1. Introduction

With the Third Conference on Population and Development held in Cairo in Egypt from 3 to 5 September 1994, it was admitted that HIV/AIDS is a threat to both health and development and that actions must be taken subsequently. The Millennium Development Goals (MDGs) had given to this matter a place of choice and since 2015, the Sustainable Development Goals (SDGs) took over the fight against the pandemic (UN, 2014).

Since its inception in the 80's, 75.7 million people have been infected with 32.7 million deaths, in the world, due to AIDS-related diseases (UNAIDS, 2020). In sub-Saharan Africa, 25.6 million people live with HIV and 440 000 died in 2019. Sub-Saharan Africa accounted for about 67% of people infected with HIV in 2019, while this part of the continent accounts for less than 10% of the world population.

The evolution of the disease is not the same in every part of sub-Saharan Africa. According to the facts-sheet published by UNAIDS on World AIDS-Day in 2018, Southern and Eastern Africa represent the most affected zone of infection with more than half of the world infected people in 2017 (59.44%), while West and Central Africa account for only 11%. It is worth mentioning that East Africa and Central Africa were the most affected at the beginning of the epidemic (Amat-Roze, 1989).

In 1985, only five countries had registered HIV/AIDS cases in the continent: Rwanda, Kenya, Botswana, Angola and Central African Republic. In 1987, this statistics changed and several other countries were affected by the disease (Congo, Uganda, Burundi, Malawi, Zambia, and Tanzania). During that year, Congo was the most affected with 62.5 cases per 100000 inhabitants. Moreover, despite the high prevalence of some coastal countries such as Guinea-Bissau, Gambia, Côte d'Ivoire, and Ghana, their boarding countries (Guinea, Sierra Leone, Liberia and Togo, Benin, Nigeria) have low rates (Amat-Roze, 1989).

In 2016, United Nations established the top 10 nations most affected by the epidemic in Africa. These nations were Swaziland (26%), Botswana (23,4), Lesotho (23,3%), South Africa (17,3%), Zimbabwe (14,9%), Namibia (13,4%), Zambia (12,5%), Mozambique (11,3%), Malawi (10%) and Uganda (7,2%) (UN, 2016). Nine out of ten of those countries are located in Southern Africa.

Given these statistics, it is easy to admit that HIV/AIDS is still a reality that varies in size across countries. Despite endeavors to dispel doubts and suspicions, questions persist regarding its natural origin or not (Pepin, 2011). Indeed, many Africans are still believing that HIV/AIDS is a virus made to slow down population growth, and an intelligently organized contrivance to seize the resource of Africa. In contradiction with some arguments like in Chersich and Rees (2008) and Kongnyuy et al. (2006), some are arguing that only sexual behavior cannot explain the origin and the diffusion of the disease (Brewer et al., 2003; Sawers and Stillwaggon, 2010). Others believe that the colonial legacy of African countries has contributed to the emergence of the pandemic (Anderson, 2018). Bertocchi, G. and Dimico, A. (2019) found that the origin is historically more distant and could be related to transatlantic slave trade. In other word, the debate still remains complex and messy (Giles-Vernick et al., 2013), and it is therefore necessary to continue exploring the possible historical factors determining the prevalence of the disease. Basically, the issues raised in this paper are the following: does the colonial history has an impact on the current-day prevalence of HIV in sub-Saharan Africa? What are the historical post-colonial socio economic national characteristics of countries in the southern part of the Sahara where HIV is prevalent? What is the individual and national profile of people with HIV?

Using a multi-level model, with data from Demographic and Health Surveys (DHS) from 16 countries across sub-Saharan Africa, the present study first revealed that the current risk of infection for an individual depends on individual characteristics such as the residential (urban or rural) environment, the economic well-being of the household where the individual lives, the age, the gender, the educational level and the marital status. This risk also varies with the national characteristics of the individual's country of residence, such as the year of independence, the colonizing country, the fertility rate in 1980, the prevalence of HIV in 1980, whether the country is landlocked or not, etc. On the other hand, the political (Democratic or non-democratic) regime does not affect the risk of being HIV positive, unlike the legal system (Common Law, Civil Law or customary) which does.

In addition to the econometric approach, the contribution of this paper is twofold. First, most of recent papers studying the relationship between history and HIV in Africa (by considering more than one country in continent) have focused on female HIV prevalence. Here, we consider a population consisting of both men and women. Second, besides political history, we consider economic history, and the period of history includes also the years of the emergence of the disease (1980's). Specifically, in this paper, history consists of three periods: the colonial times, the years of independence and the years of the emergence of HIV/AIDS.

