Remittances and under-five mortality: evidence from Sub-Saharan African countries

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Abstract

Despite increasing remittances flows in recent decades, Africa remains the region with the highest under-five mortality rates compared to the rest of the world. However, much of the literature on the effects of remittances has focused on poverty reduction and economic growth. Very little attention has been given to the health sector. The aim of this study is to examine the impact of remittances on under-five mortality in 38 countries Sub-Saharan African countries over the period 1998 to 2014. The empirical evidences are based on fixed effects, Generalized Method of moments and quantiles estimators. The main results show that remittances contribute significantly to a reduction in under-five mortality. These results are robust to the use of alternative measures of mortality, including infant and neonatal mortality, as well as the inclusion of additional control variables. Based on these results, several policy implications can be drawn.

Keywords: Remittances, Infant mortality, SSA
JEL code: E26, I10, I18, O55.

1 Introduction

Improved child health outcomes have been at the center of global development efforts in recent decades. For example, the United Nations Millennium Development Goals (MDGs) from 2000 to 2015 have prompted international agencies and national governments to achieve Goal 4 aimed at reducing child mortality. The Sustainable Development Goals (SDGs) (2016-2030) reaffirm the importance of improving children's health and survival rates as development goals. However, the pursuit of these goals calls for a substantial increase in the delivery of basic health services to the poor, and particularly those in developing countries, which Official Development Assistance (ODA) alone cannot achieve. Identifying innovative sources to cover the growing need for health expenditures and improving the health of populations is therefore relevant and timely. The World Health Organization (WHO, 2010) identifies remittances as a potentially innovative source of funding for national mobilization of health expenditures. It is in this context that this paper examines the effects of remittances on child mortality.

Indeed, the number of migrants from both African countries and more specifically Sub-Saharan Africa than other developing countries to developed countries continues to grow. According to estimates by the United Nations (UN), the number of international migrants has multiplied by 3.8 between 1970 and 2013, from 60 to 231 million. This increase in migrants is accompanied by an equally important volume of funds transfers to Sub-Saharan African countries. According to the World Bank (2006), global remittances increased from around US $30 billion a year in the early 1990s to US $318 billion in 2007. This amount of migrant remittances is far greater than official development assistance and is close to foreign direct investment.

This increasing inflow of capital has prompted researchers and policy makers to look at the macroeconomic and microeconomic effects of remittances in recipient countries. According to World Bank estimates, several countries remittances can account for 20-40% of Gross Domestic Product (GDP), and up to 50% of income, thus helping to reduce poverty and income inequality (Amuedo-Dorantes and Pozo, 2011). For example, migrant remittances have been shown in the literature to affect several dimensions of economic life, including the smoothing of consumption by recipient households (Adams, 2006; Combes and Ebeke, 2011), financial development (Aggarwal et al., 2011), poverty reduction and socio-economic development (Adams Jr and Page, 2005; De la Fuente, 2010; Adams Jr and Cuecuecha, 2013) and the quality of institutions (Attila et al., 2018). In recent years, empirical studies also recognized their contribution in improving results in the education sector (Bouoiyour et al., 2016) and even in health sector (Zhunio et al., 2012; Amega, 2018).

Despite this large volume of remittances, sub-Saharan Africa remains the region of the

world where child mortality continues to be high. Thus, according to statistics from the World Bank, the under-five mortality rates are 86; 50 and 24 per 1,000 live births respectively in sub-Saharan Africa, South Asia and North Africa in 2015. In the same vein, estimates from the 2015 United Nations Millennium Development Goals report indicate that sub-Saharan Africa bears not only nearly half of the world's under-five death burden; but it is also the only region where the number of live births and children under five are expected to increase substantially over the next few decades. According to the 2001 Abuja Declaration, the signatory countries have committed to spend at least 15% of their budget on health expenditure. However, ten years later, only six countries have achieved this goal [1]. Thus, the efforts of governments by this insufficient increase in public health expenditure must be accompanied by private efforts, particularly through the remittances of migrants. For low-incomes and conflict affected countries, remittances represent a direct alternative to access quality care, improve their health conditions, and thus reduce child mortality.

Despite the active debate about the effects of remittances, the macroeconomic literature has paid little attention to the relevance and importance of remittances on health outcomes, particularly in countries of sub-Saharan African countries. The few existing macroeconomic studies (Chauvet et al., 2009; Zhunio et al., 2012; Amakom and Iheoma, 2014; Amega, 2018) have overlooked some key determinants of child mortality such as the prevalence to women with HIV / AIDS, immunization of children and education of women. This study therefore proposes to contribute to this literature by taking into account these three determinants omitted from previous works and by examining the impact of remittances on under-five mortality in a panel of 38 Sub-Saharan African countries over the period 2000-2014. The results show that migrant remittances significantly reduce under-five mortality.

The rest of the article is organized as follows: Section 2 describes the possible mechanisms behind the effect of remittances on under-five mortality rate and presents relevant literature. The data and methodology are presented in section 3; while section 4 presents the empirical results. Finally, Section 5 concludes with political implications.

2 Transmition Channels and the literature review of the literature

In this section, we will discuss possible mechanisms behind effect of remittances on under-five mortality and presents relevant literature.

[1] Cependant en 2011, seuls cinq pays du continent africain atteignaient ce seuil ; il s'agit notamment le Libéria (19,1%), du Malawi (17,8%), le Rwanda (24%), le Swaziland (18,1%) et le Togo (15,4%) et la Zambie (16,4%) (OMS, 2014)

2.1 Channels

This subsection provides a brief review of the determinants of child mortality to see how and by what route remittances can affect children's health.

It is now recognized that health is a constituent element of human capital in the sense that each individual inherits an initial stock of health capital that deteriorates with age. This stock may be partially maintained or even improved by appropriate care (Grossman, 1972). From a child health perspective, parental attributes and behaviors are therefore just as unavoidable as contextual factors. This allows us to distinguish between socio-demographic and socioeconomic factors in child health and the functioning of the health system.

