Digital Poverty and Universal Service in Africa

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Principal research question

The "unconnected" are increasingly marginalized gradually when the French society become more and more connected. (AFUTT & ANSA, 2011). The study seeks to analyze how digital poverty affects the uptake of ICT and how it may impact access and universal service.

What is the influence of digital poverty on access and universal service?

Policy relevance

Basically, the study seeks to highlight the need to implement institutional policies that are in line with the improvement in access to universal service in a perspective of good governance. These policies must be based partly on the development of basic infrastructure, and also on taking measures to facilitate the access of the poor to universal service. To achieve this, our approach will be to show how digital poverty is helping to inequitable access to universal service by excluding the poorest of the population.

Research

Literature review

The study of the digital divide results from the desire to avoid inequalities in the distribution of ICT in countries (Rallet & Rochelandet, 2003). The inequality refers to differences that can appear in the access and uses of electronic products in general. Poverty analysis is an important part of heart of economic research. Analyzed in recent years in a multidimensional perspective, poverty is based on the privations suffered by individuals. These deprivations can according to their intensities have an adverse effect on access to certain essential basic services and vice versa. In this sense, universal service is a good illustration of deprivation. The International Telecommunication Union (ITU) defines universal service as the presence of a phone per household. Universal access is often seen as a prerequisite for the universal

service because consisting of the presence of a phone within a reasonable distance of each individual. From this definition, we see that the universal service are specific and relevant to ICT. That is why we have chosen to study access to these services not simply in terms of poverty but in terms of digital poverty. On data on US households, Kennickell and Kwast (1997) highlight the role of education, consumer skills and learning in their study of consumer adoption of electronic banking. For Diagne & Ly (2008), digital poverty refers to the lack of access and use of ICT by households and individuals in a given geographical area. They show on a sample of 17 African countries that the level of wealth and education reduces the probability of being poor digitally.

Method

The objective of this paper is to understand the dynamics of digital poverty and its effect on the universal service. This objective is divided into three points. The first one is to measure and decompose digital poverty using a multidimensional index. The second one and the third one are to identify the determinants of digital poverty and assess its effect on universal service.

Digital poverty measure that we adopt in this article is based on a set of seven variables. These variables are related to the possession of the following: radio station, post TV, decoder, PC, desk phone, mobile phone and e-mail address. These variables are binary and take one every time when the individual in question does not have the item set and 0 otherwise. Aggregation was done by a simple equally weighted summation. The decomposition of this index constructed following the procedure developed by Alkire & Foster (2011). The goal of decomposition is to analyze digital poverty by gender factor. The index of Digital Poverty is normalized to return its values between 0 and 1 according to the formula used by UNDP for the normalization of the Human Development Index (HDI).

IPN0 is, the value of the normalized index:

The normalization of the index proceeds from the want to make comparable the different dimensions that composed the index construction. It does not change fundamentally the mean of the value of the index but change the scale of the values taken par the index in order to

allow to have minimum and maximum values (Goujon, 2008).

Digital poverty determinants are identified with a linear model that takes as dependent variable digital poverty index. The model is as follows:

$$\mathbf{Y_i = a + X_iB + e_i}$$

Where Xi is the set of explanatory variables. These variables including age, sex, marital status, being in an electrified field, the level of education, income, etc. B is the vector of coefficients and e is the error term. The chosen estimation technique is the method of Fractional Regression Model that is suitable for models with this type of dependent variable. This method nevertheless has until some exceptions, similar results to that of Ordinary Least Squares (OLS).

To identify the digital poverty effect on universal service, we estimated a probit model taking as a dependent variable the use of a landline phone. The digital poverty index is added to the explanatory variables mentioned above. The presence of this index as an explanatory variable poses a problem for econometric identification of this equation parameters. Indeed, the digital poverty index is potentially endogenous. It may be so because the factors that determine the digital poverty level of an individual may be the same that determine the use of landline phone. In this sense, we estimated the model initially without bias correction of endogeneity and after corrected for this bias in order to compare the results. The correction of this bias of endogeneity was done by using the control function. This method is to estimate a model of the determinants of digital poverty index and recover its residuals in a first step. We must then use these residuals as an explanatory variable in the equation where the index is suspected to be endogenous. This technique allows for getting unbiased estimators.