The rest of the paper is organized as follows. At first, we present the data and the method of analysis. Next, we present the findings, and end with a discussion and concluding remarks.

2. Data

The data used in our work are mainly from the Demographic and Health Surveys (DHS 5 or DHS 6) of 16 African countries over the period 2009-2012 as shown in Table 1.

Table 1: The countries involved in the study, with their geographical location and the year of The DHS considered

Countries	Location	DHS
Burkina	West Africa	2010
Burundi	East Africa	2010
Cameroon	Central Africa	2011
Congo	Central Africa	2009
Côte d'Ivoire	West Africa	2011-2012
Ethiopia	East Africa	2011
Gabon	Central Africa	2012
Guinea	West Africa	2012
Lesotho	South Africa	2009
Malawi	East Africa	2010
Niger	West Africa	2012
Rwanda	East Africa	2010
Senegal	West Africa	2010-2011
Tanzania	East Africa	2010
Uganda	East Africa	2011
Zimbabwe	South Africa	2010-2011

Source: Produced by the authors.

These data were downloaded from the DHS Program website. Although this site provides DHS from all countries, we faced the problem of data availability. Indeed, it is important to have data

of the same year or approximatively, but, unfortunately the year of DHS surveys largely varies with the country. So, we could not work with all the 48 countries. The years for which data were available for several countries at the same time were 2009; 2010; 2011 and 2012, with the year 2010 prevailing. Hence, we considered 2010, corresponding to DHS 5 or DHS 6 for the involved countries. We also cared about the representativeness of the four major regions of sub-Saharan Africa (West, East, Center and South).

In each country, DHSs are supervised by the national institutes of statistics with the support of some international institutions such as USAID, WHO, UNICEF, UNFPA, etc. DHS are surveys of representative households at the national level. They provide data for a wide range of monitoring and impact evaluation indicators in the domains of population, health and nutrition. They provide information on topics such as anemia, child health, domestic violence, education, family planning, fertility and fecundity, gender, HIV (knowledge, attitudes and Behaviours), HIV prevalence, characteristics of households and respondents, mother health, nutrition, etc. The surveys use different types of questionnaire: Household questionnaire, individual questionnaire for males, and individual questionnaire for females.

In addition to data from DHS, we have gathered through various sources (World Bank, States website, history documents, etc.) historical and economic data on countries (the colonizing country, the year of independence, gross domestic product (GDP) per capita in 1980, the legal system, etc.). Finally, the approach to build the database is as follows: downloading the databases "HIV", "HOUSEHOLD" and "HOUSEHOLD MEMBERS" on the website of the DHS program, choice of countries with data for 2010 and close years (2009-2012) available, collection of historical and economic information on these countries in order to find an individual-level database for each country, and merging of all databases. It is important to mention that our study focused on people aged between 15 and 49. The different variables in this study are presented in Table 2.

Table 2: Variables and occurrences

Variables	Occurrences
Individual characteristics	
HIV status	0=negative, 1=positive
Type of residential environment	0=rural, 1=urban
Wealth index	0=very poor, 1= poor, 2=middle , 3=rich, 4-very rich
Gender	1=male, 2 =female
Age	0= [15-24[, 1= [25-34[, 2= [35-44, 3= [45-49[
Education	0=no education, 1=primary, 2=secondary, 3=higher
Marital status	0=never married, 1= married, 2= widowed, 3= divorced
National characteristics	
Location	1=West Africa , 2=East Africa, 3=Central Africa, 4=South Africa
Year of independance	
VIH Prevalence in 1980 (%)	
GDP per capita in 1980 (constant 2010)	

Variables	Occurrences
Fertility rate 1980	
Country (indicator variable)	
Colonizing country	1=France, 2=Belgium, 3=United kingdom, 4=France, United kingdom, 5=None
Land locked territory	0=no; 1=yes
Political system	1= Imperfect Democracy , 2=hybrid regime, 3= Authoritarian Regime
Legal system	1=Civil-law and Customary, 2=Common Law and Customary, 3=Common Law, Civil-law and Customary

Source: Produced by the authors.

