Digital Development and Gender Inequality in Africa

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Summary

Problem: Promoting gender equality remains one of the main priorities of development efforts as reflected in the fifth sustainable development goal. Despite these initiatives and progress made worldwide in terms of gender equality, women and girls continue to suffer from discrimination and violence in all areas of life around the world. However, digital technologies have undergone exponential development in recent decades. Our research question is therefore: What is the effect of digital development on gender inequality in Africa?

Objective: The aim is to model gender inequality in Africa by focusing on the effect of digital development and identify the channels through which digital development affects gender inequality in Africa.

Method: Our study analyzes the effect of digital development on gender inequality using the panel data method of 28 African countries from 2006-2016. The Global Gender Inequality Index (gggi) presented by the World Economic Forum is the variable used as a proxy for gender inequality. Four variables are used as a proxy for digital development: Mobile phone subscriptions, Fixed-line subscriptions, Fixed-line broadband subscriptions, and Internet users. The data on the Global Gender Inequality Index are from the World Economic Forum. The World Bank statistical tables (WDI) provided the other variables.

Results: Our results show that two of the variables related to digital developments significantly impact gender inequality in Africa. These are Internet use and mobile phone subscriptions.

Keywords: Digital development, Gender inequality, Panel.

The authors declare that they have no conflict of interest regarding this publication

JEL classification: F33, F15

1-Introduction

Promoting gender equality remains one of the main priorities of development efforts as evidenced by the fifth sustainable development goal. For the World Bank (2003), gender equality is a powerful development tool in a country. According to a report published in September 2015 by the Mckinsey Global Institute, if all countries in the world achieved perfect equality between women and men, the gain in global growth would reach 26% (or 28,000 billion dollars). Several regional initiatives have also been concerned with this concern for equity. These include: the founding legal instrument of the African Union (AU) and the African Charter on Human and Peoples' Rights, which recognize the principle of gender equality and non-discrimination; the adoption in July 2004 in Addis Ababa, by the summit of heads of state and government of the AU, of the solemn declaration on equality between men and women. For Mrs. Clark, former Prime Minister of New Zealand, "Africa's development will be faster if equality between men and women is achieved". Other studies have also shown the existence of a significant link between gender equality and economic growth (Barro and Lee [1994], Schultz [2002], Knowles et al. [2002], Amin et al. [2015]). Our article focuses on reducing gender inequality.

Despite these initiatives and progress made worldwide in terms of gender equality, women and girls continue to suffer from discrimination and violence in all areas of life around the world. The Global Gender Gap Index, presented by the World Economic Forum, is a framework for understanding the scale and scope of gender-based disparities and monitoring their progress. While this global gender inequality index has seen an improvement since 2006 in terms of reducing the gap between men and women in the areas of employment, education, health, and politics, this scourge remains one of the most pressing challenges facing the world today. Globally, in 2018 the gender gap was reduced by 0.03% compared to 2017 and by 3.6% compared to 2006. According to the Global Gender Report 2020, this gap can only be completely reduced after 99.5 years, all things being equal.

Along with the reduction of gender disparities, digital technologies have undergone exponential development in recent decades. According to the World Bank (2016),