Data sources

The data for this study come from a survey database conducted by RIA in 2012. This survey covered 11 African countries that are Uganda, Kenya, Tanzania, Rwanda, Ethiopia, Ghana, Cameroon, Nigeria, Namibia, South Africa and Botswana for about 14,000 observations.

Results and discussion

Table 1: determinants of digital poverty

Variables	Model 1 : estimation with NP	Model 2 : estimation w Alkire & Foster' indexes
Sex	-0.016 (0. 012)	0.107* (0.055)
Age	0.007*** (0.002)	0.04*** (0.008)
Age square	-0.00007*** (0.00002)	-0.0003*** (0.00009)
Marital status	-0.04** (0.016)	-0.6717*** (0.0619)
Education	-0.0067*** (0.002)	-0.0063 (0.0068)
Household head	0.0384*** (0.0135)	-0.1766*** (0.0636)
Friend with a mobile phone	-0.025*** (0.0044)	0.1863*** (0.017)
Friend with an e-mail addres	-0.0526*** (0.0046)	-0.0764*** (0.0164)
Literacy	-0.0359* (0.0186)	-0.022 (0.07)
Individual Income	-0.00001*** (2.13^{E}-06)	-0.00005*** (7.37^{E}-06)

Robust Standard deviations in parentheses; *** P <0.01, ** p <0.05, * p <0.1

Source: compilation of estimation results in Stata

Model 1 is estimated by the Fractional Regression Model method. It is so, because the dependent variable of this model is an index with its values between 0 and 1. Model 2 meanwhile is a probit estimate. The dependent variable in this model is binary and takes 1 when the individual is considered numerically poor and 0 otherwise. This binary variable comes from the calculation of the indices of Alkire and Foster. Indeed, the methodology for measuring poverty proposed by these authors is based on three indices. An H index which measures the proportion of poor in the sample; a second index A that measures the average number of deprivation suffered by poor and a third index MPI is considered as the overall index of poverty in the population. The calculation of these indexes is based, in our case, on 7 variables (dimensions) equally weighted. These authors recommend that, an individual to be considered as poor when he suffers deprivation in at least 30% of the total number of

dimensions considered. In our study, we chose to consider half dimensions considered. In this logic, individuals are numerically poor in our study are those who are deprived in 4 dimensions.

It emerges from our results that there is a positive relationship between gender and the digital poverty status. This means that being a woman increases the probability of being in a digital poverty situation. This result suggests that there is a clear disparity between the situation of women and men regarding the digital poverty. To test this hypothesis disparity we did a decomposition level of digital poverty by gender.

The relationship between age and the digital poverty intensity is not linear. First, the digital poverty level increases with age up to a certain level before start declining. In graph form, we would have an inverted U shape. This configuration is quite understandable since all young people are more prone to suffer privations of all kinds especially in the field of ICT. His situation is gradually improving when it reaches a certain age. This effect can be explained by the fact that once adult, the individual has an income to improve his use of ICT.

The effect of marital status indicates that being a married man acts negatively on the intensity of digital poverty than single. This result was not particularly important to us. The level of education is measured by the total number of years of schooling. Thus measured, the relationship between education and the intensity of digital poverty is negative. Such a result seems trivial. Indeed, the adoption and use of ICTs require a certain level of education. It is normal that those who are more educated are the ones who suffer the least of digital deprivation.

A final outcome of interest for us is the negative effect that individual income exerts on the digital poverty level. The income effect is confirmed in the two models. Gradually, as the income of an individual increases, he sucks more to qualitative changes. So, he goes beyond the consumption of basic goods. A substantial individual income makes it possible for the individual to adopt and use ICTs, which reduces its digital poverty intensity.