3. Method

3.1. Choice of the model

To conduct this study, we estimated a multi-level model. Indeed, statistical units are individuals while some variables are observed at the national level. A simple logit model cannot provide unbiased estimators. Moreover, the calculation of the variance of these estimators can be biased. To see if statistically, the country influences HIV status, and therefore to justify the use of the multi-level model, an analysis of the variance (ANOVA) on the dependent variable according to the country could be made. But here, given the binary nature of the dependent variable, an analysis of variance is not suitable. We have therefore operated a binary logistic regression by including among the explanatory variables the dummy of the countries. The results are recorded in the table below.

Table 3: Logit model estimates showing the effect of the country variable on HIV/AIDS status.

Status	**Coefficients**	**Std. Err.**	**z**	**P-value**	**Interval of confidence**	
Covariates			**Significant**			
Countries						
Burundi	0.5431514	0.1147757	4.73	0.000	0.3181951	7681077
Cameroon	1.311879	0.0932438	14.07	0.000	1.129125	1.494633
Congo	0.8332661	0.1012614	8.23	0.000	0.6347974	1.031735
Côte d'Ivoire	1.215177	0.0997552	12.18	0.000	1.019661	1.4110694
Ethiopia	0.5558401	0.0913735	6.08	0.000	0.3767515	0.7349288
Gabon	1.165176	0.0998522	11.67	0.000	0.969469	1.360882
Guinea	0.605876	0.1150991	5.26	0.000	0.3802859	0.8314662
Lesotho	3.235872	0.0897611	36.04	0.000	3.059885	3.411859
Niger	-0.7516125	0.1727732	-4.35	0.000	-1.0902242	-0.4129832
Rwanda	0.9936468	0.980124	10.14	0.000	0.801546	1.185748
Senegal	-0.1376802	0.135174	-1.02	0.000	-0.4026163	0.1272559
Tanzania	1.30254	0.0905995	14.38	0.000	1.124968	1.480112
Uganda	1.780284	0.0879929	20.23	0.000	1.607821	1.952747
Zimbabwe	2.742792	0.0879282	31.19	0.000	2.570456	2.915128
constante	-6.911876	0.095364	-72.48	0.000	-7.098786	-6.724966

Source: Produced by the authors

With a simple logit including individual characteristics, we find that the country indicator variable has a significant effect on HIV status. In other words, the country of residence explains some of the information contained in the serological status of an individual. This justifies the use of the multi-level model.

3.2.Multi-level model

Multi-level models or hierarchical models (multi-level logistic regression) are designed to meet the easier analysis needs of multi-level structured data, like in Magadi and Desta (2011) and Adetokunboh and Are (2020). Our model is of two levels: Level one that corresponds to the characteristics of individuals (age, gender, educational level, wealth index, marital status and type of residence environment) and the second level corresponding to the characteristics of the country (colonizing country, year of independence, landlocked territory, category of country, GDP per head, fertility rate, etc.). The model to consider is as follows:

$$y_{ij} = \beta_0 + x_{ij}\beta + z_j\gamma + \alpha_j + \varepsilon_{ij} \qquad (1)$$

$$j=1,\ldots,J \qquad i=1,\ldots..,n_j$$

where $\varepsilon_{ij} \sim N(0, \sigma^2_\varepsilon)$ et $\alpha_j \sim N(0, \sigma^2_\alpha)$.

The double subscripts **ij** illustrate the multilevel structure of the model. Subscript **i** refers to the individual (individual characteristics) while subscript **j** refers to the group (national characteristics). The interest variable y_{ij} refers to the HIV status of the individual **i** of the group (country) **j,** x_{ij} corresponds to the level 1 covariates: age, gender, the type of the environment of residence, etc. Concerning z_j, it represents the level 2 covariates, i.e., the geographical location of the country, whether or not the country is landlocked, the year of independence, etc. β_0, β and γ are parameters or coefficients associated with the corresponding variables. $\alpha_j + \varepsilon_{ij}$ are the unobserved terms (Givord & Guillerm, 2016). For multi-level models, in addition to the significance of the coefficients of the explanatory variables, the significance of intra-group variance must also be tested. With regard to the coefficients, the classical approach of the Student test is used. For intra-group variance, the LR test (likelihood ratio) is used.

