households or individuals to a given telecommunications service. Availability is measured by three variables, namely fixed-line penetration, mobile penetration and internet penetration.

In the context of universal service, affordability is reflected in tariff equalisation or subsidies for poor populations or disadvantaged geographical areas or in special tariffs for disadvantaged social categories (Gadrey, 1997; Stanford, 2010). The variables used to measure affordability are the access and usage tariffs for telecommunications services.

The independent variables are respectively:

- the privatisation of the incumbent operator (priv)
- the authorisation of foreign ownership in the services applied to a given service (prop),

- the opening of services to competition applied to a given service (comp),
- the separation of operating activities from market regulation (reg\_sep),
- the independence of the regulatory agency (reg\_ind),
- per capita income (gdp),
- urban population (popu),
- the vector of other control variables (X) consisting of the enrolment ratio (educ),
- the consumer price index (cpi) ;
- and a binary time variable (tps00-18).

They are captured by binary variables that describe the degree of privatisation, market liberalisation and the nature of the regulatory authority (Curien, 2005; Koski, 2002). These variables are respectively the privatisation of the incumbent operator, liberalisation and the type of regulation.

The privatisation variable of the incumbent operator refers to the total or partial opening of the capital of the incumbent operator to national or foreign private capital. Liberalisation is measured by whether or not foreign ownership is allowed in the provision of telecommunication services on the one hand, and whether or not it is opened up to competition on the other. The nature of the regulatory authority reflects whether or not an autonomous regulatory structure for the telecommunication sector is established in the deregulation process.

The model incorporates economic and control variables, namely: Gross Domestic Product (GDP) per capita; urban population, consumer price index (CPI) and school enrolment. However, a time variable of a binary nature is included to take into account the effect of some shocks and specificities, notably political, geographical, tariff, strategic, etc., that occurred during the year in the telecommunications sector.

The data is mainly drawn from three sources: the International Telecommunication Union (ITU) telecommunication indicators over the period ranging from 1998 to 2018; the activity reports of the telecommunication regulatory agencies (RAART) available on the websites of these agencies; and the World Development Indicators. The timeframe of this research covers the period from 2000 to 2018, i.e. nineteen periods.

### 3.2. The Model

The model for testing the effects of deregulation on universal telecommunications service is as follows:

$$Y_{it} = \beta_0 + \beta_1 \text{priv}_{it} + \beta_2 \text{prop}_{its} + \beta_3 \text{comp}_{its} + \beta_4 \text{reg\_sep}_{it} + \beta_5 \text{reg\_ind}_{it} + \beta_6 \text{rev}_{it} + \beta_7 \text{popu}_{it} + \beta_8 X_{it} + \varepsilon_{it} \quad (1)$$

Where *i* is the index of the CEMAC country (*i*=1 to 6), *t* is the index of the year (*t* = 2000 to 2018) and *s* is the index of the type of telecommunications service (fixed, mobile and internet).

The econometric model includes six specific equations to be estimated, including three service availability equations, namely:

- the penetration rate of fixed telephony,
- the mobile telephony penetration rate;
- the Internet penetration rate model;

and three equations on service affordability, namely two on the cost of using fixed and mobile telephone service and one on the cost of accessing mobile telephone service.

#### *Effects of Deregulation on Availability*

The effect of deregulation on service availability is measured by the penetration rate of the different types of service.

For fixed telephony, the equation to be estimated is:

$$\begin{aligned} fix_{it} = & \beta_0 + \beta_1 priv_{it} + \beta_2 prop\_moy_{it} + \beta_3 comp\_moy_{it} + \beta_4 reg\_sep_{it} + \beta_5 reg\_ind_{it} \\ & + \beta_6 rev_{it} + \beta_7 popu_{it} + \beta_8 educ_{it} + \beta_9 ipc_{it} + \varepsilon_{it} \end{aligned} \quad (2)$$

Where  $fix_{it}$  is the dependent variable representing respectively the number of fixed telephone main lines per 100 inhabitants (fix) of the country  $i$  ( $i=1$  to 6) in year  $t$  ( $t = 2000$  to 2018).

