

## Official development assistance and health in the DRC : impact and lessons learned<sup>1</sup>

### Aide publique au développement et santé en RDC : impact et leçons

Bobo B. KABUNGU<sup>2</sup>

- <sup>2</sup> Economist, Research Fellow at the Centre de Recherche en Sciences Humaines. He is particularly interested in public policy analysis and is a lecturer in several institutions of higher education and universities (Université de Goma, Institut National du Travail Social, etc.).  
Email: [bobokabungu@gmail.com](mailto:bobokabungu@gmail.com).



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**Abstract.** *Health is one of the primary concerns of public authorities throughout the world. In recent years, studies on its determinants have multiplied, with, at the heart of the debate, the economic and social determinants that are supposed to guide policies. Among these determinants of health, this article focuses on official development assistance, which is studied econometrically, using the ordinary least squares method, in relation to life expectancy in the DRC, based on time series data from 1970 to 2015. The results show that the aid received has a significant but negative impact on the health of the population, pointing to a problem of institutional quality that may negate the impact of financial assistance.*

**Keywords :** *Determinants of health, official development assistance, life expectancy, DRC, economic growth, air pollution, ordinary least squares method.*

**Résumé.** *La santé est l'une des premières préoccupations des pouvoirs publics à travers le monde. Depuis quelques années, les études sur ses déterminants se multiplient, avec, au cœur du débat, ceux économiques et sociaux censés orienter les politiques. Parmi ces déterminants de la santé, cet article s'intéresse particulièrement à l'aide publique au développement dont il étudie économétriquement, grâce à la méthode des moindres carrés ordinaires, la relation avec l'espérance de vie en RDC, à partir des données chronologiques durant la période allant de 1970 à 2015. Il en ressort que l'aide reçue a un impact significatif mais négatif sur la santé de la population, présageant un problème de qualité des institutions qui peut annihiler l'impact de l'assistance financière.*

**Mots-clés :** *Déterminants de la santé, aide publique au développement, espérance de vie, RDC, croissance économique, pollution de l'air, méthode des moindres carrés ordinaires*

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## Introduction

Health is understood as a state of serenity that is both quantifiable using objective indicators such as life expectancy or infant mortality rate, and subjective insofar as it refers to a certain perception of the quality of life. The Institut de santé publique du Québec, cited by Bourdillon, Brücker and Tabuteau (2016), defines public health as the study of the determinants of the health of the population and the actions taken to improve it, and specifies that these determinants can be physical, psychosocial and sociocultural.

With specific reference to the DRC, WHO (n.d.) notes that influencing the determinants of health, including income, education, and access to safe drinking water, remains one of the priorities in the country's contribution to the Global Health Action Program. In addition, the Ministry of Public Health in the DRC (2016) has included in its 2016-2020 Plan the rationalization of health financing in order to be useful in a context of dwindling domestic resources dedicated to this sector.

The above highlights the interest of this study, which focuses on the socioeconomic determinants of health in the DRC, with a focus on official development assistance.

In its Institutional Publication section, the Agence Française de Développement (2015) indicates on its website that international aid, which represents approximately 15.0% of the total State budget, has become vital for the DRC, a country that suffers from numerous fragilities threatening its stabilization. The agency also reports that, in relation to gross national income, official development assistance to the DRC is higher than the average for countries in the sub-region:

**« The gradual stabilization of the country between 2001 and 2003 allowed donors to return to the DRC. Since this resumption of activity, the volume of official development assistance (ODA) to the DRC has continued to increase, reaching a net amount of \$2.9 billion in 2012. This amount represented**

**17.8% of gross national income (GNI), compared to 25.2% in 2006. By way of comparison, in all the countries of sub-Saharan Africa, this ratio averaged 3.2% in the same year (...). Although aid is declining in relative terms, it remains a very important resource for the DRC** » (Agence Française de Développement, 2015, p. 8).