The diagnosis of the model is to identify which of the fixed effects model and the random effects model is the most suitable. The Mundlak test was used for this purpose. This consists in estimating the following model:

$$y_{ij} = \beta_0 + x_{ij}\beta + z_{ij}\gamma + \dot{x}_{.j}\theta + u_j + \varepsilon_{ij}, \qquad (2)$$

$$\text{where } u_j \sim N(0, \sigma^2_u)$$

$\dot{x}_{.j}$ is the mean of individual characteristics in country **j**. If θ is not significantly different from zero, then the random effect model is the most suitable. In this work, the implementation of the Mundlak test has brought to the choice of the random effect model. Ethiopia is a special country because it has not been colonized. The review of the country's history allowed us to analyze the outcome of the various wars of domination that the country experienced and to consider the year 1896 as the year of independence of Ethiopia. Given this peculiarity of this country, and for the sake of robustness of the results, we estimated two models, one of which including Ethiopia and the other excluding it. The interpretation tools used to present the results are coefficients and odds-ratios.

4. Results

As mentioned, we first estimated a first model that excludes Ethiopia. Table 4 presents the results.

Table 4: Estimates from the multi-level model with random effects (without Ethiopia)

Independent variables	Coefficients	Odds-Ratios	P >|z|
Type of environment of residence (Ref= Rural)			
Urban	0.410 (0.033)	1.506	0.000
Wealth index (Ref= very poor)			
Poor	0.134 (0.038)	1.143	0.001
Middle	0.135 (0.039)	1.144	0.001
Rich	0.149 (0.041)	1.160	0.000
Very rich	0.154 (0.048)	1.167	0.001
Gender (Ref=Male)			
Female	0.329 (0.025)	1.390	0.000
Education (Ref=No education)			
Primary	0.292 (0.040)	1.338	0.000
Secondary	0.191 (0.045)	1.210	0.000
Higher	-0.222 (0.076)	0.801	0.004
Age (Ref= [15-24])			
[25-34]	1.071 (0.037)	2.920	0.000
[35-44]	1.281 (0.040)	3.601	0.000
[45-49]	1.087 (0,051)	2.964	0.000
Marital status (Ref= Never married)			
Married	0.261 (0,037)	1.298	0.000
Widowed	1.587 (0.058)	4.892	0.000
Divorced	1.082 (0,050)	2.951	0.000
Political system (Ref=Imperfect democracy)			
Hybrid regime	0.190 (0.155)	1.209	0.222
Authoritarian regime	0.115 (0.121)	1.121	0.344
Country location (Ref=West)			
East	0.355 (0.151)	1.425	0.019
Central	0.215 (0.147)	1.240	0.146
South	6.225 (0.494)	505.561	0.000
Colonizing country (Ref= France)			
Belgium	1.270 (0.146)	3.559	0.000
United Kingdom	0.243 (0.195)	1.275	0.212
France and United Kingdom	1.108 (0.102)	3.029	0.000
Year of Independence	-0.351 (0,020)	0.703	0.000
Prevalence of HIV in 1980	0.268 (0.019)	1.308	0.000
GDP per capita in 1980	0.0001 (9.36e-06)	1.0001	0.000

Fertility rate in 1980	0.245 (0.114)	1.278	0.031
Littoral (Ref=Not landlocked)			
Landlocked	0.822 (0,092)	2.276	0.000
Constant	679.519 (39.313)	1.3e+295	0.000
Log-likelihood = -28089.731			
Number of observations: 165426		Observation per group	
Number of groups: 14		Min	6741
Wald chi2 (28) = 10201.71		Average	11816.1
Prob chi2 = 0.000		Max	19680
LR test for rho=0 : P-value=1.000			

Source: Produced by the authors. *Standard errors in (.)*

The analysis of Table 4 shows that the individual characteristics influencing the risk of HIV/AIDS are the residential environment (rural people are less at risk), gender (women are more vulnerable to the disease than men), education level (when you move from an individual with no education level to a higher education level, the risk increases, except the transition to the university level where the risk decreases), economic welfare index or wealth index (the poorest are less vulnerable), age (the 35 - 44 years old are the most vulnerable, as in Adetokunboh and Are, 2020), and the marital status (widows are most vulnerable and singles are the least concerned). As for the national characteristics (details of which are provided below), the country's geographical location in Africa, the colonizing country, the year of independence, the prevalence of HIV in 1980, the fertility rate in 1980, the colonizing country, whether or not the country is landlocked are the variables that are significantly associated with the individual's HIV/AIDS status. However, the level of economic growth in 1980 has no significant impact (or the effect is very low).

Geographical location: Our findings reveal that the "central" modality is not significant. Compared to individuals whose country is located in West Africa, individuals whose country is located in Eastern or Southern Africa are more likely to be HIV positive. More specifically, individuals from a country located in East Africa, or southern run respectively 1.42 times or 505.6 times the risk of HIV infection than countries in West Africa.