For mobile telephony:

$$\begin{aligned} mob_{it} = & \beta_0 + \beta_1 priv_{it} + \beta_2 prop\_m_{it} + \beta_3 comp\_m_{it} + \beta_4 reg\_sep_{it} + \beta_5 reg\_ind_{it} \\ & + \beta_6 pib_{it} + \beta_7 popu_{it} + \beta_8 educ_{it} + \beta_9 ipc_{it} + \varepsilon_{it} \end{aligned} \quad (3)$$

Where  $mob_{it}$  is the dependent variable representing the number of mobile phone subscribers per 100 inhabitants (mob) in the country  $i$  ( $i=1$  to 6) in year  $t$  ( $t = 2000$  to 2018).

For the Internet service:

$$\begin{aligned} net_{it} = & \beta_0 + \beta_1 priv_{it} + \beta_2 prop\_moy_{it} + \beta_3 comp\_moy_{it} + \beta_4 reg\_sep_{it} + \beta_5 reg\_ind_{it} \\ & + \beta_6 pib_{it} + \beta_7 popu_{it} + \beta_8 educ_{it} + \beta_9 ipc_{it} + \varepsilon_{it} \end{aligned} \quad (4)$$

Where  $net_{it}$  is the dependent variable representing the number of internet service users per 100 inhabitants of country  $i$  ( $i=1$  to 6) in year  $t$  ( $t = 2000$  to 2018).

#### Effects of Deregulation on Affordability

Affordability will be measured on the one hand by the cost of access to mobile telephony and on the other hand by the subscription prices for fixed and mobile telephony services.

The equation to be estimated for the cost of access to mobile telephony is as follows:

$$\begin{aligned} cout\_m_{it} = & \beta_0 + \beta_1 priv_{it} + \beta_2 prop\_m_{it} + \beta_3 comp\_m_{it} + \beta_4 reg\_sep_{it} + \beta_5 reg\_ind_{it} \\ & + \beta_6 pib_{it} + \beta_7 popu_{it} + \beta_8 educ_{it} + \beta_9 ipc_{it} + \varepsilon_{it} \end{aligned} \quad (5)$$

Where  $cout\_m_{it}$  is the dependent variable representing the mobile phone subscription cost of the country  $i$  ( $i=1$  to 6) in year  $t$  ( $t = 2000$  to 2018).

The user cost equations are as follows:

For fixed telephony:

$$\begin{aligned} usage\_f_{it} = & \beta_0 + \beta_1 priv_{it} + \beta_2 prop\_f_{it} + \beta_3 comp\_f_{it} + \beta_4 reg\_sep_{it} + \beta_5 reg\_ind_{it} \\ & + \beta_6 pib_{it} + \beta_7 popu_{it} + \beta_8 educ_{it} + \beta_9 ipc_{it} + \varepsilon_{it} \end{aligned} \quad (6)$$

Where  $usage\_f_{it}$  is the dependent variable representing the price per minute of fixed telephony call in the country  $i$  ( $i=1$  to 6) in year  $t$  ( $t = 2000$  to 2018).

**For mobile telephony:**

$$\begin{aligned} usage\_m_{it} = & \beta_0 + \beta_1 priv_{it} + \beta_2 prop\_m_{it} + \beta_3 comp\_m_{it} + \beta_4 reg\_sep_{it} + \beta_5 reg\_ind_{it} \\ & + \beta_6 pib_{it} + \beta_7 popu_{it} + \beta_8 educ_{it} + \beta_9 ipc_{it} + \varepsilon_{it} \end{aligned} \quad (7)$$

Where  $usage\_m_{it}$  is the dependent variable representing the price per minute of mobile telephony call in the country  $i$  ( $i=1$  to 6) in year  $t$  ( $t = 2000$  to 2018).



#### 4. RESULTS OF THE ECONOMETRIC ANALYSES

This section presents the results of the econometric analyses, which empirically describe the different aspects of telecoms policy, namely privatisation, liberalisation, the mode of regulation and the level of significance of their impact on the availability and affordability of telecoms services.

