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Understanding the effect of international remittances on undernourishment in Sub-Saharan Africa: A spatial model approach

Hamed SAMBO*

Abstract - This paper investigates the impact of remittances on undernourishment in Sub-Saharan Africa using panel data from 35 countries spanning the years 2001-2011. The generalized moments estimator under the presence of spatial autoregressive parameter was used after taking into account the spatial interaction between countries. We find that remittances contribute to the reduction of undernourishment in Sub-Saharan African. However, the elasticity of calorie consumption to remittances is low. Moreover, the impact of remittances is more pronounced in intermediate income deciles countries than in the countries in lower income deciles and higher income deciles.

JEL Classification
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Key-words
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* Centre d'Economie de l'Université Paris Nord (CEPN), Université Paris 13.
hamed.sambo@univparis13.fr

1. INTRODUCTION

For years, the relationship between income and nutrition has yielded a debate among researchers in development economics. According to the Engel curve, a rise of consumers incomes leads to a substitution of food quantity for food quality, which implies an increase in demand for calories. Therefore, the elasticity of calorie consumption to income is greater than zero (Subramanian & Deaton, 1996). However, different studies have found that this elasticity is closed to zero (Behrman & Deolalikar, 1987; Bouis & Haddad, 1992), meaning that an increase of income doesn't lead to a significant increase in calorie consumption. More recently, based on facts in India, Deaton & Drèze (2009) have found that in spite of high growth rate of per capita income and per capita consumption, per calorie consumption has been falling for a quarter of the century. One explanation given by the authors is that an increase of per capita income has probably led to a move out from agricultural sector to modern sector, resulting to a fall of calorie consumption for physical heavy which in turn reduce the total calorie consumption. Indeed, considering that people use calories for two purposes, own nutrition and heavy physical labor, Deaton & Drèze (2009) argues that, in a single labor market with common wage, the relationship from strength to income through work and calorie consumption will induce a positive relationship between income and calorie consumption. However, a rise of real wages will induce a decline of physical labor leading to a fall in calorie consumption for work even as the calorie consumption for improving nutritional status is increasing but still inadequate. However, this analysis does not take into account the preferences of individuals for other aspects of food, namely taste, appearance, odor, status value or cultural preference. When these preferences are taken in account, it is likely that additional incomes do not induce a significant improvement in calorie intake even though there is a rise in food consumption (Behrman & Deolalikar, 1987). This is because a part of the money is spent to get more calories and the other to get tasty foods which are more expensive.

More recently, Banerjee & Duflo (2011) have provided a detailed analysis of the food consumption behavior of poor households. They argue that people eat little not because they are too poor to buy foods but because it is not clear that the additional productivity translates into higher earnings if employers do not know that a well-nourished worker is more productive. Indeed, if employers pay the same wage to all workers, then there would be no reason to eat more and get stronger. People also don't know that their good nutrition leads to a better health for their children. Therefore, poor choose their foods not for their nutritional values, but for how good they taste. Under, these arguments, it is not surprising that, with additional income, poor choose to consume tasty foods rather than nutritive foods. Another fact that Banerjee & Duflo (2011) pointed out is that there are other things more important in the lives of poor than food due to social pressures or social contexts, especially in developing countries. These things include weddings, dowries, and christenings. Given that too many others pressures and desires competing with food, it is then likely to see that poor do not eat any more or any better when their income goes up.