Moreover, by consulting the World Bank database, it can be seen, at first glance, that there is a parallel between the evolution of macroeconomic aggregates such as the economic growth rate and official development assistance and the trend of social indicators such as life expectancy and infant mortality, between 1970 and 2015, with the exception of the 1990s, which were characterized by economic collapse and destruction of the social fabric. Indeed, all these indicators improved significantly between the 1970s and the first six years of the 2010 decade, but at different levels: life expectancy increased by thirteen years, infant mortality fell by 54.0%, economic activity increased by 7.4 percentage points, and official development assistance increased by a factor of 3.7 between the two periods.

This similar evolution in terms of trend is not sufficient to affirm the existence of a causal relationship between the variables. An elaborate study is therefore necessary. Our modest ambition is to use the literature and available data on the subject to verify, using an econometric method, the empirical relationship between official development assistance received by the DRC and the overall state of health in the country. The originality of our analysis will be to use life expectancy to capture health in its global dimension, to go back beyond the 1990s in the chronology and to contribute to decision support, at a time when the political power claims to be socio-democratic and relies in particular on external support to improve the living conditions of the Congolese population.

## 1. Literature review

### 1.1. Concept and classification of health determinants

In the field of health, a determinant implies an element of influence that modifies the probability of occurrence of a health event. Alla (2016) calls «health determinants» the factors that influence the health status of individuals or populations and on which the principle of public health intervention is based.

In terms of classification, four conceptual models can be distinguished:

- (i) Lalonde's model (1974), which identifies four main categories of determinants (human biology, environment, lifestyle, organization of the health care system);
- (ii) the Evans and Stoddart (1990) model, which identifies six (genetic heritage, social environment, physical environment, health care system, individual reaction, prosperity);
- (iii) the Dahlgren and Whitehead (1991) model, which uses the health inequalities approach with five sub-groups of health determinants (general socio-economic, cultural and environmental conditions, living and working conditions, social and community networks, lifestyles, age, gender and hereditary factors) and that of the Commission on Social Determinants of Health (CSDH, 2008) developed under the aegis of the WHO, which presents a synthesis of the previous models in three categories of aspects: macro aspects linked to the socioeconomic and political context, structural aspects linked to health inequalities and socioeconomic status, which are at the heart of the model, and aspects that call for the intermediate determinants of health, which are material, psychosocial and environmental circumstances, biological and behavioural factors and the health system.

### 1.2. Empirical literature on: aid received as a determinant of health

Overall, the economic situation and the environment have some influence on the health of populations, with a different impact depending on the environment and the level of development of the countries or regions considered. With regard specifically to the «aid received» variable, many authors have linked it to health, as captured, as the case may be, by infant mortality or life expectancy.

Among these researches, Korachais study (2010) remains a reference. Indeed, using data from 88 developing and transition countries over the period 1996-2007, his work suggests that aid allocated to health is effective in improving child survival, and that it is more effective in the countries most affected by high mortality rates. Nearly twelve years earlier, Burnside and Dollar (1998) studied the relationship between total aid and child mortality as a proxy for health using the Least Squares Method (LSM). Their research results in evidence that improved aid reduces child mortality. Wolf (2007) conducted a macroeconomic study of the determinants of health with per capita public spending on health, AIDS prevalence, access to safe water, fertility rate and total aid as a % of GDP as explanatory variables. Using OLS and cross-sectional data from 110 countries, he shows that fertility and birth rates as well as total aid (as a % of GDP) significantly and negatively affect health captured by the infant mortality rate.

For their part, Williamson and Boehmer (1997) highlighted the quality of institutions, the contribution of state involvement and cultural norms to health. They reveal that the quality of institutions and gender equality very significantly improve life expectancy in the sample of 97 countries considered.

Based on this theoretical and empirical background, we formulate the hypothesis that official development assistance received by the DRC has significantly and positively influenced health in this country from 1970 to 2015.