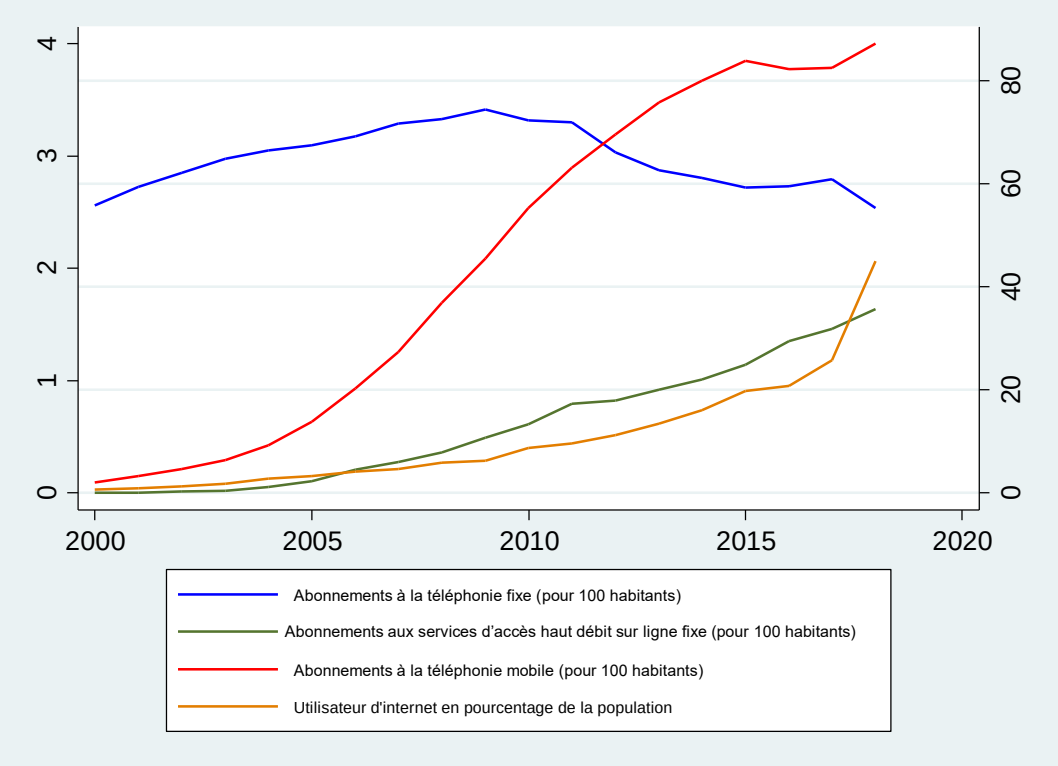
the size of mobile telephone networks worldwide has almost doubled every two years since 2002. Furthermore, in 2011, about 90 high-income countries in the world had mobile penetration rates of up to 100%. Commonly used ICT proxy variables are: mobile telephone subscriptions, fixed-line telephone subscriptions, fixed-line broadband subscriptions, and internet users. In Africa, the average annual growth rate of mobile telephone subscriptions between 2000 and 2018 is 23%, and that of fixed-line broadband subscriptions is 59.22% for the same period. Figure 1 shows the evolution of these four variables in Africa. Under these conditions, the analysis of the nature of the relationship between digital development and gender inequality deserves our attention.

The literature on the nature of the relationship between ICT and gender is not only contradictory but also scarce. On the subject, two opposing theses are: The first asserts that ICTs reduce gender inequality: Chen (2004) showed that a high level of ICTs can lead to the improvement of gender equality in several ways. For example, ICTs can influence public opinion on gender equality by increasing women's educational opportunities and also women's economic opportunities socially. Zhou et al. (2019) showed that the use of the internet can attenuate discriminatory attitudes towards women. On the other hand, for the second thesis, ICTs do not lead to the reduction of gender disparities but on the contrary, they tend to widen the gender gap [Liff and Sheperd (2003); Moreno- Galbis et al. (2007); Dijk (2005), Warschauer (2003)].

From the above, we can say that the effect of ICT on Gender is not known a priori. To our knowledge, very few studies have been conducted in Africa on the subject. Our research question is as follows: What is the effect of digital development on gender inequality in Africa?

The objective of our study is to assess the impact of digital development on gender inequality in Africa. To achieve this objective we test the hypothesis that digital development reduces gender inequality in Africa.