Year of independence: It appears from the estimates that the earlier the independence of the country of residence, the higher the risk for an individual of that country to be HIV positive. Individuals from early independent country have a higher probability to HIV/AIDS occurrence than those from a country that did not get independence early. Specifically, every individual runs 1.42 times the risk of being HIV positive than those from a country that gained independence one year later than his country.

1980 HIV prevalence rate: The prevalence of HIV in 1980 in the country increases the current risk of HIV infection for the individual. More precisely, when the prevalence rate in 1980 increases by one point, it multiplies by 1.3 the risk of being HIV positive. This could surely mean that the disparities between countries at the beginning of the epidemic have not changed completely, three decades later (Hanson and Hanson, 2008), despite initiatives from donors to reduce the prevalence of the disease (Gaibulloev and Sandler, 2012).

Fertility rate in 1980: Fertility rate in 1980 increases the risk for an individual in the country to be HIV positive. This means that individuals from a country with a high fertility rate in 1980

are at a relatively high risk of being HIV positive today. An increase in the fertility rate in 1980 by a point multiplied by 1.27 the risk of being HIV positive.

Landlocked country: The estimates show that direct access to sea impacts on HIV status. Specifically, compared to individuals from non-landlocked countries, individuals living in a landlocked country run 2.27 times the risk of being HIV positive than those from a non-landlocked country.

The colonizing country: Compared to individuals whose country was colonized by France, individuals whose country was colonized by Belgium or both France and the United Kingdom are more likely to be HIV positive (3.56 and 3.02 times respectively higher). Robinson (2011) found similar result.

We have tried to understand the effect of the colonizing country on HIV/AIDS status today. Probably, a colonial legacy explains this fact. The review of the literature led us to study the contribution of the legal system. Indeed, the legal system denotes the institutions and their functioning allowing the enforcement of rules and principles governing the nation (David et al., 2016). From this definition, it can be clearly understood that the legal system in place in a former colony may depend on the colonizing country. For example, it is reported that Common Law is applied in many former colonies of the British Empire (David et al, 2016). In our data, the joint distribution of the legal system and the colonizing country shows that former colonies mostly practice the legal system of their colonizing country, besides the customary (traditional) rule system.

Therefore, we estimated the model by replacing the variable that captures the colonizing country with that of the legal system (see Appendix 1). It can be seen that individuals living in a Civil-Common-Law and customary rule country run 2.14 times the risk of being HIV positive than individuals in Civil-law system.

Remark. The introduction of Ethiopia in the model has completely changed the results. While individual characteristics continue to have a significant effect, none of the National variables now have an effect (except for the geographical location), even when we exclude the variable capturing the year of independence. This contradicts our results in Table 3. Ethiopia is therefore a somewhat atypical country and we have only retained the model without Ethiopia (see Appendix 2).

5. Conclusion and discussion

Besides individual characteristics such as age, gender, economic well-being, marital status, educational level and the residential environment, this study showed that the risk of being HIV positive in sub-Saharan Africa varies according to the region of the continent we consider. Indeed, countries in eastern and Southern Africa are the most affected. This confirms UNAIDS statistics. Furthermore, the colonizing country is also decisive. Compared to an individual from a country colonized by France, an individual from a country colonized by the United Kingdom is 3.02 times more likely to be HIV positive. A closer analysis reveals that this could be due to the legacy of the metropolitan colonial legal system. Indeed, individuals living in a country under Common Law and customary rule are 1.73 times more likely to be HIV positive than individuals living in a civil-law and customary rule country or otherwise. This result is in line with Anderson (2018) who has shown that women in Common Law are more affected by the epidemic than those of the civil-law country. Similarly, individuals belonging to a country that did not obtain independence quickly had a lower probability of HIV/AIDS occurrence than those from a country having obtained independence earlier. Why does independence determine

today HIV prevalence? It is delicate to give an explanation. One hypothesis could be that these countries have seen their health system deteriorate more quickly when the colonizer left. One might also think that access to independence has led to a certain licentiousness that the inhabitants have confused with freedom. Our results also suggest that countries with high rates at the beginning of the epidemic are still those in which the virus is prevalent up today. This suggests that people are not yet sensitized enough, given the fact that the preventive measures taken to curb the disease since its emergence were mean to entail a decrease in its incidence (Temah, 2009). Finally, it could be noted that when GDP per capita in 1980 is high in one country, the risk of HIV/AIDS among its inhabitants increases (but very lowly). This is in line with Couderc N., Ventelou, B. (2005). Indeed, economic growth promotes mobility, attracts foreigners and fosters inter-human encounters (Magrama, 2008; Over and Piot, 1993; Pathé, 1991).