## 2. Methodology

### 2.1. Specification of the econometric model

Modeling is a formalization of theory. It is therefore an important step in the implementation of an economic theory. On the basis of the literature review exploited in the theoretical part, our model is that of multiple linear regression. It will be estimated by the Ordinary Least Squares (OLS) method following the example of Burnside and Dollar (1998) and Wolf (2007).

However, while these authors preferred to use infant mortality as a proxy for health, in this study we chose life expectancy at birth, which «represents the average life span - in other words, the average age at death - of a fictitious generation subject to the mortality conditions of the year. It characterizes mortality independently of age structure» (INSEE, 2016).

This choice is justified by the fact that «life expectancy at birth is one of the most frequently used indicators of health status» today (OECD, n.d.) and that it considers health in many of its dimensions that culminate in the length and quality of life. Mususa Ulimwengu (2015) states that life expectancy is considered appropriate for measuring aspects of health in society and conducive to economic resilience. Messaili and Tlilane (2017) used this aggregate to capture health status in a longitudinal analysis covering the period 1974-2010.

The theoretical model to be estimated can be specified as follows:

$$(1) \quad \text{LEB} = F(\text{EGR}, \text{INFR}, \text{ODA}, \text{ECO2}, \text{PGR})$$

Where :

LEB :	Life expectancy at birth	ODA :	Official development assistance
EGR :	Economic growth rate	ECO2 :	Emission of greenhouse gases
INFR :	Inflation rate	PGR :	Population growth rate

Equation (1) can be read as follows: life expectancy is a function of or dependent on the eco-

nomie growth rate, the inflation rate, the official development assistance, the CO2 emission and the population growth rate.

Adopting the linear form, equation (1) becomes:

Adopting the linear form, equation (1) becomes:

$$(2) \quad \text{LEB} = \beta_0 + \beta_1 \text{EGR} + \beta_2 \text{INFR} + \beta_3 \text{ODA} + \beta_4 \text{ECO2} + \beta_5 \text{PGR} + \mu_t$$

Where :

- $\beta_0$  is the characteristic dimension coefficient of the economy (the constant) ;
- $\beta_{i(i, 1-5)}$  are the weights or parameters to be estimated ;
- $\mu_t$  is the error term, capturing all other variables not included in the model.

Thus, the following signs are expected:

$$[\beta_0 ; \beta_1 \text{ and } \beta_3] > 0 \text{ et } [\beta_2 ; \beta_4 \text{ and } \beta_5] < 0.$$

### 2.2. Estimation methodology and data source

The estimation of the parameters of the selected multiple linear regression model was done using the EVIEWS software. This estimation was carried out through several tests and this, in a well determined order. The approach followed consisted of four steps, namely:

- (i) the unit root test (Augmented Dicky-fuller test to investigate the stochastic properties of the series considered in the model by analyzing their order of integration);
- (ii) the estimation of the model parameters by the Ordinary Least Squares (OLS) method;
- (iii) the Granger causality test in order to see the causal effect of the different variables on health in the DRC; and
- (iv) the test of the OLS hypotheses for model validation.

The sample selected for this study is composed of 46 observations. These are secondary quantitative data, with an annual frequency, from 1970 to 2015. They were drawn mainly from the World Bank database. The various statistical yearbooks of the Central Bank of Congo were used to complete the information on inflation and economic growth.

### 3. Results

#### 3.1. Evolution of the variables

Between 1970 and 2015, we observe that life expectancy in the DRC has maintained an upward trend, with the exception of the 1990s, during which the evolution stagnated, in a context of economic decline, hyperinflation, a decrease in public development aid and the growing impoverishment of the population. With regard to the environment, as measured by air quality, it is noted that the trend in CO2 emissions (kg per USD of 2010 GDP) shows an upwardly concave hyperbola. Indeed, excluding the first ascending phase between 1970 and 1980, it is noticed globally a fall of the emissions until 2000, then a progressive increase which accelerates from 2013. The graphs in the appendix are edifying in this regard.