Regarding socio-demographic factors, we distinguish the effects of age and fertility of the mother, the interval between births, and genetic factors. Indeed, the age and health of the mother have a strong influence on child survival (Lachaud, 2004). Two groups of people are more at risk here than others, especially children born to women under the age of eighteen and children born to women over forty. On the other hand, the higher the births order of the child, the higher the risk of dying, regardless of the mother's age (Barclay and Kolk, 2015). With regard to the interval between births, the shorter the interval between births, the higher the risk of mortality for children (Molitoris, 2017).

Socio-economic factors and the functioning of the health system correspond to the housing conditions, the socio-economic status of the parents and the provision of care. Given the extreme vulnerability of young children, they are more than others sensitive to habitat conditions. Among the most significant criteria, we can cite the number of people in the household, the quality and quantity of water available, the presence of latrines and the proximity of health services (Sastry, 1997). For socio-economic status, in addition to the parents' income level, which provides the child with the care and food that is essential for his or her development (Thomas and Strauss, 1992), it is necessary to highlight the role of education of the latter, and mainly that of the mother (Glewwe, 1997; Sandiford et al., 1995). Finally, the effect of the functioning of the health system on infant mortality is generally assessed through insurance mechanisms, public health expenditure, and vaccination coverage, whose role in improving child survival has largely been demonstrated empirically (Kumar et al., 2013; Breiman et al., 2004).

From this brief literature review on some determinants of child mortality, we can immediately recognize that remittances can only have an impact on children's health through the socio-economic status of households. Remittances, once received by the household, will directly contribute to an increase in income (Fajnzylber and Lopez, 2008). This increase in income

will thus contribute globally to the reduction of poverty (Adams Jr and Cuecuecha, 2013) and thus to the improvement of health. In more detail, the literature review shows that the recipient household's expenditure pattern can be modified by remittances (Acosta et al., 2008). This modification, which seems to be accepted by most empirical studies, can be carried out in two directions: by an increase in current consumption expenditure (allowing both consumption support and the coverage of several health and education expenses); or the other way around, exemple an increase in the propensity to save or invest, as seen by the purchase of durable goods and investments in real estate. From this distinction, we perceive that remittances can affect children's health through current consumption expenditure. Indeed, it is thanks to this expansion of the budget line that households will be able to invest more money in factors affecting health. Thus, these funds will have an effect on health either through support for consumption (indirect effect), that is to say the improvement of food, hygiene conditions and habitat in general (Duryea et al., 2005); either directly through increased spending on health care per capita (Valero Gil, 2009; Yol et al., 2017; Azizi, 2018).

2.2 Literature review

Empirical works on the effects of remittances on health status and especially child mortality is quite rare at both micro and macro levels.

At the micro level, empirical investigations on the impact of remittances on health outcomes focused on three measures of health outcomes including: nutritional status, life expectancy and infant mortality. The work of Kanaiaupuni and Donato (1999) on the rural population in five regions in Mexico reveals that in the short-run, migration would have a negative effect on children's health, but that this trend is reversed in the long-run. For these authors, remittances improve infant's health, but this effect depends on the position of the family in the migration process (recent or old). Frank and Hummer (2002) use logistic regression and show that membership in a Mexican migrant household provides protection against low birth weight, mainly through remittances. However, this result does not take in to account the problem of endogeneity. Córdova (2006) confirms this result and shows that remittances contribute to reduce infant mortality in Mexico. Acosta et al. (2008) analyze the impact of remittances on poverty and human capital through household survey data from Latin America. The authors find that children from remittance-receiving households were overweight and better-sized than those in non-recipient households. Using a set of anthropometric indicators constructed according to the WHO standards and the 2006 household survey in Ecuador, Antón (2010) analyzes the impact of remittances on the nutritional status of children under five in this country. Using the

instrumental variable method to account for endogeneity, the study highlights a positive and significant effect of remittances on the nutritional status of children in the short-run; however, no significant impact on long run anthropometric indicators is established.

At the macroeconomic level, based on panel data from 84 developing countries, Chauvet et al. (2009) analyze the respective impact of aid, remittances and brain drain on infant mortality. Their results show that remittances reduce child mortality and that the impact of health care is non-linear, suggesting more effective health assistance in the poorest countries. In addition, remittances appear to be more effective in reducing mortality among children from the wealthiest households, while the health effects are not pro-poor. Zhunio et al. (2012) investigate the effect of international remittances on health and education outcomes in a sample of 69 low- and middle-income countries. They find that remittances play an important role in increasing life expectancy and reducing child mortality.

Terrelonge (2014), based on the Double Least Squares (2SLS) method, studies the joint impact of remittances and public health spending on household health expenditures and health outcomes on a panel of 138 developing countries between 1995 and 2009. The results reveal that remittances do not appear to affect household health expenditure; however, they have a negative and significant effect on infant mortality. The author concludes that remittances reduce child mortality by improving the standard of living by easing household budget constraints. Also using the 2SLS estimate, Amakom and Iheoma (2014) showed that an increase in remittances in sub-Saharan Africa contributes to an improvement in life expectancy at birth of 0.4% to 1.2% on average. This effect was larger than that caused by public health expenditure per capita, which was 0.5% on average for each 10% increase in public health expenditure per capita.

Amega (2018) examined the effects of remittances for 46 subsaharan african countries over the period 1975 to 2014. Using GMM method, author shows that remittances reduce infant and adult mortality; extend life expectancy at birth to 65 years (survival up to 65 years) and the overall life expectancy of the population. additionnally, The author establishes a greater reduction in adult mortality compared to infant mortality; and implicitly infers that adults are the most sensitive to remittances. Azizi (2018) examines the effects of migrant remittances on human capital and labor supply using data from 122 developing countries between 1990 and 2015. Nine health variables are used, including health expenditures, life expectancy, nutritional status and infant mortality rates. The results show that remittances improve health outcomes in developing countries.