Figure 1: Evolution of proxies for digital development in Africa, 2000-2018



Source: Author from WDI data

The contribution of this study is twofold. The first lies in the methodology: Our study analyzes the effect of digital development on gender inequality using the panel data method. This method allows to take into account the heterogeneity of individuals; provides more variability, more degrees of freedom, less collinearity between variables and more precision [Sylvestre (2002) and Pirotte (2011)]. Unlike previous studies, four variables are used as a proxy for digital development: Mobile phone subscriptions, Fixed line subscriptions, Fixed line broadband access service subscriptions and Internet user. The second contribution is empirical and aims to enrich the literature on the nature of the relationship between digital development and gender in Africa . This study should facilitate the work of governments and institutions involved in reducing gender inequalities by providing them with an effective and useful tool for promoting gender equality.

The rest of our work is organized as follows: the second section is devoted to the literature review, the third section presents the econometric model and the estimation methodology, the fourth provides information on the source of our data, the fifth section presents the results and the last section the conclusion and implications in terms of economic policies.

2-Review of the literature on the relationship between ICT and gender

The literature on the nature of the relationship between ICT and gender is not only contradictory but also scarce, especially for empirical work. This section presents theoretical and empirical studies on the link between ICT and gender.

Hasan (2012) shows that ICTs can play a role in gender equality by enhancing the empowerment of women who are discriminated against in the socio-cultural context of Bangladesh. The use of ICTs influences discriminated women to achieve individual satisfaction, independence, and decision-making roles through economic participation in the household. They also enable women to acquire education, knowledge, and skills needed for the reorganization of society.

Daly (2003), in his article entitled: “ICT, Gender Equality, and Empowering Women " shows that ICTs may not have an impact on gender equality. It states: "In countries that do not seize the opportunities offered by ICTs, technology cannot be expected to promote equality."

Desk research conducted by Webb (2016), shows that the availability of information and communication technologies does not guarantee equitable access and gender equality. His analysis is based on extensive research on ICTs conducted with gender and empowerment as the main analytical objectives.

Sorgner et al. (2017) Analyses the effects of destructive and transformative digitalisation on workers in developing and transition countries. The results suggest that there are marked gender differences in the effects of new digital technologies.

For Dijk (2005) and Warschauer (2003), information and communication technologies which should contribute to the development of all human beings, in

fact widen the inequalities between the developed and the underdeveloped world, between the rich and the poor, between men and women, etc., thus creating what is called the "digital divide".

Zhou et al. (2019) on a study conducted with the 2010, 2013 and 2015 waves of the Chinese General Social Survey to study the impact of internet use on attitudes regarding the roles of women and men find from OLS and IV estimates that internet use can alleviate discriminatory attitudes towards women.

Chen (2004), focuses on the role that information and communication technologies can play in improving gender equality, in order to enhance long-term economic growth. He shows from a panel model of 209 countries over the period 1960-2002 estimated by OLS and IV that increasing ICT infrastructure tends to improve gender equality in education and employment and that gender equality in education is an important factor in improving gender equality in employment.

Moreno- Galbis et al. (2007) focused on studying the impact of ICT on the gender pay gap along the wage distribution by building their analysis on two complementary French surveys conducted in 1998 and 2005 on a large sample of employees. Using the Difference-in-Difference method, the study concludes that the gender gap estimated for the group of ICT users is not really different from the gap for non-users. They also showed that the gender pay gap among ICT users is explained by a divergence in pay with identical characteristics.

Liff and Shepherd (2003) investigated a number of additional determinants that may impact the digital gender divide. Their findings in a survey conducted in the United Kingdom showed that a gender divide continues to exist, not only in terms of whether or not the Internet is used, but also in terms of the use of this technology and the utility it provides to men compared to women.

Gu et al. (2016) studied the relationship between gender equality in education and the diffusion of ICT in rural China by estimating the impact of telephone and internet access on children's school enrollment with a probit model . Using data from the China National Health and Nutrition Survey for the period 1991-2009. They found that the diffusion of telephone and internet access contributes to the increase in female school enrollment.