In recent years, migrant remittances have experienced strong growth in developing countries, outpacing public development aid. Since these transfers are directly sent to individuals and act in the form of supplementary income, the question that arises, given the relationship between income and calorie consumption, is whether they have an effect on calorie consumption in developing countries. According to the new economics of labor migration, the migration decision is made along households in order to minimize their risks and overcome limitations occurred as a consequence of the failures of the national markets (Stark, 1991). In turn, families abroad send remittances which have a positive impact on the economics of poor. The effect

of remittances on poverty is well-documented in the economic literature. Researchers agree that remittances contribute to the reduction of poverty in receiving countries (Imai & al., 2014; Margolis & al., 2015; Bang & al., 2016). However, as described above, the reduction of poverty don't necessarily lead to an additional calorie consumption. In addition, most of these studies have focused on monetary poverty instead of a multidimensional poverty, which includes at some extent the outcomes of good nutrition. Other studies have analyzed the effect of remittances on food consumption. Adams & Cuecuecha (2013) have found in their study in Ghana that food consumption increase with the receipt of remittances. However, households receiving remittances spend less at the margin on food. Remittances have also been found to dampen the impact of the positive food price shock and food price instability on household consumption in vulnerable countries for which the majorities are in Sub-Saharan Africa (Combes & Ebeke, 2011; Combes & al., 2014). However again, these studies do not make it possible to know the real impact of remittances on the calorie consumption. Existing studies on the relationship between remittances and nutrition are more directed towards nutritional or health status of children (Hildebrandt & al., 2005; Antón, 2010) rather than global undernourishment.

This paper attempt to fill this gap in the literature by investigating the impact of remittances on undernourishment in Sub-Saharan Africa, the region which hosts most developing countries. Indeed, despite the continuous decrease of undernourishment in Sub-Saharan Africa, the region is the one with the largest proportion of undernourished in the world. According to FAO (2015), between 2014 and 2016, 23.2% of the population was estimated to be undernourished in Sub-Saharan Africa, compared to 12.1% in Asia and 5.5% in Latin America and the Caribbean (LAC). At the same time, remittances received in Sub-Saharan Africa were estimated to 34.8 billion USD in 2015 (World Bank).

The analysis is conducted on the panel of 35 Sub-Saharan African countries. To estimate the impact of remittances on undernourishment, we use the generalized moments estimator for autoregressive spatial panel developed by Kapoor & al. (2007). The reason behind this choice was the possibility to account for random shocks (price spikes, droughts, floods...) which are usually spatially autocorrelated. Indeed, when spatial units are spatially autocorrelated, usual panel regression models produce an inconsistent estimate of the parameters (Le Gallo, 2007).

Our findings suggest that the reception of remittances results in a decrease of the proportion of undernourished in Sub-Saharan Africa. This result is explained by the fact that most of the households that receive remittances in Sub-Saharan Africa dedicate them to consumption. However, the elasticity of nutrition to remittances is very small but overpasses that to GDP per capita. Remittances were also found to be a hedge against flood shocks in Sub-Saharan Africa. We also find that GDP per capita, domestic credit, and private investment contribute to a reduction of the proportion of undernourished in the region. In addition, having a great share of agricultural land also leads to a significant reduction of the proportion of under- nourished in Sub-Saran Africa. Grouping countries by decile of per capita GDP, we found that the impact of remittances on undernourishment is low in both the top and the bottom GDP per capita deciles. However, the impact is much higher in decile 4 for which the per capita GDP is between 420 USD and 518 USD. This result can be explained by the fact that people in bottom deciles countries compared to those in decile 4 can not afford migration costs leading to less migration and fewer remittances in bottom deciles. In addition, the countries in the bottom deciles are those suffering the most from undernourishment. In top deciles countries, the money received from migrants is more devoted to education, healthcare and investment rather than consumption. This explains the less effect of remittances in the top decile countries.

The paper is structured as follows, Section 2 describes the trend of four income flows and that of the prevalence of undernourishment from 1990 to 2015, and Section 3 provides an understanding of the use of remittances in Sub-Saharan Africa. A description of the data and the methodology is presented in Section 4. In Section 5, we outline the main results and conclude in Section 6.