##### 4.1. Availability

For fixed telephony, the total linear coefficient of determination shows that 6.54% of the variability in fixed telephony penetration is explained by the independent variables in the model (see Table 1 below).

**Table 2.** Summary of the results of the fixed telephony penetration model

Variable	Coefficient	Pvalue
Privatisation of the incumbent operator (piv)	-0.0091	0.899
Allowing foreign ownership in fixed telephony (prop_f)	-0.0498	0.909
Opening to competition in fixed telephony (comp_f)	-0.0560	0.569
Independence of the regulatory agency (reg_ind)	0.1334	0.265
Income per capita (rev)	-0.1722	0.675
Urban population (popu)	1.5600	0.655
Gross secondary school enrolment rate (educ)	0.6905	0.068*
Consumer price index (cpi)	1.1639	0.287
Constant	-0.0984	0.821
R <sup>2</sup> overall = 0.06543      R <sup>2</sup> within = 0.0734      R <sup>2</sup> between = 0.0046		
Prob >Chi2 = 0.6034		
Number of observation (N) = 102		

(\*\*\*) significant at 1%, (\*\*) significant at 5%, (\*) significant at 10%,

**Source:** Author, based on STATA 14 software.

Regarding the between or inter-individual estimator, it shows that fixed effects contribute 0.46% to the model. Deregulation policies did not have a significant positive impact on the number of fixed-line subscribers in the CEMAC zone between 2000 and 2018. These results can be justified by the fact that this segment has not been opened up to competition in the CEMAC zone and that the incumbent operators have remained wholly or partially state-owned in this sub-region, with the result that the level of investment has been low. Apart from Gabon, all attempts to privatise incumbent operators have ended in failure and a return to publicly owned companies (as in CAR and Equatorial Guinea). The establishment of a mobile telephone network requires less investment than a fixed network (Waverman *et al*, 2005) and the return on investment is higher, which could justify the attraction of foreign capital for this sector of activity.

- With regard to the availability of mobile telephony

Table 2 below shows that the total linear co-efficient of determination indicates that 18.48% of the variability in mobile phone penetration is explained by the independent variables in the model. The privatisation of the incumbent operator is significant at the 5% level and has a negative sign. This result reflects the fact that the non-privatisation of the incumbent operator has negatively influenced mobile penetration. Given that the data on foreign ownership in the mobile telephone sector have not changed over time, the estimates of the liberalisation of the telecommunications market have focused solely on the variable opening up to competition, which is significant at the 1% level and has a positive sign. This result confirms that the opening up of the mobile telephony segment to competition has had a significant and positive influence on the availability of telecommunication services, which has contributed to increasing access to universal service in the CEMAC countries.

Finally, the creation of autonomous regulatory agencies also seems to have had a positive impact on the mobile telephony penetration rate in the CEMAC countries, judging by the 1% significance level and the positive sign of the Reg\_ind variable presented in Table 2 in the Annex. The variable relating to the separation of operating activities from regulatory activities being quasi-invariant over time, it has not been taken into account in the estimates.

**Table3.** Summary of the results of the mobile telephony penetration model

Variable	Coefficient	Pvalue
Privatisation of the incumbent operator (priv)	-0.5039	0.080**
Authorising foreign ownership in mobile telephony (prop_m)	-	-
Opening up competition in mobile telephony (comp_m)	1.9892	0.000***
The independence of the regulatory agency (reg_ind)	1.7174	0.000***
Income per capita (rev)	-0.4394	0.701
Urban population (popu)	3.2324	0.740
Gross secondary school enrolment rate (educ)	0.2939	0.774
Consumer price index (cpi)	0.0733	0.981
Constant	4.7378	0.000***
R <sup>2</sup> overall = 0.1848      R <sup>2</sup> within = 0.5253      R <sup>2</sup> between = 0.1353		
Prob > Chi2 = 0.000		
Number of observation (N) = 102		

(\*\*\*) significant at 1%, (\*\*) significant at 5%, (\*) significant at 10%,

Source: author, based on STATA 14 software.