This literature review allowed us to note that the previous work omitted some important

determinants of child mortality, such as: child immunization, the prevalence of women to HIV, and women's education.

3 Data and methodology

3.1 Data

We investigate a panel of 38 Sub Saharan African countries with data for the period 2000-2014 from: (i) the world development indicators (WDI) and Global Consumption and Income Project (GCIP). The periodicity and countries under investigation are chosen according to data availability constraints. The full description of the data is as follows:

The dependent variable is under-five mortality rate (IMR 1). For robustness checks we additionally use infant mortality rate (IMR 2) and neonatal mortality rate (IMR 3) has alternative dependant variables. These three measures of child mortality are increasingly being used in the literature Akinlo and Sulola (2018). The main independent variable is remittances received (% GDP). To reduce bias that may arise from possible variable omissions and consistent with recent literature on infant mortality, six control variables are included. They comprise (i) GDP per capita, (ii) Immunization measles, (iii) public health expenditure, (iv) prevalence of women to HIV (v) income inequality measure by Palma ratio and, (vi) education of women. The selection of these variables is consistent with recent infant mortality literature (Arthur and Oaikhenan, 2017; Akinlo and Sulola, 2018). In line with the underlying literature, negative linkages are expected between GDP per capita, Immunization, Health expenditure, education and child mortality variables. On the other hand, we expect a positive relationship between prevalence of women to HIV, Palma ratio and child mortality variables.

The definitions of variables are presented in Table 1 while Table 2 and 3 respectively display descriptive statistics with the presentation of countries and the correlation matrix.

Table 1: Definitions and sources of variables

Variables	Definitions	Sources
Mortality rate	Mortality rate, under-5 (per 1,000 live births)	World Bank (WDI)
	Mortality rate, infant (per 1,000 live births)	World Bank (WDI)
	Mortality rate, neonatal (per 1,000 live births)	World Bank (WDI)
GDP per capita	GDP per capita (constant 2010 US$)	World Bank (WDI)
Remittances	Personal remittances, received (% of GDP)	World Bank (WDI)
Immunization	Immunization, measles (% of children ages 12-23 months)	World Bank (WDI)
Prevalence of HIV	Prevalence of HIV, female (% ages 15-24)	World Bank (WDI)
Health expenditure	Health expenditure, public (% of GDP)	World Bank (WDI)
Education	School enrolment, secondary, female (% gross)	World Bank (WDI)
Palma ratio	The ratio of the richest 10% of the population's share of gross national income divided by the poorest 40%'s share	GCIP
Corruption	Control of corruption index	World Bank (WGI)
Polity2	democracy index	Polity IV
Population	Population in urban agglomerations of more than 1 million (% of total population)	World Bank (WDI)

WDI: World Development Indicators. GCIP: Global Consumption and Income Project.

Table 2: Summary statistics and presentation of countries

Panel A : summary statistics

	Variable	Obs	Mean	Std. Dev	Minimum
Mortality rate	Mortality rate, under-5	570	104.143	41.777	13.8
	Mortality rate, infant	570	66.728	23.474	11.9
	Mortality rate, neonatal	570	32.159	9.745	8.9
Remittances	Remittances	539	4.160	6.980	.0002
Control variables	GDP per capita growth	569	2.300	4.109	-31.342
	Immunization	570	75.009	15.843	30
	Prevalence to HIV	525	3.896	5.348	.1
	Health expenditure	570	2.782	1.390	.045
	Education	383	40.302	26.593	3.988
	Palma ratio	568	6.431	1.546	2.483
	Control corruption	532	-.537	.5769	-1.566
	Polity2	525	3.202	4.922	-9
	Population	510	37.392	15.643	11.259

Panel B presentation of countries (38): Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Comoros, Congo, Dem, Rep, Cote d'Ivoire, Djibouti, Ethiopia, Gambia, The, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia.

Table 3: Correlation matrix

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
(1) IMR1	1												
(2) IMR2	0,944	1											
(3) IMR3	0,745	0,793	1										
(4) Remit	-0,196	-0,099	0,051	1									
(5) GDPPg	-0,085	-0,052	-0,07	-0,155	1								
(6) Immun	-0,262	-0,34	-0,19	0,104	-0,12	1							
(7) Preva	0,031	-0,083	-0,28	-0,176	0,091	0,096	1						
(8) HEX	-0,099	-0,198	-0,243	-0,028	0,122	0,408	0,318	1					
(9) Educ	-0,073	-0,169	-0,219	0,351	-0,2	-0,03	-0,13	-0,196	1				
(10) Palma	0,128	0,027	0,024	0,11	-0,09	0,214	0,541	0,215	0,172	1			
(11) PopU	-0,09	-0,14	-0,071	-0,192	0,081	0,152	0,04	0,26	-0,46	-0,042	1		
(12) Corrup	-0,053	-0,217	-0,214	0,001	0,077	0,29	0,478	0,566	-0,12	0,458	0,137	1	
(13)Polity2	0,049	0,069	-0,064	-0,001	-0,03	-0,03	0,293	0,021	-0,19	0,322	-0,01	0,172	1

Note: IMR1: Mortality rate, under-5 ; IMR2 : Mortality rate, infant; IMR3: Mortality rate, neonatal. Remit: remittances; GDPPg: GDP per capita growth; Immun : Immunization; Preva: Prevalence of women to HIV; HEX: Health expenditure; Educ : Education; Palma : Palma ratio. PopU: Population in urban agglomerations. Corrup: corruption.

Two main points are apparent from the descriptive statistics: (i) All variables display a high level of consistency as their mean values are perpetually within the maximum and minimum values of these series and (ii) from standard deviations, there is a substantial variation between indicators, hence we can expect reasonable relationships to emerge from the estimations. The correlation matrix gives us a priori idea of the relationship between the different variables. For example, remittances, GDP per capita, immunisation, Health expenditure and education have the expected negative correlation with under-five mortality rate. On the other hand, prevalence of women to HIV and income inequality (Palma ratio) are positively correlated to under-five mortality rate.