Mandour (2009), analyzes the impact of ICT on gender equality in Egypt by focusing on wage rate differences and employment opportunities. To investigate the possibility that the gender gap in employment differs significantly between ICT and non-ICT sectors, two series of panel regressions were estimated. It shows that the development of the ICT sector positively impacts gender equality in employment in Egypt. It also shows that there is a significant positive relationship between gender equality in employment and the level of ICT infrastructure in Egypt.

Previously reviewed studies on the relationship between ICTs and gender show that there is no agreement on the precise impact of ICTs on gender equality. The issue remains inconclusive. Furthermore, while these studies examine the effect of ICTs on gender, few are specific to African countries.

3-Model to be estimated

Our econometric analysis model is based on the panel data method.

The panel data method has several advantages: In addition to its ability to take into account the heterogeneity of individuals; it provides more variability, more degrees of freedom, less collinearity between variables and more precision (Baltagi [2001], Sylvestre [2002] and Pirotte [2011]). We estimate a model in which gender inequality (gggi) depends on digital development (dnum) and a number of control variables drawn from the literature review:

$$gggi_{it} = \alpha_0 + \alpha_1 dnum_{it} + \alpha_3 pib_{it} + \alpha_4 sex_{it} + \alpha_5 ide_{it} + \varepsilon_{it} (1)$$

With ε_{it} the error term; α is the parameter to be estimated; i represents the country and t the period.

Definition of variables

Our study analyzes the effect of digital development on gender inequality. The Global Gender Inequality Index (gggi) presented by the World Economic Forum is the variable used as a proxy for gender inequality. It is between 0 and 1. The score 0 represents inequality between men and women and the score 1 means equality. The independent variables are:

- **Digital development (dnum)**

Four variables are used as proxies for digital development:

- Log Mobile phone subscriptions, per 100 inhabitants (mobile phone): these are subscriptions to public mobile phone services. It is supposed to reduce gender inequality.
- Fixed line subscriptions per 100 inhabitants (Fixphone): this is the sum of the active number of a fixed line. It is supposed to have a negative impact on gender inequality.
- Subscriptions to fixed-line broadband access services, per 100 inhabitants (fixbroadband): we only expect this variable to influence the reduction of gender inequality.
- Internet user as a percentage of population (internet): It is supposed to reduce gender inequality in Africa.

- **Log GDP per capita (gdp)**

It is the gross domestic product divided by the mid-year population. The latter is supposed to influence the reduction of gender inequality.

- **Foreign direct investment, net inflows as a percentage of GDP (FDI) :**

Foreign direct investment is the net inflow of investment to acquire a lasting interest in an enterprise operating in an economy other than that of the investor.

- **Sex ratio at birth, girls per 1000 boys (sexratio) :**

This variable is supposed to influence the reduction of gender inequality (Derek [2004]).

With the four proxy variables of digital development, we will have four equations to estimate:

$$gggi_{it} = \alpha_0 + \alpha_1 \text{mobilphone}_{it} + \alpha_3 pib_{it} + \alpha_4 sexratio_{it} + \alpha_5 ide_{it} + \varepsilon_{it} (2)$$

$$gggi_{it} = \alpha'_0 + \alpha'_1 \text{Fixphone}_{it} + \alpha'_2 pib_{it} + \alpha'_3 sexratio_{it} + \alpha'_4 ide_{it} + \varepsilon'_{it} (3)$$

$$gggi_{it} = \alpha''_0 + \alpha''_1 \text{fixbroadband}_{it} + \alpha''_2 pib_{it} + \alpha''_3 sexratio_{it} + \alpha''_4 ide_{it} + \varepsilon''_{it} (4)$$

$$ggi_{it} = \alpha_0''' + \alpha_1'''\text{internet}_{it} + \alpha_2'''pib_{it} + \alpha_3'''sexratio_{it} + \alpha_4'''ide_{it} + \varepsilon_{it}'''(5)$$

3-data source

Our study analyzes the impact of digital development on gender inequality in Africa. In this sense, we use a panel of African countries. However, given the unavailability of data on gender inequality for some countries, our panel is limited to 28 African countries: Algeria, Angola, Benin, Botswana, Burkina Faso, Cameroon, Ivory Coast, Egypt, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mali, Morocco, Mauritania, Mozambique, Namibia, Nigeria, Uganda, Senegal, Tanzania, Chad, Tunisia, Zambia and Zimbabwe. Data on the overall gender inequality index come from the World Economic Forum. The other variables were provided by the World Bank statistical tables (WDI) relative to the countries considered from 2006 to 2016. Most of these variables are integrated of zero order [1].