In conclusion, deregulation policies have had a positive and significant effect on the number of mobile phone subscribers in the CEMAC zone from 2000 to 2018. This effect can be observed depending on the various channels for measuring deregulation, i.e. privatisation, liberalisation and the mode of regulation. These results are consistent with those obtained by Koski (2000) in the case of European countries.

As far as the control variables are concerned, none of them is significant. For the urban population, this would mean that the mobile phone service is not specific; the whole population, regardless of their place of residence, demands it. However, the significance of the constant value reflects the existence of other factors not included in the model that influence the availability of mobile telephony. Examples include the volume of investments made in the telecommunications sector or the direct contributions of operators to universal service funds.

- For the internet service

The deregulation of telecommunications in Central Africa has had a very significant impact on the Internet penetration rate. The independent variables explain over half of the variability of the dependent variable (see Table 3 below).

**Table4.** Summary of results of the Internet penetration model (model 3)

Variable	Coefficient	Pvalue
Privatisation of the incumbent operator (priv)	1.2315	0.000***
Average authorisation of the foreign ownership (prop_average)	7.9638	0.000***
Average openness to competition (comp_mean)	1.6596	0.000***
Independence of the regulatory agency (reg_ind)	1.2026	0.004***
Income per capita (rev)	3.8007	0.008***
Urban population (popu)	-8.4553	0.488
Gross secondary school enrolment rate (educ)	-0.1022	0.938
Consumer price index (cpi)	-6.7238	0.079*
Constant	-4.7495	0.002***
R <sup>2</sup> overall = 0.5477      R <sup>2</sup> within = 0.4820      R <sup>2</sup> between = 0.8701		
Prob > Chi2 = 0.000		
Number of observation (N) = 102		

(\*\*\*) significant at 1%, (\*\*) significant at 5%, (\*) significant at 10%,

Source: from STATA 14 software.

Indeed, the total linear coefficient of determination is 54.77%. Concerning the between estimator, it shows that the fixed effects contribute 87.01% to the model. For the significance of the model parameters, the Fisher test shows that the explanatory variables are jointly significant at the 1% threshold. In conclusion, the deregulation policies based on privatisation and liberalisation have had a positive and significant impact on the number of internet users in the CEMAC zone from 2000 to 2018.



As regards the control variables, per capita income and the CPI are the two significant variables, respectively at the 1% and 10% threshold. The income elasticity is estimated at 3.8 and the price elasticity at -6.72. Therefore, all other things being equal, an increase in the income of a CEMAC inhabitant by one point would generate an increase of exp (3.8) internet users, i.e. 45 users. Similarly, an increase in inflation of one percentage point would decrease the number of internet users by about exp (-6.72), or less than one. Nevertheless, for the secondary school enrolment variable, the non-significance is contrary to the literature, according to which the level of use of internet services is related to the level of education. Likewise, as in the previous model, the significance of the constant at the 1% threshold reflects the existence of other factors not included in the model that influence the number of users of internet services.

#### 4.2. Affordability

This section presents the empirical results of telecommunication policies on the affordability of mobile and fixed telephone services in the CEMAC zone.

As shown in Table 4 below, deregulation policies have not had a positive and significant impact on the price of fixed-line telephony in the CEMAC zone from 2000 to 2018.

**Table5.** Summary of the results of the fixed-line price model (model 4)

Variable	Coefficient	Pvalue
Privatisation of the incumbent operator (priv)	-0.1916	0.368
Allowing foreign ownership in fixed telephony (prop_f)	-0.0245	0.838
Average opening to competition in fixed telephony (comp_f)	-	-
Independence of the regulatory agency (reg_ind)	0.0411	0.764
Income per capita (rev)	-0.6812	0.158
Urban population (popu)	175.0457	0.043**
Gross secondary school enrolment rate (educ)	-0.7033	0.019**
Consumer price index (cpi)	0.9784	0.240
Constant	-0.0730	0.350
$R^2$ overall =0.2526 $R^2$ within =0.2253 $R^2$ between =0.6225		
Prob >Chi2 =0.0425**		
Number of observation (N) = 51		