3.2 Methodology

3.2.1 Fixed effects and GMM estimators

This study employs a balanced panel dataset that consist of 38 sub Saharan African countries over the period 2000 – 2014, where countries and the period of interest were chosen based on the availability of data. For this purpose, we formulate the following panel model:

$$IMR_{it} = \beta_0 + \beta_1 IMR_{it-1} + \beta_2 Remit_{it} + \beta_3 X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Where $IMRit$ is the under-five Mortality rate per 1,000 live births of country i at period t; Remit, remittances received as a percentage of GDP; Xi is the vector of control variables (GDP per capita growth; Immunization; Prevalence of women to HIV; Health expenditure;

Education of women and Palma ratio); μ_i is the country-specific effect, and ϵ_{it} the error term; ui is an unobserved time-invariant the country-specific effect, vt and ϵ_{it} the error term. To estimate Equation (1) we use the fixed-effects estimator. The ui, are assumed to be random and independent of the ϵ_{it}. Additionally, the vector Xi is independent of the ui and the ϵ_{it} for all and t

To estimate Eq (1), we first apply the fixed-effects estimator. However, when the FE technique is used to estimate this model, the estimated coefficients are inconsistent and likely to be biased since the lagged value of dependent variable is correlated with the error term (Nickell, 1981). Moreover, many studies have highlighted the possibility of an inverse relationship between remittances and health outcomes (Burns et al., 2017). Given the existence of an endogenous relationship between remittances and health outcomes (Burns et al., 2016), to estimate Equation (1) we apply the Generalized Method of Moment (GMM) proposed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). GMM is useful for several advantages. First, GMM estimator has been widely used to address the endogeneity problem that appears in panel data estimation of growth regressions (Arellano and Bover, 1995; Blundell and Bond, 1998). Second, GMM estimator also take into account the biases that appear due to country-specific effects or the presence of the lag dependent variable in the right side of the model. Third, GMM also avoids simultaneity or reverse causality problems. The consistency of the GMM estimator depends on two things: the validity of the assumption that the error term does not exhibit serial correlation (AR2) and the validity of the instruments (Hansen test). GMM method have two variant namely, the one-step estimators and two-step estimators. However, the two-step estimator has been proved to be more efficient than the one-step estimator because it uses optimal weighting matrices (Law et al., 2017). Therefore, this paper applies the two-step system GMM to investigate the effect of foreign direct investment on infrastructure.

3.2.2 Quantile regression

The structure of our sample leads us to question the results that can be obtained by the application of conventional estimation methods such as OLS. In our sample, we have countries with different levels of development, as classified by the World Bank. Moreover, not all countries in our sample have the same degree of dependence on natural resources, and therefore not the same type of political structure. This difference in political structure and dependence on natural resources in some ways brings into question the standard assumptions of OLS. It can therefore be safely stated that the residual normality assumption underlying OLS does not

apply to our case. This is because the values of variables such as remittances, GDP per capita and other independent variables follow an asymmetric distribution. Beyond the questioning of the hypothesis of normality of the residues, the traditional OLS is based on means value and only enables researchers to approximate the conditional mean and conditional median located at the center of the distribution, given an incomplete description of a conditional distribution (Mosteller and Tukey, 1977). To deal with this problem, we apply the quantile regression developed by (Koenker and Bassett Jr, 1978). While the OLS estimator is based on minimizing the sum of squared residuals, quantile regression is based on the minimization of the weighted sum of absolute deviations.

The θth quantile estimator of climate change policies is obtained by solving the following optimization problem, which is presented without subscripts for simplicity in Eq.(3)

$$\underbrace{\min}_{\beta} \sum_{Y_i X_i' \theta} \theta \left| Y_i - X_i' \theta \right| + \sum_{Y_i \prec X_i' \theta} (1 - \theta) \left| Y_i - X_i' \theta \right| \tag{2}$$

By setting =0.5, we can obtain the median regression, which is a special case of the quantile regression. We can use variation of o to obtain other quantiles of the conditional distribution. To convey a senses of the relationship between selected explanatory variables across the conditional under five mortality distribution, we report the results for the 25th, 50th, 75th, 90th, and 95the quantiles. We used in this study the quantile bootstrap method (Buchinsky et al., 1994). This type of analysis has some non-negligible advantages: first, when the error term is heteroscedastic and not normally distributed, this method gives robust results.

4 Results

In this section we present and discuss the empirical result for the effect of remittances on the under-five mortality rate for all of Sub Saharan African countries (ALL) and Lower Middle Income Countries (LMIC), Lower Income Countries (LIC), Conflicts countries and Non conflicts countries respectively.

4.1 Baseline estimations

In our baseline model (Table 4) we have introduced the variable GDP per capita. The first column of this table gives the results of the remittance effects on under-five mortality in sub-Saharan Africa, columns (2) and (3) show the income level and finally columns (4) and (5) consider the stability of the countries. In column (1) we find that the coefficient associated with the variable remittances is negative and significant at the 1% threshold, meaning that

remittances reduce mortality of less than 5 years. Thus, an increase in unit remittances leads to a drop in under-five mortality of 1,165 units in sub-Saharan Africa. This result is consistent with that found by Zhunio et al. (2012) and Azizi (2018) show that a high level of remittances is associated with a decrease in under-five mortality.

The coefficient associated with the GDP per capita variable is also negative and significant at 1%, meaning that the level of GDP per capita reduces under-five mortality. This result is consistent with the work of Zakir and Wunnava (1999) Baldacci et al. (2004) and Cutler et al. (2006) show that a high income level is a necessary condition to improve the level of existing health infrastructure, through access to quality water, better sanitation, improved quality of nutrition and finally access to quality care at a lower cost; resulting in the reduction of child mortality. At the same time, a comparative analysis between the effect of remittances and the growth rate of GDP per capita on under-five mortality shows that the coefficient associated with the variable remittances is greater than that associated with GDP per capita.