2. INCOME FLOWS AND UNDERNOURISHMENT IN FIVE SELECTING COUNTRIES FROM 1990-2015

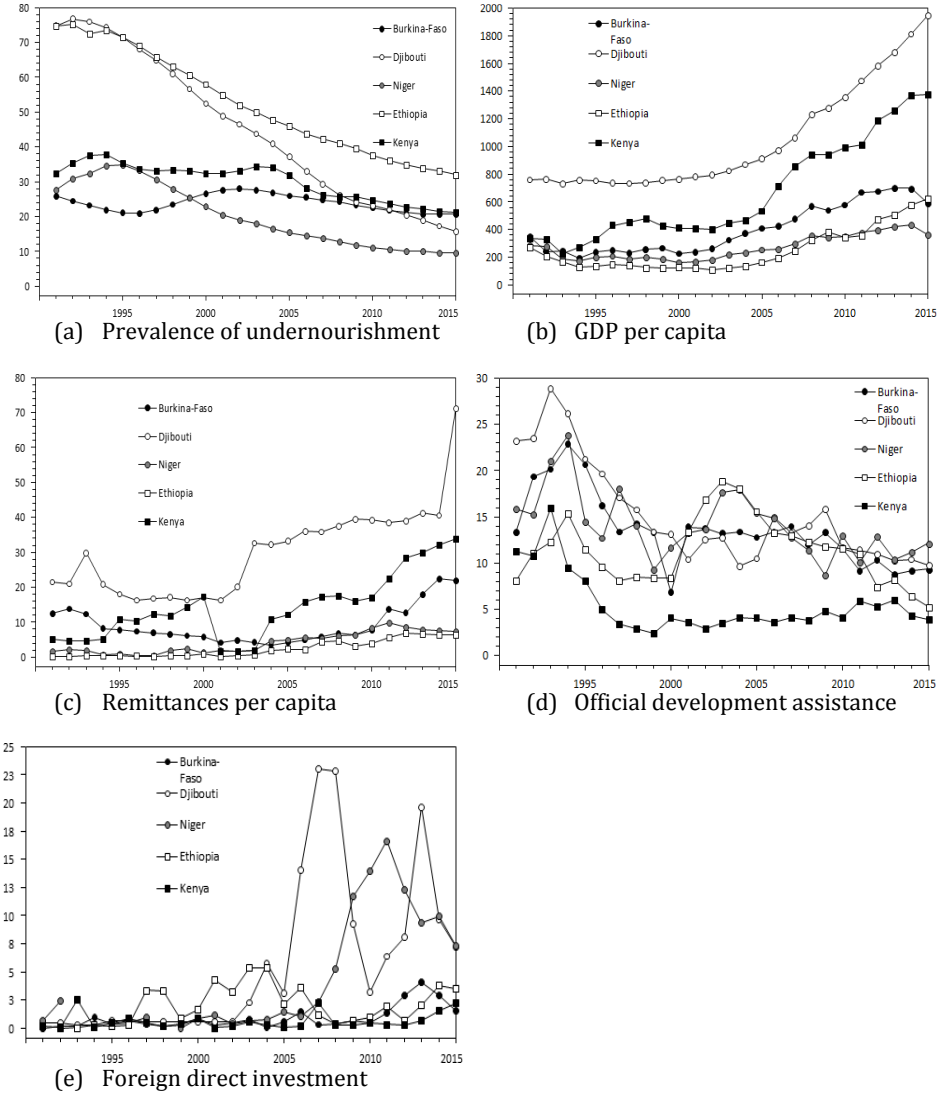
In this section, we analyze the trends of four income flows and that of undernourishment[1] in five sub-Saharan African countries from 1990 to 2015. We focus on two types of income flows: external flows which include official development assistance, foreign direct investment and remittances; and one internal income flow, a country per capita GDP. Figure 1 shows that, compared to Burkina Faso and Kenya, where undernourishment has not declined significantly from its 1990 level, in Djibouti, Niger, and Ethiopia, there has been a sharp drop from 1994. All five countries, however, have experienced considerable growth in per capita GDP since 2000. Per capita GDP growth, therefore, does not explain the decline in undernourishment observed from 1994. However, it can not be denied that it contributed to the decline in the level of undernourishment from 2000 onwards in some countries. For example, Ethiopia, the country with the highest per capita GDP growth over the period, is also the country that has seen its level of undernourishment shrink considerably, catching up and even falling below the level of undernourishment in Burkina Faso and Kenya. However, despite Kenya's strong per capita GDP growth, nutrition has not improved significantly in the country. Moreover, Niger, which saw its level of undernourishment decline significantly from 1994 onwards, experienced only a small increase in its per capita GDP. Theories that support that the income elasticity of calorie consumption is close to zero are verified for Kenya (Behrman & Deolalikar, 1987; Bouis & Haddad, 1992) while those in favor of zero elasticity can be confirmed for Ethiopia (Subramanian & Deaton, 1996). If the per capita GDP has a controversial effect on undernourishment in the 5 countries, what about migrant's transfers?