With regard to individual characteristics, we have concluded that the risk of being HIV/AIDS positive increases with the economic well-being of the household in which the individual lives. Even though the finding is in line with some papers (Barnighausen et al., 2007; Fox, 2010, 2012), it contradicts some points of the literature supporting that the level of poverty favours the transmission of the virus (Stillwaggon, 2002; Kim and Watts, 2005; Hunsmann, 2010; Buot et al., 2014; Mabaso et al., 2018; Adetokunboh and Are, 2020). However, this can be explained by the fact that the increase in the level of economic well-being is not always accompanied by good education. Moreover, in more well off households, too frequent parental absence can foster non-responsible behaviors on the side of the other household members.

Finally, for this work, we would have preferred taking into account natural resource availability of countries in 1980's. However, we faced data limitation problem on that matter.

6. References

Adetokunboh, O. O. and Are, E. B. (2020), 'Distribution and determinants of HIV prevalence in South Africa', *Annals of epidemiology*, Vol. 52, Conference abstract, 116-116. DOI: 10.1016/j.annepidem.2020.08.061.

Amat-Roze, J-M. (1989), 'L'infection à VIH et le SIDA en Afrique noire : facteurs d'épidémisation et de régionalisation', *Cahiers d'outre-mer*, Vol. 168, 333-355. DOI: 10.3406/caoum.1989.3318.

Anderson, S. (2018), 'Legal origins and female HIV', *American Economic Review*, Vol. *108*, 1407-1439. DOI: 10.1257/aer.20151047.

Barnighausen, T. et al (2007), 'The socioeconomic determinants of HIV incidence: evidence from a longitudinal, population-based study in rural South Africa', *AIDS*, Vol. 21 (suppl 7), S29-S38. DOI: 10.1097/01.aids.0000300533.59483.95.

Bertocchi, G. and Dimico, A. (2019), 'The long-term determinants of female HIV infection in Africa: The slave trade, polygyny, and sexual behaviour', *Journal of Development Economics*, 140, 90-105. DOI: 10.1016/j.jdeveco.2019.05.005.

Brewer, D. D. et al. (2003), 'Mounting anomalies in the epidemiology of HIV in Africa: cry the beloved paradigm', *International Journal of STD & AIDS*, 14, 144-147. DOI: 10.1258/095646203762869142.

Buot, M-L. G. et al. (2014), 'Beyond race and place: distal sociological determinants of HIV disparities', PLoS *ONE*, 9, e91711. DOI: 10.1371/journal.pone.0091711.

Chersich, M. F. and Rees, H. V. (2008), 'Vulnerability of women in Southern Africa to infection with HIV: biological determinants and priority health sector interventions', *AIDS*, 22 (suppl 4), S27-S40. DOI: 10.1097/01.aids.0000341775.94123.75.

Couderc N., Ventelou, B. (2005). 'AIDS, economic growth and the epidemic trap in Africa'. *Oxford Development Studies*, 33, 417-426. DOI: 10.1080/13600810500199236.

Fox, A. M. (2010), 'The social determinants of HIV serostatus in sub-Saharan Africa: an inverse relationship between poverty and HIV?', *Public Health Reports*, 125 (Suppl 4), 16-24. DOI: 10.1177/00333549101250S405.

Fox, A. M. (2012), 'The HIV – poverty thesis re-examined: poverty, wealth or inequality as a social determinant of HIV infection in sub-Saharan Africa?', *Journal of Biosocial Science*, 44, 459-480. DOI: 10.1017/S0021932011000745.

Gaibulloev, K. and Sandler, T. (2012), 'Aid for AIDS in Africa', *Empirical Economics*, 43, 1171-1197. DOI: 10.1007/s00181-011-0527-3.

Giles-Vernick, T. et al. (2013), 'Social history, biology, and the emergence of HIV in colonial Africa', *Journal of African History*, 54, 11-30. DOI: 10.1017/S0021853713000029.

Givord, P., & Guillerm, M. (2016). 'Les modèles multiniveaux', *Document de travail M2016/05*, INSEE, Paris, France. Available at https://www.insee.fr/fr/statistiques/2022152 (Accessed: 8 april 2020).