4-Estimation method

We adopt the panel data estimation of the fixed effect or random effects model. The first is the within method and the second is the generalized least squares (GLS) method. The within method involves a correlation of the unobserved heterogeneous effects with the explanatory variables of the model. It measures the variability of each observation relative to the mean of the individual to which this observation belongs and this to eliminate the individual effects:

$$Y_{it} = \alpha + \beta X_{it} + v_i + e_{it}(6)$$

$$\bar{Y}_i = \alpha + \beta \bar{X}_i + v_i + \bar{e}_i(7)$$

$\bar{Y}_i = \sum_t Y_{it}/\ T$; $\bar{X}_i = \sum_t X_{it}/\ T$and $\bar{e}_i = \sum_t e_{it}/\ T$. Subtracting (7) from (6) we have:

$$Y_{it} - \bar{Y}_i = \beta(X_{it} - \bar{X}_i) + e_{it} - e_i(8)$$

[1] The Levin et al . (2002) and Im et al. (2003) tests are used in our study. The first assumes an autoregressive unit root and the second a heterogeneous unit root

The MCO estimator can be used on this new equation.

In the random effect model there is no correlation between the individual effects and each of the explanatory variables:$Cov(X_{it}, v_i) = 0$

In particular the estimator of random effects is equivalent to the estimation of:

$$Y_{it} - \theta\bar{Y}_i = \alpha(1-\theta) + \beta(X_{it} - \theta\bar{X}_i) + (1-\theta)v_i + (e_{it} - \theta e_i) \quad (9)$$

Or

θ is a function of $\sigma_v^2$and σ_e^2.

The choice of the best specification is based in most studies on the Hausman statistical test (1978). This test allows to determine if the coefficients of the two estimates (fixed and random) are statistically different. It then compares the variance-covariance matrix of the two estimators:

$$W = (\beta_f - \beta_a)' var(\beta_f - \beta_a)^{-1}(\beta_f - \beta_a) \quad (10)$$

With $\beta_f$and $\beta_a$the estimators resulting respectively from the fixed effects method and the random effects method. If we reject the null hypothesis then we will prefer the fixed effects estimation to that of random effects otherwise we will use the random effects which are effective if there is no correlation between the errors and the explanatory variables.

5-Results and interpretations

The following table presents the results of the estimation of our four models by the within method. The dependent variable is the global gender inequality index (ggi). Each of the regressions has the same number of control variables with each of the four proxies of digital development. The results of the Hausman test (1978) reported in the appendix show that the within method is preferred to that of generalized least squares in our four models. The "cluster robust " option is used

to correct for possible problems of autocorrelation of errors and heteroscedasticity [Wooldridge (2013)].

Table: results of the estimates

Method	Fixed Effects			
regression	(1)	(2)	(3)	(4)
Idea	-0.0001	-0.0001	-0.000002	0.0001
	(-0.32)	(-0.30)	(-0.01)	(0.31)
sex ratio	3,5663***	4.6869**	4,8934***	4,6684***
	(2.96)	(2.67)	(2.87)	(2.84)
GDP	0.0512**	0.1163***	0.1072***	0.0755***
	(2.06)	(6.49)	(6.34)	(4.00)
mobile phone	0.0133**			
	(2.57)			
landline		-0.0001		
		(-0.05)		
Fixbroaband			0.003	
			(1.47)	
Internet				0.0007*
				(1.92)
constant	-3.6739***	-5.5028***	-5.6199**	-5.0429**
	(-2.81)	(-3.10)	(-3.23)	(-3.01)
obs	308			
R^2	0.41	0.36	0.36	0,38