Figure 1 shows a strong correlation between migrant remittances and per capita GDP, with the growth phases of GDP per capita coinciding with those of mgrants' remittances. In addition, countries with high growth rates are also those with high remittances. Since the trend in long-distance transfers is the same as that of GDP per capita for all countries, the same conclusions can be drawn as before. This is justifiable because remittances operate in the form of supplementary income to the household, although the uses may be different. The literature also shows that migrant remittances have a positive impact on economic growth (Pradhan & al., 2008; Nsiah & Fayissa, 2013; Driffield & Jones, 2013; Zghidi & al., 2016).

While migrant remittances and per capita GDP have contributed to the decline in undernourishment in some countries from 2000 onwards, it does not explain the decline in undernourishment observed in 1994 in Djibouti, Niger, and Ethiopia. Thus, what explains this decline in 1994? One possible explanation would be that, following the increase in undernourishment in 1990 (Figure 1), aids has increased to save countries from a probable famine (very high undernourishment), which explains why the decline in 1994 coincides with the decline in development aid (Figure 1). If we assume that development aid played a role in reducing undernourishment in 1994, what about foreign direct investment (FDI)?

[1] Undernourishment is measured by the FAO prevalence of undernourishment index which is defined as the probability that a randomly selected individuals from the reference population is found to consume less than 1,800 calories a day, a minimum requirement for an active and healthy life.

Figure 1: Trend of undernourishment and four income flows in selecting countries



(a) Prevalence of undernourishment (b) GDP per capita

(c) Remittances per capita (d) Official development assistance

(e) Foreign direct investment

Source: Author.

The inspection of Figure 5 shows that it is difficult to establish a link between FDI and undernourishment in the five countries. The only countries where FDI has highly grown are Niger and Djibouti, starting later in 2005 after the onset of the decline in2007, did not lead to an increase in undernourishment.

Although this analysis can not be generalized to all sub-Saharan African countries, it provides an initial idea of the impact of these different income streams on undernourishment.

3. THE USES OF REMITTANCES IN SUB-SAHARAN AFRICA

As argued by Deaton (2010), learning about development requires the investigation of mechanisms. Understanding how the money sent by migrants are spent in Sub-Saharan may help to respond to the question on whether remittances contribute to the reduction of undernourishment in the region. In this section, we investigate the uses of remittances, basing on surveys that were conducted in most Sub-Saharan Africa countries.

In order to understand the development impact of remittances, in 2006, the Southern Africa Migration Project (SAMP) devised a migration-remittances survey in 5 SADC countries: Botswana, Lesotho, Mozambique, Swaziland, and Zimbabwe (Pendleton & al., 2006). The survey reveals that across the five countries, remittances are mostly used for food purchases, following school fees, clothing and transportation. Indeed, 82% of households used received money to buy foods while 52%, 52%, and 34% devoted money respectively to school fees, clothing, and transportation. However, while foods remain the main items that remittances are used for, there is a little change in the rank of other uses of money for different countries. In Botswana, Lesotho, and Zimbabwe, clothing is the second item group for which remittances are mostly devoted to (63% of households in Botswana, 76.1% in Lesotho and 57%). Regarding, Mozambique and Swaziland, school fees are the second items that remittances are spent on (49% of households in Mozambique and 55% in Swaziland). It is important to note that the households that claimed to spend their remittances on food may also use them for other purposes. Therefore, the sum of the share of household using remittances for different expenditures is not expected to be equal to 100%.