Hanson, S. and Hanson, C. (2008), 'HIV control in low-income countries in sub-Saharan Africa: are the right things done?', *Global Health Action*, 1:1, 1837. DOI: 10.3402/gha.v1i0.1837.

Kim, J. C. and Watts, C. H. (2005), 'Gaining a foothold: tackling poverty, gender inequality, and HIV in Africa', *BMJ*, 331, 769-772. DOI: 10.1136/bmj.331.7519.769.

Kongnyuy, E. J. et al. (2006), 'Wealth and sexual behaviour among men in Cameroon', *BMC International Health and Human Rights*, 6. DOI: 10.1186/1472-698X-6-11.

Mabaso et al. (2018), 'Determinants of HIV infection among adolescent girls and young women aged 15-24 years in South Africa: a 2012 population-based national household survey', *BMC Public Health*, 18, 183-183. DOI: 10.1186/s12889-018-5051-3.

Magadi, M. and Desta, M. (2011), 'A multilevel analysis of the determinants and cross-national variations of HIV seropositivity in sub-Saharan Africa: Evidence from the DHS', *Health & Place*, 17, 1067-1083. DOI: 10.1016/j.healthplace.2011.06.004.

Magrama, K. (2008). 'Les facteurs explicatifs de la prévalence du VIH/SIDA chez les femmes au Cameroun', Mémoire de DESSD, IFORD, Yaoundé, Cameroun. Available at https://ireda.ceped.org/inventaire/ressources/kaltsam_2008.pdf (Accessed: 27 january 2021).

Over, M. and Piot, P. (1993). '*HIV infection and sexually transmitted diseases'*. In: *Disease Control Priorities in Developing countries*, New York: Oxford University Press for the World Bank. Available at https://www.healthworkscollective.com/wp-

content/uploads/2013/01/dcp1-ch20.pdf (Accessed: 27 january 2021).

Pathé A-M. (1991). 'La France et l'indépendance de l'Afrique noire'. *Vingtième Siècle. Revue d'histoire*, 30, 106-108. Available at https://www.persee.fr/doc/xxs_0294-1759_1991_num_30_1_2386 (Accessed: 27 january 2021).

Pepin, J. (2011), '*The Origins of AIDS'*, Cambridge: Cambridge University Press, eBook Academic Collection - North America. DOI: 10.1017/CBO9781139005234.

Robinson, R. S. (2011), 'From population to HIV: the organizational and structural determinants of HIV outcomes in sub-Saharan Africa', *Journal of the International AIDS Society*, 14 (Suppl 2):S6. DOI: 10.1186/1758-2652-14-S2-S6.

Rodier, J. (2017), 'SIDA: le nombre de victimes divisés par deux depuis 2005'. Available at https://www.jeuneafrique.com/459446/societe/sida-nombre-de-victimes-divise-deux-2005/ (Accessed : 2 february 2019).

Sawers, L. and Stillwaggon, E. (2010), 'Concurrent sexual partnerships do not explain the HIV epidemics in Africa: a systematic review of the evidence', *Journal of the International AIDS Society* 2010, 13:34. DOI: 10.1186/1758-2652-13-34.

Stillwaggon, E. (2002), 'HIV/AIDS in Africa : Fertile Terrain'. *Journal of Development Studies*, *38*, 1-22. DOI: 10.1080/00220380412331322561.

Temah, C. T. (2009), 'Les déterminants de l'épidémie du VIH/SIDA en Afrique Subsaharienne', *Revue d'économie du développement*, *17*, 73-106. DOI : 10.3917/edd.231.0073.

UNAIDS (2020), '*Fiche d'information'*. Available at https://www.unaids.org/sites/default/files/media_asset/UNAIDS_FactSheet_fr.pdf (Accessed: 9 may 2021).

7. Appendices

Appendix 1: Estimates from the multi-level model with random effects, including the legal system as explanatory variable (without Ethiopia)

Table 5: Estimates from the multi-level model with the legal system as explanatory variable

Independent variables	Coefficients	Odds-Ratios	P >|z|
Type of environment of residence (Ref= Rural)			
Urban	0.408 (0.033)	1.503	0.000
Wealth index (Ref= very poor)			
Poor	0.133 (0.038)	1.143	0.001
Middle	0.134 (0.039)	1.144	0.001
Rich	0.148 (0.041)	1.160	0.000
Very rich	0.153 (0.048)	1.166	0.001
Gender (Ref=Male)			
Female	0.329 (0.025)	1.390	0.000
Education (Ref=No education)			
Primary	0.300 (0.040)	1.350	0.000