When we are interested in income level, we can see that the effect of remittances is greater in low-income countries compared to those of middle-income countries. Thus a 1-unit increase in remittances decreases infant mortality rate by 1.068 units and 1.714 units in LMIC and LIC respectively. Additionally, the effect of remittances on under-five mortality is more important in conflict countries than in non-conflict countries. This result was predictable because generally in countries affected by conflict, the precariousness in which children evolve makes them susceptible to an increase in remittances.

Table 4: Remittances and under five mortality (baseline model)

	Dependent variables: Infant mortality rate				
	ALL	LMIC	LIC	Conflict	Non conflict
Remittances	-1.165***	-1.068***	-1.714***	-1.366***	-0.990***
	(0.315)	(0.373)	(0.455)	(0.495)	(0.360)
GDP per capita	-0.0236***	-0.0562***	-0.141***	-0.0977***	-0.0199***
	(0.00219)	(0.00604)	(0.0116)	(0.00841)	(0.00217)
Constant	149.5***	210.5***	200.8***	229.2***	141.8***
	(4.373)	(12.65)	(7.031)	(9.564)	(4.781)
Observations	539	127	323	99	440
Number of country	38	9	23	8	30
R2 (within)	0.201	0.428	0.373	0.618	0.177
F-test	62.66	43.35	88.52	72.11	43.96

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively. Standard errors

We additionally carry out the estimation with a number of control variables to make the coefficients reported in Table 4 robust and unbiased. The inclusion of control variables is done in line with recent empirical research on infant mortality (Amega, 2018; Azizi, 2018; Akinlo and Sulola, 2019); the results are reported in Table 5-6. Table 5 gives the results of the effect of

remittances on under-five mortality in the entire sample, while Table 6 takes into account the income level and stability of countries. The effect of remittances in Table 5 remains negative and significant after taking into account the different control variables. For example, an increase in one-unit remittances translates into a reduction in under-five mortality of 1,318 units. This result indicates that when households in sub-Saharan African countries receive money from family members living abroad, they spend it either on health care or for everyday consumption such as diet, all things that contribute to improving the health status of children and therefore their survival.

When we look at the different control variables, we find that the immunization of children has a negative and significant effect at the 1% level on under-five mortality in all models. For example, an increase in immunization coverage of one unit results in a decrease in under-five mortality of 0.604 units. Other macroeconomic studies (Arthur and Oaikhenan, 2017; Akinlo and Sulola, 2019) and also microeconomics (Breiman et al., 2004) have highlighted the role of vaccination in improving child survival. These results confirm the central role of immunization coverage in health systems for the prevention of childhood diseases and the improvement of child survival by controlling epidemics or communicable diseases. This highlights the need to strengthen Expanded Programs on Immunization (EPI) in Sub-Saharan African countries as child immunization has been promoted as a global strategy to improve the survival and health of children by reducing the number of children preventable deaths.

The effect of public health spending on under-five mortality is shown to be negative and significant at the 5% level. These results reveal that an additional unit of public health expenditure as a percentage of GDP translates into a reduction in under-five deaths of 2,463 units. It is therefore necessary for the governments of sub-Saharan African countries to increase the share of public health expenditure in line with the 2001 Abuja recommendations. This result is in line with other studies on child mortality in Africa (Anyanwu and Erhijakpor, 2009), sub-Saharan Africa (Novignon et al., 2012) and India (Kumar et al., 2013). We also find a positive and significant effect at the 5% threshold of women's HIV / AIDS prevalence on under-5 mortality, suggesting that a high prevalence of HIV is associated with increased child mortality, specifically, and an increase in the female HIV prevalence rate of one unit results in an increase in under-five mortality of 1.494 units. This result could be justified by the fact that mothers, being most in contact with children can easily contaminate them in case of infection. Since child mortality is closely related to maternal health, it has been empirically demonstrated that mother-to-child transmission occurs through breastfeeding (Newell et al., 2004).

Income inequality measured by the Palma ratio variable has been shown to be an acceler-

ating factor for under-five mortality. Indeed, high inequality in income distribution is likely to negatively affect child survival as it may reflect unequal access to health care to the detriment of the poorest. This result confirms existing empirical work on the positive link between infant mortality and income inequality (Mayer and Sarin, 2005; Olson et al., 2010). Finally, we find a negative and significant effect of women's education on under-five mortality. Thus, an increase in the enrollment rate of women in one unit translates into a reduction in under-five mortality of 1.132 units in all the countries considered. Indeed, this result is consistent with the empirical work that has highlighted the role of women's education in reducing child mortality (Grépin and Bharadwaj, 2015; Makate and Makate, 2016). The main explanation for this result is that the most educated mothers will tend to move to the modern health system for their children's health, both for preventive care, including immunization and for curative care.

Table 5: : Results for all samples with control variables

	Dependent variable : Mortality rate, under-5				
	(1)	(2)	(3)	(4)	(5)
Remittances	-0.992***	-1.217***	-1.375***	-1.356***	-1.318***
	(0.246)	(0.251)	(0.246)	(0.245)	(0.235)
GDP per capita	-0.0165***	-0.0162***	-0.0211***	-0.0173***	-0.0100***
	(0.00176)	(0.00174)	(0.00371)	(0.00374)	(0.00366)
Immunisation	-1.592***	-1.494***	-1.365***	-1.293***	-0.604***
	(0.0886)	(0.0917)	(0.0907)	(0.0913)	(0.102)
Health expenditure		-3.568***	-2.040*	-2.044*	-2.463**
		(0.992)	(1.083)	(1.078)	(1.010)
Prevalence to HIV			2.788***	2.975***	1.494**
			(0.773)	(0.765)	(0.664)
Palma ratio				3.653***	6.322***
				(0.956)	(0.967)
Education					-1.132***
					(0.114)
Constant	256.2***	259.4***	236.5***	200.8***	172.5***
	(6.853)	(6.830)	(10.04)	(13.57)	(12.47)
Observations	539	539	495	493	324
Number of country	38	38	35	35	34
R2 (within)	0.515	0.527	0.576	0.584	0.732
F-test	176.2***	138.5***	123.4***	105.9***	110.6***

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively. Standard errors reported in parenthesis.