In 2008, a survey on remittances in Uganda was also conducted by the Bank of Uganda and the Uganda Bureau of Statistics. In contrast to SADC countries, it was found from this survey that remittances are mostly used in education in Uganda (27.4% of the total amount of received cash). Nevertheless, there is less difference with the share of cash used in household expenditure (food, clothing...) which counts for 22.7% of total received remittances. Building works are also one major item in which remittances-received households devote an important share of the money they received from migrants (21.2% of the total amount of received cash). Land purchase, business and saving was ranked respectively fourth, first and sixth use of remittances.

Following the survey in Uganda, in 2010, the World Bank through a Future of African Remittances Team conducted a survey in three East African countries including Uganda. The two other countries in which the survey was conducted are Ethiopia and Kenya. In contrast to the above survey, the World Bank survey of 2010 reveals that remittances are mostly spent in small business (35% of total remittances), followed by education (25% of total remittances) and daily expenses (24% of total remittances) in Uganda. However, both World Bank and Bank of Uganda's surveys show that consumption is not the first use of remittances in Uganda. The World Bank survey also showed that, in Kenya, the money received from migrants is mostly devoted to migrant physical investment (27% of total remittances), followed by new house building (18% of total remittances) and land purchase (15% of total remittances). Food purchases count only for 2% of total remittances received in Kenya. However, in Ethiopia, more than a half of total amount of remittances is devoted to daily expenses. Education and small business count respectively for 29% and 9% of the total money received from migrants in the country.

In 2010, BCEAO, a Central Bank of West African Economic and Monetary Union (WAEMU), have also performed a survey on remittances in the countries of the union: Benin, Niger, Burkina-Faso, Senegal, Togo, Mali, Guinea-Bissau and Côte

d'Ivoire (BCEAO, 2013). The survey indicates that household receiving remittances spend more than a half of the received money on consumption in the region. Indeed, 54.6% of the money received is spent on consumption while 21.3% is spent on investment and 3.4% and 6.4% respectively on health-care and education.

However, heterogeneity in the use of remittances occurs within the countries of the Union. In Benin, 29.6% of remittances are devoted to consumption, 23% to property investments and 28.1% to others investments. Burkina-Faso and Côte d'Ivoire follow the same trend in the use of money received from migrants. Indeed, remittance-receiving households in Burkina-Faso spend 37.3% of remittances on consumption, 25.7% on property investments, 16.3% on other investments and 15% on education, while those of Côte d'Ivoire spend 36.2% of remittances on consumption and 29.3% on property investments.

The WAEMU's country in which the great share of remittances is spent in consumption is Senegal, with 70% of received money spent in consumption and only 7.6% in property purchase and 7.4% in education and health-care. Senegal is followed by Niger, Mali and, Guinea-Bissau in which consumption expenditures hold respectively 52.1%, 48.7% and 48% of total remittances received by each country. In Niger, only 2.8% and 0.7% of remittances are used respectively in health-care and education. In Mali, 5.2% of the money received is devoted to education while 4.2% is devoted to health-care. In Guinea-Bissau, education expenditures and health-care expenditure count respectively for 11% and 18% of total remittances. In contrast to the rest of WAEMU's countries, remittance-receiving households in Togo spend more on property investments (35.6% of the total money received). However, there is less difference with a share of money used for consumption which counts for 33% of remittances.

Although remittances are mostly spent on consumption, it is still not enough to conclude that they lead to a significant calorie consumption and thus a reduction of the proportion of undernourished in Sub-Saharan. Indeed, as underlined above rising food consumption may not necessarily provoke a significant improvement in calorie consumption which depends on the nutrients intake.