Secondary	0.198 (0.045)	1.219	0.000
Higher	-0.213 (0.076)	0.807	0.005
Age (Ref=[15-24])			
[25-34]	1.072 (0.037)	2.922	0.000
[35-44]	1.282 (0.040)	3.604	0.000
[45-49]	1.088 (0.051)	2.968	0.000
Marital status (Ref= Never married)			
Married	0.260 (0.037)	1.297	0.000
Widowed	1.588 (0.058)	4.898	0.000
Divorced	1.081 (0.050)	2.949	0.000
Political system (Ref=Imperfect democracy)			
Hybrid regime	0.270 (0.442)	1.310	0.542
Authoritarian regime	0.256 (0.262)	1.291	0.330
Country location (Ref=West)			
East	1.435 (0.360)	4.199	0.000
Central	0.808 (0.394)	2.243	0.040
South	6.892 (1.194)	505.6012	0.000
Year of independence	-0.395 (0.061)	984.898	0.000
HIV prevalence in 1980	0.241 (0.046)	1.272	0.000
GDP per capita in 1980	0.0001 (0.00003)	1.0001	0.000
Fertility rate in 1980	0.856 (0.281)	2.355	0.002
Legal system (Ref= Civil-law and Customary)			
Common Law et Customary	-0.458 (0.511)	0.632	0.370
Common Law, Civil-law and Customary	0.764 (0.334)	2.146	0.022
Littoral (Ref=Not landlocked)			
landlocked	0.729 (0.250)	2.073	0.004
Constant	760.869 (119.537)	-	0.000
Log -likelihood = -28116.019			
Number of observations: 165426		Observations per group	
Number of groups: 14		Min	6741
Wald chi2 (27) = 4790.96		Average	11816.1
Prob chi2 = 0.000		Max	19680
LR test for rho=0 : P-value=0.000			

Source: *Produced by the authors. Standard errors in (.)*

Appendix 2: Model including Ethiopia

Table 6: Estimates from the model including Ethiopia

Independent variables	**Coefficients**	**Odds-Ratios**	**P >|z|**
Type of environment of residence (Ref= Rural)			
Urban	0.466 (0.032)	1.594	0.000

Wealth index (Ref= very poor)			
Poor	0.134 (0.038)	1.144	0.000
Middle	0.135 (0.039)	1.144	0.001
Rich	0.143 (0.040)	1.154	0.000
Very rich	0.226 (0.046)	1.254	0.000
Gender (Ref=Male)			
Female	0.326 (0.024)	1.386	0.000
Education (Ref=No education)			
Primary	0.392 (0.037)	1.481	0.000
Secondary	0.278 (0.043)	1.321	0.000
Higher	-0.150 (0.071)	0.859	0.035
Age (Ref= [15-24])			
[25-34]	1.072 (0.036)	2.922	0.000
[35-44]	1.284 (0.039)	3.613	0.000
[45-49]	1.075 (0.049)	2.932	0.000
Marital status (Ref= Never married)			
Married	0.281 (0.036)	1.325	0.000
Widowed	1.655 (0.056)	5.236	0.000
Divorced	1.140 (0.048)	3.127	0.000
Political system (Ref=Imperfect democracy)			
Hybrid regime	0.201 (0.843)	1.222	0.812
Authoritarian regime	0.017 (0.540)	1.017	0.974
Country location (Ref=West)			
East	0.679 (0.433)	1.973	0.117
Central	0.532 (0.578)	1.703	0.357
South	2.607 (1.222)	13.562	0.033
Year of independence	0.003 (0.009)	1.003	0.751
HIV prevalence in 1980	0.038 (0.067)	1.038	0.575
GDP per capita in 1980	0.0000146 (0.0000596)	1.00001	0.807
Fertility rate in 1980	-0.021 (0.448)	0.979	0.962
Littoral (Ref=Not landlocked)			
Landlocked	0.422 (0.425)	1.525	0.320
Constant	-12.078 (18.371)	5.68e-06	0.511
Log-likelihood= -30504.681			
Number of observations = 193782		Observation per group	
Number of groups= 15		Min	6741
Wald chi2 (26) = 5209.61		Average	12918.8
Prob chi2 = 0.000		Max	28355
LR test for rho=0 : P-value=0.000			

Source: *Produced by the authors. Standard errors in (.)*