Table 6 presents the effect of remittances on under-five mortality in low- and middle-income countries (LMICs), low-income countries (LICs), countries in conflict, and stable countries. Overall, remittances have a negative and statistically significant effect on under-five mortality, regardless of the income level and the country's situation. However, the effect of remittances on under-five mortality is greater in countries in conflict and in low-income countries. For example, when considering income level, an increase in remittances of one unit translates into a

decrease in under-five mortality of X unit in low-income countries compared to 1.957 units in low-income countries and intermediate. Similarly, an increase in remittances is associated with a reduction in under-five mortality of 2,497 units in conflict countries compared with 1,088 in stable countries.

As for control variables, the effect of GDP per capita on under-five mortality has been insignificant in low-income and stable countries. In addition, public health spending also has different effects depending on the level of income of countries. In low-income countries, public spending has a negative but not significant effect on children's health. A contradictory result is found in countries in conflict in which public health expenditure has proved to have a positive effect on mortality but also not significant. The effect of HIV / AIDS prevalence is shown to be positive and significant at the 1% level in all countries except for low- and middle-income countries where the effect is negative but not significant.

Table 6: Results for LMIC, LIC, Conflict and Non-Conflict countries with control variables

	Dependent variable : Mortality rate, under-5			
	LIC	LMIC	Conflict	Non conflict
Remittances	**-0.0663**	**-1.957*** **	**-2.497*** **	**-1.088*** **
	(0.682)	**(0.275)**	**(0.622)**	**(0.226)**
GDP per capita	0.0154	-0.0153***	-0.0309***	0.00459
	(0.0117)	(0.00482)	(0.00883)	(0.00372)
Immunisation	-0.340***	-0.724***	-0.743***	-0.557***
	(0.126)	(0.156)	(0.186)	(0.104)
Health expenditure	-1.245	-7.322***	2.759	-2.596***
	(1.200)	(1.758)	(1.960)	(0.977)
Prevalence to HIV	7.583***	-0.353	21.64***	2.823***
	(1.358)	(0.878)	(7.318)	(0.628)
Palma ratio	6.825***	13.45***	5.779**	3.876***
	(1.381)	(1.773)	(2.282)	(1.010)
Education	-1.299***	-1.083***	-1.271***	-1.122***
	(0.159)	(0.198)	(0.267)	(0.110)
Constant	112.2***	180.8***	188.8***	155.1***
	(15.45)	(19.44)	(18.91)	(13.42)
Observations	193	101	55	269
Number of country	22	9	8	26
R2 (within)	0.763	0.846	0.947	0.742
F-test	75.57***	66.92***	102.2***	96.83***

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively. Standard errors reported in parenthesis.

4.2 Robustness check

4.2.1 Using alternative dependent variables

To verify the robustness of our results, we first re-estimated Equation (1) using two other variables related to child mortality including infant mortality and neonatal mortality. The results obtained are presented in Tables 7. Overall, the results of these tables are consistent with previous results. The main difference is the positive but not significant effect of the prevalence of HIV / AIDS on infant mortality. We also find that migrant remittances have a greater effect on reducing under-five mortality compared to other child mortality indicators. Indeed, an additional unit of remittances helps reduce by 1.318; 0.669 and 0.286 units respectively for under-five mortality, infant and neonatal. The same observation is also made with GDP per capita, the effect of which is still less important on the reduction of mortality compared to remittances.

Table 7: Results for all countries with alternative dependent variables

	Dependent variable					
	IMR2			IMR3		
	(1)	(2)	(3)	(4)	(5)	(6)
Remittances	-0.709***	-0.715***	-0.669***	-0.301***	-0.299***	-0.286***
	(0.128)	(0.130)	(0.118)	(0.0432)	(0.0436)	(0.0426)
GDP per capita	-0.00914***	-0.00831***	-0.00590***	-0.00286***	-0.00237***	-0.00131**
	(0.00194)	(0.00199)	(0.00183)	(0.000654)	(0.000666)	(0.000662)
Immunisation	-0.716***	-0.699***	-0.306***	-0.253***	-0.244***	-0.121***
	(0.0474)	(0.0486)	(0.0512)	(0.0160)	(0.0162)	(0.0185)
Health expenditure	-1.008*	-1.043*	-1.315***	-0.627***	-0.630***	-0.648***
	(0.566)	(0.573)	(0.505)	(0.191)	(0.192)	(0.183)
Prevalence to HIV	1.310***	1.348***	0.418	0.0918	0.113	0.235*
	(0.404)	(0.406)	(0.332)	(0.136)	(0.136)	(0.120)
Palma ratio		0.818	2.724***		0.459***	0.975***
		(0.508)	(0.483)		(0.170)	(0.175)
Education			-0.618***			-0.224***
			(0.0567)			(0.0205)
Constant	133.6***	125.8***	108.7***	58.14***	53.65***	49.56***
	(5.246)	(7.215)	(6.229)	(1.769)	(2.414)	(2.256)
Observations	495	493	324	495	493	324
Number of country	35	35	34	35	35	34
R2 (within)	0.550	0.549	0.740	0.538	0.542	0.715
F-test	111.3	91.77	114.8	105.8	89.14	101.4

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively.
Standard errors reported in parenthesis