4. METHODOLOGY AND DATA

4.1. Model and estimation

The analysis of the impact of remittances on undernourishment using panel data requires a careful specification of the model to be used. In this study, the indicator employed to measure undernourishment relies on the total food supplied in the country, including food imports. Therefore, a fall in the production of foods in country *i* may affect the undernourishment of countries *j* with which *i* has food trade relationship. Undernourishment caused by a fall in food production in country *i* may then affect undernourishment in countries *j*. To simplify, we assume that *i* trades food with its neighbor countries *j*. Under this assumption, usual panel data models yield inconsistent estimate of the parameters of the model (Le Gallo, 2007; Schaffar, 2014).

In order to take into account spatial correlation between countries, we use the specification in Elhorst (2014). The model is then written as follow:

$$PoU_{it} = \lambda \sum_{j=1}^{N} w_{ij} PoU_{it} + \phi + \beta_1 Remit_{it} + \beta_2 X_{it} + c_i + \alpha_t + v_{it} \qquad (1)$$

where PoU_{it} is the prevalence of undernourishment for country *i* at time *t* (*i =1,.. ,N* and *t = 1,.., T*), $Remit_{it}$ is the per capita remittances of country *i* at time *t*, and ϕ is

the constant term parameter. The variable $\sum_{j=1}^{N} w_{ij} PoU_{jt}$ denotes the interaction effect of undernourishment in country *i* with the undernourishment in neighboring countries, w_{ij} is the i, jth element of a $N \times N$ spatial weights matrix W. X_{it} is a $1 \times (K-1)$ vector of exogenous control variables with K denoting the number of explanatory variables. v_{it} is an i.i.d error term for *i* and *t* with zero mean and variance σ^2, while c_i denotes spatial specific effects and α_t the time-period specific effects. Including spatial specific effects allows for the control of space-specific time-invariant variables whose omission could bias our results. In the same manner, time-period specific effects allow the control of all time specifics effects.

The correlation between countries may also come from interaction effects in error term. This is consistent with a situation in which random shocks are spatially cor-related. As random shocks pass through the error term, we rewrite v_{it} as follow: $v_{it} = \rho \sum_{j=1}^{N} w_{ij} v_{it} + u_{it}$. Model 1 becomes:

$$PoU_{it} = \lambda \sum_{j=1}^{N} w_{ij} PoU_{it} + \phi + \beta_1 Remit_{it} + \beta_2 X_{it} + c_i + \alpha_t + \rho \sum_{j=1}^{N} w_{ij} v_{it} + u_{it} \qquad (2)$$

To test whether this model is more appropriate to describe the data than a model without any spatial interaction effects, we use the generalized and the robust Lagrange Multiplier (LM) test proposed by Burridge (1980), Anselin (1988) and Anselin & al. (1996). The result (Table 1) indicates that only spatial error correlation have to be accepted, meaning that $\lambda = 0$ but $\rho \neq 0$ at 5 % significance level. This suggests that the countries considered in this study share common random shocks with the neighbors. This can be illustrated with the 2006-2011's horn of Africa food crisis and the 2010-2011's Sahel food crisis which affect respectively most of horn of Africa countries and most of Sahel countries located in the same area. Therefore, the model to be estimated is then:

$$PoU_{it} = \phi + \beta_1 Remit_{it} + \beta_2 X_{it} + c_i + \alpha_t + \rho \sum_{j=1}^{N} w_{ij} v_{it} + u_{it} \qquad (3)$$

Different approaches have been proposed to estimate the parameters of this model. Kapoor et al. (2007) proposed a generalization of the generalized moments estimators suggested in Kelejian & Prucha (1998) while Fingleton (2008) extend their work to develop GM estimators for spatial moving average panel data model. We use the generalized moments estimators of Kapoor & al. (2007) because it allows the disturbance terms to be both spatially and time-wise correlated as well as heteroscedastic.