#### 3.2. Estimation, validation and interpretation of results

The purpose here is to estimate our model as specified above while respecting all the econometric steps. After the Augmented DICKEY FULLER (ADF) unit root test, we had to «stationaryze» the series by expressing them in first difference. Hereafter, the results of the final estimation after all corrections.

Table 1. Results of the estimation of the parameters of equation (2)

Endogenous variable	Constant	D.EGR	D.ODA
<b>D.LEB</b>	0.006976* (0.001392) [5.012476]	- 0.001248* (0.000410) [-3.041310]	- 1.61E-05*** (9.46E-06) [-1.700729]
R <sup>2</sup> = 0.999195 R <sup>2</sup> cor.= 0.999053 D.W=1.853408			
F - s t a t i s - t i c : 7030.718 Prob(F - s t a t i s - t i c) : 0.000000			

NB: The figures in brackets are standard deviations and in square brackets are t-statistics.

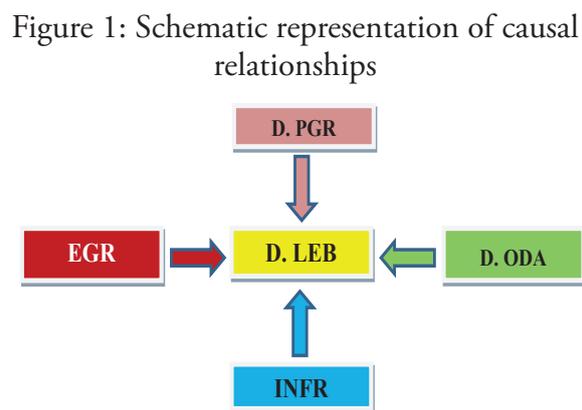
The asterisk (\*) indicates that the coefficient is significant at the 1% level, (\*\*) indicates that it is significant at the 5% level and (\*\*\*) indicates that it is significant at the 10% level.

Source: Author's calculations using EVIEWS 7 software

This estimate highlights that a 1% increase in the population growth rate would result in a 0.001% decrease in life expectancy, reflecting the fact that population density affects population health, all other things being equal. As we know, crowding in large urban centers in the DRC is a conducive environment that increases the risk of spreading various diseases. However, the impact is still minor due to the fact that the country is very large (2 345 000 km<sup>2</sup>).

As for the official development assistance received, it turns out that an increase of 1% would imply a decrease in life expectancy of 0.0000161%. This can be explained by the fact that this assistance is not always directed towards the social sectors (education, health, etc.) and basic infrastructure (roads, water, energy, etc.), which have an undeniable effect on lifestyles.

In addition, the results of the Granger causality test can be summarized in the following diagram:



Source: Representation suggested by the author on the basis of econometric estimates.

The analysis of this diagram shows that four of the five exogenous variables (determinants of health) retained in the model cause life ex-

pectancy (proxy for health) in the Granger sense. There is therefore a causal relationship between the economic growth rate, the inflation rate, the population growth rate, official development assistance and life expectancy.

As for the post-estimation analysis, we present below, following the econometric approach suggested by Bourbonnais (2015), the results of the tests useful for the validation of the model. These are the tests of: Jarque-Bera, Breusch-Godfrey LM test and ARCH, being retained that those of nullity of the mathematical expectation of the error and of the robustness of the model did not pose any problem.

Table 2. Results of post-estimation tests

Tests	Statistics	Probability
Breusch-Godfrey Serial Correlation LM Test	Fischer	0.3305
Normalité	Jarque-Bera	0,4731
Heteroskedasticity Test: ARCH	Fischer	0.9780

Source: *Author's calculations using EVIEWS 7 software*

In addition to the unit root test and the overall goodness of fit of the model, Table 2 shows that all the econometric tests were successful. Indeed, the result according to the Jarque-Bera test shows that the errors are normally and independently distributed, as the ad hoc critical probability (0.4731) is greater than 0.05. The ARCH test confirms the homocedasticity of the errors (0.9780 > 0.05). As for the Breusch-Godfrey LM test, it indicates that the errors of the model under review are uncorrelated (0.3305 > 0.05).