Table 8: Fixed effects with more control variables

	Dependent variable : Mortality rate, under-5				
	(1)	(2)	(3)	(4)	(5)
Remittances	-0.787***	-1.099***	-1.157***	-1.353***	-1.134***
	(0.250)	(0.244)	(0.246)	(0.250)	(0.250)
GDP per capita	-0.0165***	-0.0269***	-0.0220***	-0.0191***	-0.0200***
	(0.00179)	(0.00217)	(0.00378)	(0.00391)	(0.00402)
Immunization	-1.588***	-1.506***	-1.354***	-1.316***	-1.322***
	(0.0932)	(0.0898)	(0.0937)	(0.0943)	(0.0972)
Health expenditure			-1.830*	-2.202**	-2.059*
			(1.080)	(1.099)	(1.097)
Prevalence of women to HIV			3.149***	2.537***	2.835***
			(0.808)	(0.798)	(0.833)
Palma ratio				3.424***	2.831***
				(0.970)	(0.973)
Education					-1.131***
					(0.117)
Population	0.737**	0.366	0.698***	0.751***	0.651***
	(0.284)	(0.248)	(0.215)	(0.206)	(0.212)
Control corruption	-1.486		-0.688		5.451
	(5.458)		(4.011)		(4.254)
Democracy		-1.340**		-1.090**	-1.360**
		(0.523)		(0.510)	(0.529)
Constant	260.2***	270.7***	240.4***	212.6***	223.5***
	(7.653)	(6.872)	(10.75)	(14.63)	(15.45)
Observations	299	289	270	272	256
Number of country	32	29	29	28	28
R2 (within)	0.406	0.594	0.703	0.717	0.715
Fisher	35.87***	74.48***	78.95***	74.88***	60.96***

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively. Standard errors reported in parenthesis.

4.2.2 Using additional control variables

Second, the addition of additional control variables including the growth rate of the urban population, the corruption control index and the quality of democracy. The results are shown in Table 8 and show no differences for our variable of interest. The effect of remittances on under-five mortality remains negative and significant at the 1% level. In the same vein, the quality of democracy also contributes to the reduction of under-five mortality. This result demonstrates that governments in sub-Saharan Africa would benefit by improving the quality of democracy in order to improve the survival of the under-fives. This result was also highlighted by Wigley and Akkoyunlu-Wigley (2017) for whom democratic governments are more incentivized and able to reduce under-five mortality than their autocratic counterparts. On the other hand, we establish a positive and significant relationship at the 1% threshold between urban population growth and under-five mortality. This result could be justified by the difficulties of controlling the spread of communicable diseases in urban areas, particularly in the metropolises of

sub-Saharan African countries which are experiencing strong demographic growth and the presence of slums. The negative effects of the phenomenon of rural exodus resulting in anarchic occupation of the urban space, promoting the promiscuity and the expansion of slums which are all favorable conditions for the development of insecurity and communicable diseases affecting survival children. This discovery is in line with Arthur and Oaikhenan (2017) who suggest that the quest for better jobs and better social amenities will put pressure on health facilities in urban areas, causing an increase in mortality rates.

4.2.3 Accounting for endogeneity

Third, in order to account for a possible endogeneity bias, equation (1) was re-estimated by the GMM system method. The results are shown in Table 9. Overall, the results obtained are almost similar to the previous ones. Overall and in all models, the coefficients associated with the remittance variables are negative and significant at the 1% threshold, meaning that any increase in remittances results in a decrease in under-five mortality. As for the control variables, the results obtained are in agreement with those found above. Thus, there is a negative and significant effect of GDP per capita growth, immunization of children, public health expenditure and education of women on under-five mortality. On the other hand, there is a positive relationship between women's HIV prevalence, income inequality and under-five mortality.

Table 9: Remittances and infant mortality, System GMM

	Dependent variable : Mortality rate, under-5			
	(1)	(2)	(3)	(4)
Remittances	-0.396***	-0.762***	-0.136***	-0.123***
	(0.127)	(0.156)	(0.0124)	(0.0131)
GDP per capita	-0.000109*	-0.000292***	-0.00132***	-0.00124***
	(6.22e-05)	(8.66e-05)	(0.000105)	(0.000144)
Immunization	-0.0916***	-0.0311	-0.165***	-0.152***
	(0.0270)	(0.0220)	(0.0172)	(0.0182)
Health expenditure		-2.193***	-0.521***	-0.448***
		(0.533)	(0.126)	(0.125)
Prevalence to HIV			0.856***	0.761***
			(0.0559)	(0.0477)
Palma ratio				0.208**
				(0.0948)
Education				
L.Dependent	0.985***	0.988***	0.950***	0.950***
	(0.00769)	(0.0109)	(0.00591)	(0.00626)
Constant	-11.78***	-15.80***	-11.02***	-11.46***
	(2.797)	(3.200)	(1.806)	(1.942)
Observations	509	478	439	438
AR(1)	0.0760	0.00382	0.00692	0.07022
AR(2)	0.481	0.329	0.305	0.320
Number of country	38	38	35	35
Instruments	26	27	30	30
Hansen OIR	0.290	0.122	0.341	0.308
Fisher	10276***	4549***	14669***	15166***

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively. Standard errors reported in parenthesis.