Table 2: Decomposition of digital poverty by gender

Indexes	Factor of
	Women
H_10	1
H_20	0.963
H_30	0.933
H_40	0.866
H_50	0.714
H_60	0.262
H_70	0.664
MPI_10	0.003
MPI_20	0.0029
MPI_30	0.0029
MPI_40	0.0028
MPI_50	0.0024
MPI_60	0.0012
MPI_70	0.0003

Source: compilation of estimation results in Stata

Table 3 shows the results of the decomposition of digital poverty by gender. From the estimation results of Model 2, it has appeared that there is a difference in the effect of digital poverty by the gender. Table 3 goes further to seize the levels which are the differences between men and women. When we consider the index H which shows the proportion of private individuals, we see that overall, men are less private than women. Although this effect is not reflected in the index MPI which is the measure of digital poverty in this case.

Table 3: Adoption of the fixed telephone

Variables	Model 3 : use of landline ph without endogeneity b correction	Model 4 : use of landline ph with endogeneity bias correcti
IPN	-3.205** (1.242)	-6.363*** (1.044)
Sex	-0.0734 (0. 400)	-0.108 (0.403)
Age	-0.0001 (0.008)	0.0036 (0.0103)
Marital status	0.720* (0.379)	0.712* (0.415)
Education	-0.009 (0.076)	-0.067 (0.072)
Literacy	-0.220 (0.191)	-0.604*** (0.197)
Individual income	-0.0001** (0.00004)	-0.0001 (0.00004)
Residuals		3.634*** (1.203)

Robust Standard deviations in parentheses; *** P <0.01, ** p <0.05, * p <0.1

Source: compilation of estimation results in Stata

Table 4: Correlation between the landline use and Digital poverty level

Variables	Coefficients de corrélation	
Téléphone fixe	1.0000	-0.1008
Indice de Pauvreté Numérique	-0.1008	1.0000

Source: compilation of estimation results in Stata

Table 3 presents the adoption of fixed telephone models. Table 4 shows the correlation matrix between the use of fixed telephone and digital poverty index. The motivation behind these two tables is the same and remains the one that consists to test the nature of the effect that digital poverty intensity exerts on the use of fixed telephone. Our goal is to identify the digital poverty effect on universal service. As a reminder, the International Telecommunication Union (ITU) defines universal service as the presence of a phone per household. And Universal Access is often seen as a prerequisite for the universal service because consisting of the presence of a phone within a reasonable distance of each. In this sense, we chose the fixed telephone as a measure of universal service although sometimes in Africa households do not use this service not because they cannot afford but because the service provider has failed. Our results indicate a negative relationship between the level of digital poverty and use of fixed telephone, indeed confirmed by the negative correlation presented in Table 4. We obtain the same effect when we run the estimation with a mobile phone.

Limitation and further study of the research

This study analyzes the digital poverty in multidimensional approach in one period. It would be better to have data for several years in order to include in the research the dynamic feature. For the monitoring of digital poverty, it is important to follow the shifts in the aspects entering in the digital poverty measure.

Summary of findings

This paper studied the numerical poverty and its effect on the universal service. Our results indicate that gender, age, education and income are among other key factors that determine the level of poverty. It appeared that there is a disparity in the intensity of digital poverty regarding gender factor. It is also clear from our results that the intensity of digital poverty has a negative influence on the universal service even though the universal service is measured by landline phone or mobile phone. Our main recommendation is to set up politics that can allow a gradually high part of individuals to use the ICT.

References

AFUTT, & ANSA. (2011). L ’ accès de tous aux télécommunications : quelles offres pour quels besoins?

Alkire, S., & Foster, J. (2011). *Understandings and Misunderstandings of Multidimensional Poverty Measurement* (No. 43).

Diagne, A., & Ly, M. A. hadji. (2008). L'adoption des technologies de l'information et de la communication (TIC) par les ménages africains au sud du Sahara : analyse comparative à partir des micros données, 1–33.

Rallet, A., & Rochelandet, F. (2003). La "fracture numerique" : une faille sans fondement ?".

Tangian, A. S. (2005). *A composite indicator of working conditions in the EU-15 for policy monitoring and analytical purposes* (No. 135) (pp. 1–78).