Moreover, the stability analysis via the CUSUM test shows that the estimated model is stable.

### Conclusion

The objective of this research was to verify econometrically, using socio-economic data from 1970 to 2015, by means of an econometric method, the impact that the «manipulation» of a variable of interest considered as an «instrument» (in this case, official deve-

lopment assistance) could have on an explained variable (in this case, life expectancy, a proxy for health), our postulate having been that official development assistance received by the DRC had a positive and significant effect on the overall state of health in the country. Using OLS, we analyzed socioeconomic data captured on an annual basis and found that official development assistance, as well as population growth, had a negative impact on health in DRC. Our hypothesis is therefore invalidated.

The results support those of Williamson and Boehmer (1997) who underlined the disadvantage of a high birth rate on health, but qualify the statements of Burnside and Dollar (1998) who found that the aid received contributed to improving the health of the population of the recipient country. On the other hand, our study agrees with that of Wolf (2007) for whom aid has a negative effect on health. Hence the interest in considering a study integrating the quality of institutions (Williamson and Boehmer, 1997) to capture possible elements of corruption or misappropriation of public funds that may render the aid received null and void. In addition, it would also be useful to consider the portion of aid that is primarily allocated to health.

This being said, policies should therefore improve the allocation of this assistance after an audit of the management of the aid received so far. This should help channel external (and even internal) resources to pro-health areas, with a view to rationalizing health financing as set out in the DRC's National Health Development Plan. In addition, the public authorities would benefit from investing more in awareness-raising to establish family planning in people's minds, so as to better regulate population growth in view of the negative impact of population growth on health.