The variables included in X_{it} were chosen in line with the existing literature. They include GDP per capita, Foreign Direct Investments (FDI), Official Development Assistance (ODA), public expenditures in agriculture, domestic credits, political stability, private investments, domestic food prices, food price volatility and the share of agricultural. Indeed, although the impact of income on undernourishment is controversial (Subramanian & Deaton, 1996; Behrman & Deolalikar, 1987; Deaton & Drèze, 2009; Banerjee & Duflo, 2011), there are studies showing that GDP per capita contributes to the reduction of undernourishment (Klasen, 2008). Regarding official development assistance, the literature is also controversial on their impact in developing countries. At one extreme, there are theories arguing that people are trapped in poverty in developing countries and foreign aid is the key to help them to invest in the area that will lift them out poverty-trap (Sachs, 2005). At the other extremes are theories by Easterly (2006) and Moyo (2009) arguing that foreign aids corrupt and undermine the local institution. These bad outcomes of foreign aids could lead to an increase of undernourishment since having the good institutions is

one of the conditions for the reduction of undernourishment in the Sen (1981) entitlement theory. According to this theory, in an economy with private ownership and exchange in form of trade and production, the entitlement set for a given person depends on the endowment of the person and the exchange mapping. People can use their endowment to produce food or sell their labor power to get wage and buy food. The role of foreign direct investment in the reduction of undernourishment can be through the later. Indeed, foreign direct investment, especially greenfield investment, lead to a demand for workers which can be absorbed by those who want to sell their labor power to buy food. Food price, as well as food price volatility, are also the determinant of undernourishment usually cited in the literature. High food prices can lead to an increase of undernourishment (less consumption of calories) (Anríquez & al., 2013). However, Banerjee & Duflo (2011) have stated that food price has had no significant impact on calorie consumption in India from 2005. Indeed, food prices have declined in the country between 1980 and 2005, and in spite of an increase of food price in 2005, the decline in calorie consumption happened when the price of food was going down.

In order to count for the possible role of remittances in mitigating shocks, such as drought and floods, we include two dummies variables, for droughts and floods, among explanatory variables and generate the interaction terms of remittances with these dummies. The addition of interaction term is motivated by the study of Combes & Ebeke (2011) who found that remittances are a hedge against natural disasters, agricultural shocks, discretionary fiscal policy, financial and systemic banking crises, and exchange rate instability. The dummies variables on the level of income in a country were also added in the explanatory variables. They were calculated basing on the decile of per capita GDP. The thresholds, as well as the mean of per capita income, are indicated in Table 2.

Table 1: Spatial correlation tests

Ho: Error has No Spatial Autocorrelation Ha: Error has Spatial Autocorrelation		
	Statistic	P-value
LM error (Burridge)	5.9011	0.0151
LM error (Robust)	6.1813	0.0129
Ho: Spatial Lagged Dependent Variable has No Spatial Autocorrelation Ha: Spatial Lagged Dependent Variable has Spatial Autocorrelation		
	Statistic	P-value
LM error (Anselin)	0.0000	1.000
LM error (Robust)	0.2802	0.5966

Source: Author.

Estimation of equation 3 involves the specification of the $N \times N$ spatial weights matrix W. The choice of spatial weights matrix is a difficult task in the spatial analysis as the results may change with alternative specifications. The literature on spatial weights matrix is classified into exogenous weight matrix and parametrized weight matrix. The exogenous matrix includes binary contiguity matrix, inverse distance matrix, and k-nearest neighbors matrix. Binary contiguity matrix based on boundaries could not be used in this study since it lets islands such as Madagascar, Cabo Verde with no interaction partners. Therefore, to estimate equation 3, we use an exponential distance weights matrix which is based on a negative exponential function of distances. An exponential distance weights matrix assumes that the impact of random shocks in country *i* on neighboring countr ies *j* diminishes when the