(\*\*\*) significant at 1%, (\*\*) significant at 5%, (\*) significant at 10%

**Source:** Author, based on STATA 14 software.

The total linear coefficient of determination shows that 23.29% of the variability in the price of mobile phone usage is explained by the independent variables of the model (see Table 5 below). This variation is the result of differences in country-specific effects. This result shows that the linear coefficient of determination associated with the within estimator is 0.9818. This result shows that deregulation policies have not had a significant impact on the price of mobile phone usage in the CEMAC zone from 2000 to 2018. These results are contrary to the literature, in particular the results of Koski (2002) for European countries and those of Garbacz and Thompson (2007) for developing countries, where competition in the mobile phone sector has favoured the affordability of the telecommunications service.

**Table6.** Summary of results of the mobile phone usage model (model 5)

Variable	Coefficient	Pvalue
Privatisation of the incumbent operator (priv)	-0.1399	0.499
Allowing foreign ownership in mobile telephony (prop_m)	-	-
Opening up competition in mobile telephony (comp_m)	-0.0512	0.698
Independence of the regulatory agency (reg_ind)	0.1228	0.111
Income per capita (rev)	-0.2372	0.646
Urban population (popu)	228.5215	0.006***
Gross secondary school enrolment rate (educ)	0.0692	0.809
Consumer price index (cpi)	-0.0549	0.947
Constant	-0.0960	0.512
$R^2$ overall =0.2329 $R^2$ within =0.1175 $R^2$ between =0.9818		
Prob >Chi2 =0.0708*		
Number of observation (N) = 51		

(\*\*\*) significant at 1%, (\*\*) significant at 5%, (\*) significant at 10%

**Source:** Author, based on STATA 14 software.

The value of the total linear coefficient of determination (0.0941) indicates a weak explanation of the variability of the mobile phone subscription price by the independent variables of the model (see Table 6 below). The non-privatisation of incumbent operators, the liberalisation of the sector and market regulation are not the main factors in the fall in sim card prices observed in the sub-region. In the same vein, the control variables of purchasing power of the population, level of education, size of the urban population and price inflation had little influence on sim card prices.

**Table 7.** Summary of results for the mobile phone subscription cost model (model 6)

Variable	Coefficient	Pvalue
Privatisation of the incumbent operator (priv)	-0.6977	0.141
Allowing foreign ownership in mobile telephony (prop_m)		
Average openness to competition (comp_m)	0.1177	0.698
Independence of the regulatory agency (reg_ind)	-0.1133	0.522
Income per capita (rev)	-0.0734	0.950
Urban population (popu)	238.4189	0.208
Gross secondary school enrolment rate (educ)	0.3402	0.605
Consumer price index (cpi)	-2.3138	0.218
Constant	-0.1365	0.685
$R^2$ overall =0.0941 $R^2$ within =0.0784 $R^2$ between =0.5251		
Prob >Chi2 =0.7249		
Number of observation (N) = 51		

(\*\*\*) significant at 1%, (\*\*) significant at 5%, (\*) significant at 10%,

**Source:** Author, from STATA 14 software.

In total, deregulation policies on the standpoint of privatisation and liberalisation have not had a significant impact on the subscription costs of mobile phone users in the CEMAC zone from 2000 to 2018.

## 5. CONCLUSION

The objective of this article was to measure the effects of deregulation on universal telecommunications service in the CEMAC countries. The results of the Koski (2002) model adapted from data from 2000 to 2018 show that deregulation has not had a positive and significant effect on the number of fixed-line subscribers. The availability of mobile and Internet services has been positive, but to varying degrees, to the opening of the telecommunications market to competition. The opening up of mobile markets to competition seems to have greatly facilitated the spread of mobile phones. However, deregulation policies have not had a positive and significant impact on the price of fixed telephony in the CEMAC zone, due to tariff rebalancing. The same is true for the price of mobile phone usage, although this price has decreased significantly over the study period.

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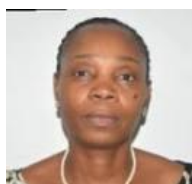
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