4.2.4 Using a non-parametric analysis

In order to control the heterogeneity of the distribution, the fixed effect quantile regression to Koenker (2004) was used. Table 26 summarizes the results of the estimation of the quantile regression. Results are reported for the 25th, 50th, 75th, 90th and 95th percentiles of the conditional distribution of child mortality. By focusing on remittance remittances, we can see that the coefficients associated with the variable remittances are negative, significant and heterogeneous. However, as we move towards the highest quantiles, the impact of remittances on under-five mortality increases in absolute value. This means that the significant impact of remittances in Sub-Saharan Africa is increasing in magnitude as countries with high mortality levels move closer. This result confirms those found in the previous tables and the potential role of migrant remittances in improving child health in sub-Saharan Africa. In general, the results show that the impact of different factors on under-five mortality is clearly heterogeneous.
x

Table 10: Remittances and under5 mortality: Quantile regression

	Dependent variables: Mortality rate, under-5				
	Q.25	Q.50	Q.75	Q.90	Q.95
Remittances	-0.636**	-0.726***	-1.001***	-2.243***	-2.575***
	(0.282)	(0.189)	(0.203)	(0.556)	(0.480)
GDP per capita	-0.00681**	-0.00862***	-0.00663***	-0.00409	-0.00649
	(0.00264)	(0.00177)	(0.00190)	(0.00520)	(0.00449)
Imminization	-0.382**	-0.407***	-0.483***	-0.490	-0.842***
	(0.164)	(0.110)	(0.118)	(0.323)	(0.279)
Health expenditure	-3.487**	-2.046*	0.678	-1.236	-0.854
	(1.601)	(1.075)	(1.151)	(3.154)	(2.726)
Prevalence of women to HIV	1.869***	1.695***	1.609***	4.447***	5.354***
	(0.478)	(0.321)	(0.343)	(0.941)	(0.813)
Palma ratio	7.175***	10.07***	9.989***	14.22***	12.68***
	(1.828)	(1.227)	(1.314)	(3.601)	(3.112)
Education	-0.871***	-1.049***	-1.197***	-1.353***	-1.092***
	(0.193)	(0.130)	(0.139)	(0.380)	(0.329)
Constant	120.9***	123.6***	136.5***	133.3***	167.8***
	(14.09)	(9.459)	(10.13)	(27.76)	(23.99)
Observations	324	324	324	324	324
Pseudo R2	0.321	0.392	0.406	0.387	0.405

Notes: *,**,*** denote statistical significance at the 10%, 5% and 1% levels respectively.
Standard errors reported in parenthesis.

5 Conclusion and policy implications

Improving child survival is one of the United Nations Sustainable Development Goals. The goal is to reduce neonatal mortality to less than 12 per 1000 live births and under-five mortality to less than 25 per 1000 live births by 2030. While looking for effective funding mechanisms for the health system is not a new development challenge, strategies to identify alternative sources of income is increasing. One of the alternative sources of financing health expenditure seems to be the remittances. Remittances received by Sub Saharan African countries have increased significantly over the last decades. This has generated a broad debate about their macroeconomic impacts. Part of the empirical literature has indicated that remittances improve the health conditions of receiving countries. In light with this literature, this paper investigates the impact of remittances on the under-five mortality rate of 38 Sub-Saharan African countries over the period 2000-2014. The empirical evidence is based on Fixed effects (FE). The results indicate that remittances have a negative and highly significant impact on under-five mortality rate. Our results are robust for including several other control variables, the use of alternative dependent variables and the application of different estimation technique. These results are consistent with that of Zhunio et al. (2012) who find that remittances reduces the infant mortality of 69 low and middle income countries, Azizi (2018) who also finds a negative effect of remittances on under-five mortality, infant mortality and neonatal mortality in 122 developing countries; and Amega (2018), who finds a similar effect specifically in 46 countries in sub-Saharan Africa. The analysis also reveals that public health spending, GDP per capita, child immunization and women's education make a significant contribution to improving under-five survival in sub-Saharan Africa. From our results it is also clear that the prevalence of women with HIV / AIDS and income inequalities are factors that significantly promote child mortality.

Several political implications can be drawn from our analyses. The positive and significant contribution of remittances to child health outcomes suggests first that governments should implement policy reforms to further facilitate remittances by opening channels through which these funds flow to increase income available for the most dependent households. This could be achieved for example by acting on the shipping costs that are still the highest in the world. Secondly, although governments must promote remittances for the consumption or health expenditures of recipient households, insurance mechanisms for health should be further considered. These mechanisms would protect households against catastrophic health expenditures (catastrophic payment) as prescribed by WHO.

Our results also show that increased income translates into improved outcomes for children's health. However, the effect of rising income is smaller than other variables such as pub-

lic health spending. Thus, the governments of Sub-Saharan African countries should increase the share of budgets allocated to public health expenditure in accordance with the Abuja Declaration. Beyond this increase, policies aimed at improving the efficiency of public spending on health should be further implemented. Such efficiency policies would include, for example, directing available resources to cost-effective health interventions such as preventive health care.

In addition, economic policies in sub-Saharan African countries should move more towards reducing income inequalities to improve child survival; this will promote better access to health care for all socioeconomic groups. In the same vein, it is also necessary to intensify the policies aimed at increasing the education of mothers, because a better educated mother will be more concerned to carry out all the prenatal consultations and to respect the schedule of the vaccinations for a year complete immunization of children. Also, more provision of testing and antiretroviral testing is also needed to reduce HIV / AIDS related child mortality. For children exposed to the virus, follow-up interventions should be stepped up to reduce the mortality differential between unexposed and exposed children. In addition, the large urban population in sub-Saharan Africa has been shown to have a positive effect on under-five mortality. To remedy this, we suggest implementing policies aimed at improving the technical platforms in rural health centers in order to improve the quality of care. We also encourage governments to promote job creation, particularly through entrepreneurship in rural areas, in order to limit the phenomenon of rural exodus.

Finally, the positive effect of vaccination on child survival calls for a greater extension of immunization coverage, particularly through the Expanded Program on Immunization (EPI). In 1974, WHO launched EPI as a public health initiative aimed at improving the health and survival of children through routine and universal immunization coverage in general, these programs have paid off, raising child immunization rates from 5% at the start of the initiative to 83% in 2014 (Chan, 2014). However, empirical evidence suggests persistent disparities in vaccination coverage between rural and urban areas, and between socio-economic statuses in various sub-Saharan African countries (Ataguba et al., 2016). As a result, policies to reduce socio-economic inequalities in child immunization should be better targeted and targeted at vulnerable children in slums and disadvantaged neighborhoods, and those in more isolated areas.

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