*p<10%; **p<5%; ***p<1%; Absolute value of t statistics in parentheses

The results of our estimations correspond to our expectations for some of our variables of interest (notably for mobile phone subscriptions and also for internet users). Indeed, for these variables, the coefficients appear positive and significant, they therefore positively influence the reduction of gender inequalities in Africa. This result is consistent with our hypothesis and that of Chen (2004) and Hasan [2012] who found that digital developments can have a negative effect on gender

inequality. A high level of ICT can influence public opinion on gender equality by increasing women's educational opportunities and also women's economic opportunities socially. It can also allow women to acquire the knowledge and skills necessary to obtain a respectful social reorganization.

Furthermore, contrary to our expectations, fixed-line telephone and broadband access service subscriptions fixed line flow rate appear with insignificant coefficients. They therefore have no impact on gender inequality in Africa. The results related to subscription to fixed-line broadband access services can be explained by the recent nature of the phenomenon. According to Cariolle and Goujon (2019), access to broadband services in Sub-Saharan Africa primarily benefits the richest, urban dwellers, and the most educated. All our control variables appear significant except foreign direct investment. FDI therefore has no impact on gender inequality in Africa.

6-conclusion

This work attempts to answer the question of the link between digital development and gender in African countries. These two quantities have undergone remarkable progress in recent decades, especially for digital. The particularity of our work lies in the choice of the study area . Indeed, to our knowledge, African countries have not been the subject of much research in this area. The specific objective of our study is to analyze the impact of digital development on gender inequality in Africa, using four proxies for digital development. To analyze this impact, we used a panel model of African countries from 2006 to 2016 estimated by the within method . Several important results come from our estimates:

Our results show that two of the variables related to digital developments have a significant positive impact on gender inequality in Africa. These are: Internet use and Mobile phone subscriptions. No significant impact was found for the other two proxies of digital development. This can be explained on the one hand by the recent nature of the phenomenon related to fixed-line broadband access services and on

the other hand by the decline observed in recent times in fixed-line subscriptions. These results are consistent with those of Chen (2004) and Hasan [2012]. A positive and significant effect of GDP per capita and the Sex ratio at birth on gender inequality was also found. In short, our study allows us to affirm that digital development contributes to the reduction of gender inequalities in Africa. It therefore provides an effective and useful tool for promoting gender equality in Africa.

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Annexe

Stationarity test

variables	IPS		LLC		Order of integration
	Without trend	With trend	Without trend	With trend	
landline	0.8863	0.0123	0.0000	0.0000	I(0)
ggi	0.9748	0.0196	0.0020	0.0000	I(0)
idea	0.0003	0.0000	0.0000	0.0000	I(0)
mobile phone	0.0785	1,0000	0,0000	0,0000	I(0)
pibhab	0,9860	0,8194	0,0000	0,0000	I(0)
ratiosex	0,1249	1,0000	0,0020	1,0000	I(1)
fixbroadband	1,0000	1,0000	0,9846	0,6926	I(1)

Test de Hausman

	Chi2(4)	Prob>Chi2
Modèle 1	145,97	0,000
Modèle 2	171,38	0,000
Modèle 3	32,57	0,000
Modèle 4	69,1	0,000

Statistique descriptive

Variables	**Obs**	**Mean**	**Std.Dev**	**Min**	**Max**
pib	308	247708,4	399207,5	774,0779	1957810
mobilphone	308	62,60999	35,94924	1,099166	157,3118
fixphone	308	2,817825	3,338939	0,0620952	14,6411
Fixbroaband	308	0,5974973	1,172549	0,000331	7,042219
internet	308	12,02835	12,4355	0,3105927	58,27124
Ide	308	4,04175	5,224896	-5,208123	41,80964
sexratio	308	1,037938	0,0119153	1,02	1,066