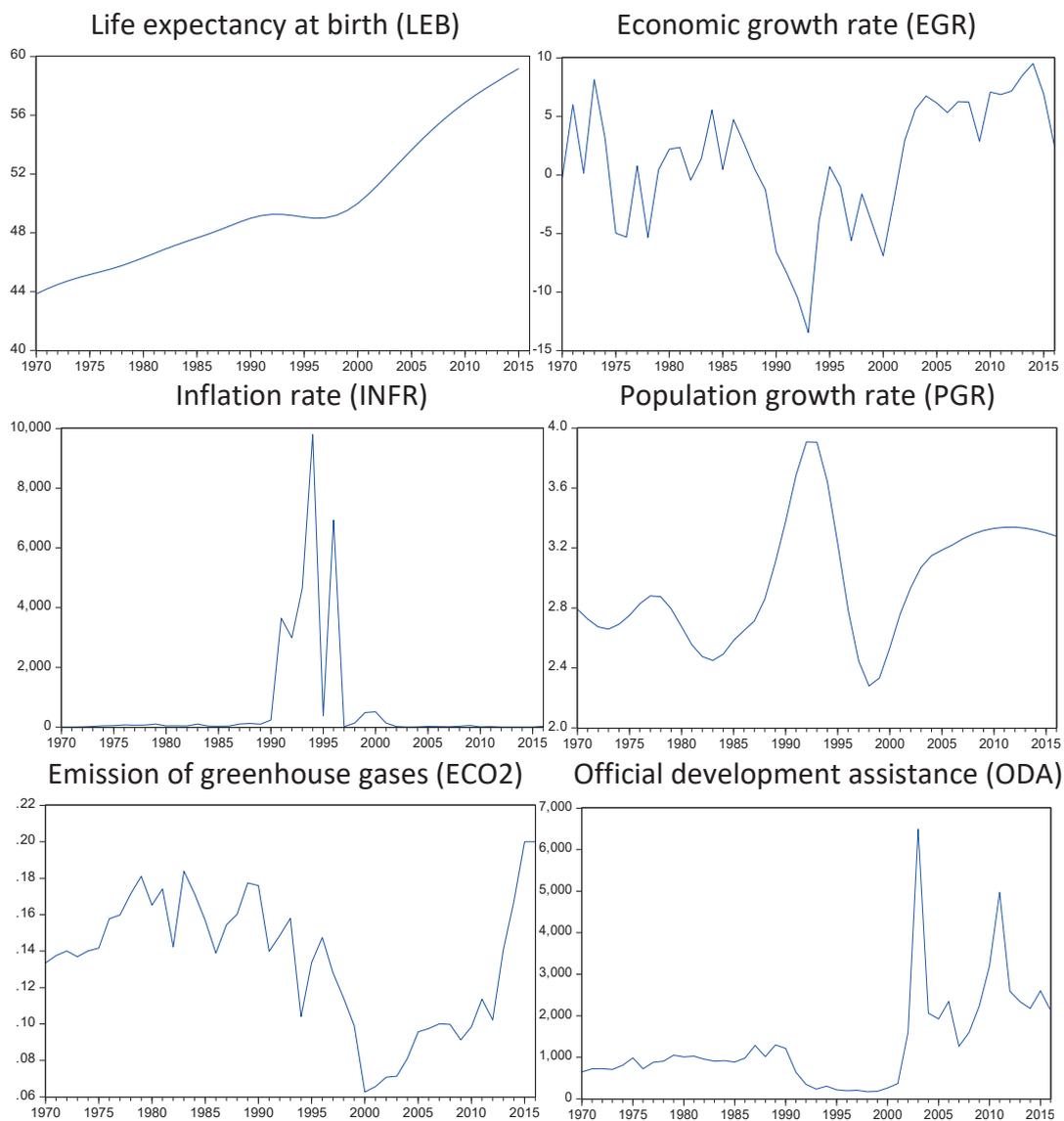
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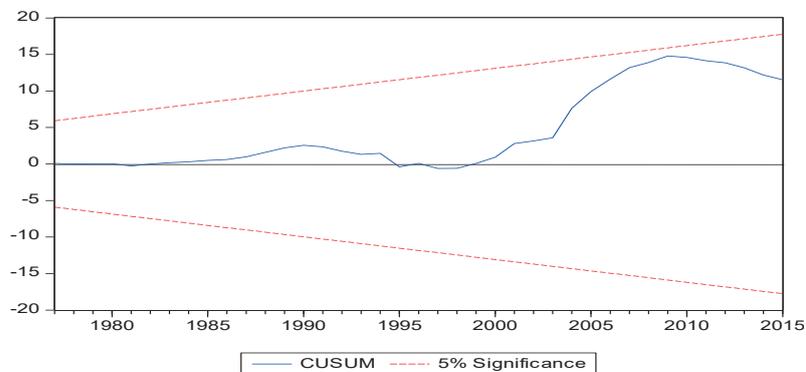
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# Annexes

Graphique 1. Change in variables from 1970 to 2015



Graphique 2. CUSUM test



**Tableau 2. Augmented Dickey Fuller (ADF) test results**

Series	Test à niveau				Stationarization			Order of integration
	ADF	Threshold	VCM	DECISION	ADF	VCM	DECISION	
EGR	-2.627	1%	-2.61	Stationary				I(0)
		5%	-1.94					
		10%	-1.61					
INFR	-2.536	1%	-2.61	Stationary				I(0)
		5%	-1.94					
		10%	-1.61					
PGR	-0.762	1%	-3.61	Non-stationary	-5.0002	-3.610	Stationary	I(1)
		5%	-2.93			-2.938		
		10%	-2.60			-2.607		
LESPV	2.018	1%	-3.61	Non-stationary	-3.5507	-4.211	Stationary	I(1)
		5%	-2.93			-3.529		
		10%	-2.60			-3.196		
LEB	-1.588	1%	-3.58	Non-stationary	-5.6586	-3.584	Stationary	I(1)
		5%	-2.92			-2.928		
		10%	-2.60			-2.602		
D.LECO2	-1.397	1%	-3.58	Non-stationary	-6.9283	-3.584	Stationary	I(1)
		5%	-2.92			-2.928		
		10%	-2.60			-2.6022		