distance between *i* and *j* becomes higher. Let d_{ij} (d is a Euclidean distance based on longitude and latitude of centroid) denote centroid distances from each country *i* to all countries $\neq i$:

$$w_{ij} = \exp(-2d_{ij})$$

Table 2: Descriptive statistics on GDP per capita by decile

Decile	Mean	st dev	min	max
1	221.2387	47.24972	116.7956	275.7769
2	317.9721	26.06084	278.2105	359.1549
3	391.6511	16.81975	360.8283	417.1546
4	467.8627	31.31757	420.0534	518.3311
5	582.4032	46.40058	523.9092	671.6339
6	798.001	76.09828	676.7354	911.7183
7	1051.187	88.07473	927.173	1195.445
8	1624.384	378.1721	1197.471	2395.621
9	3403.899	569.9144	2541.343	4327.645
10	6482.726	1597.249	4390.256	10893.48

Source: Author.

4.2. Data and description

We use data from 35 Sub-Saharan African countries, spanning the years 2001-2011. Data were collected from different sources. Undernourishment is measured by the FAO (Food and Agriculture Organization of the United Nations) prevalence of undernourishment index. The index is defined as the probability that a randomly selected individual from the reference population is found to consume less than a minimum calories requirement for an active and healthy life. It relies on the Dietary Energy Consumption (DEC) which is difficult to compute due to the lack of suitable survey regularly conducted in most countries. Thus, the available DEC for human consumption in a country for one year is estimated through data on production, trade, and utilization of food commodities. The index ranges from 0 to 100, with 100 indicating a high level of undernourishment in the country. Regarding remittances, we use the World Bank's remittances data. Remittances comprise personal transfers, transfers in cash or in kind received by resident households from nonresident households, and Compensation of employees referring to the income of border, seasonal, and other short-term workers who are employed in an economy where they are not resident and of residents employed by nonresident entities. The data don't allow the understanding of which category of people (rural or urban population, rich or poor...) remittances are sent for. Thus, remittances per capita were computed by dividing the total amount of remittances received in country *i* by the population of this country. Data on political stability, domestic credits and those of official development assistance (ODA) were also collected from the World Bank database (World Development Indicators). Political stability and absence of violence are captured by an index which measures the perceptions of the likelihood of political instability and/or politically- motivated violence, including terrorism. The index is running from approximately -2.5 to 2.5, with higher values corresponding to better stability. Domestic credits, measured as a percentage of GDP, refer to the credits provided by the financial sector. They include all credits to various sectors on a gross basis, with the exception of credit to the central government, which is net. The financial sector includes monetary authorities and deposit money banks, as well as other financial

corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits).

Regarding data on macroeconomic variables such as GDP per capita and the net inflow of foreign direct investment, we used the World Economic Outlook and the IMF's balance of payment database.

Table 3: Descriptive statistics

Variable		Mean	Std. Dev.	Min	Max	Obs.
	overall	23.345	12.652	5	54.8	N = 385
Prevalence of undernourishment	between		12.203	5	50.036	n = 35
	within		3.8803	9.809	39.809	T = 11
	overall	521.11	2442.53	0.55367	20616.8	N = 385
total remittances	between		2028.49	2.510	12111.7	n = 35
	within		1399.41	-10530.6	9026.23	T = 11
	overall	38.888	71.083	0.0605	360.02	N = 385
Remittances per capita	between		69.643	1.080	298.653	n = 35
	within		18.137	-51.285	133.373	T = 11
	overall	50.668	17.8753	18.114	80.920	N = 385
Share of agricultural land	between		18.0356	18.836	80.200	n = 35
	within		1.647	41.246	57.711	T = 11
	overall	29.035	40.720	-70.377	227.783	N = 385
Domestic credit (% of GDP)	between		39.104	-12.770	175.677	n = 35
	within		12.993	-89.079	106.789	T = 11
	overall	10.590	12.090	-0.2319	115.405	N = 385
ODA	between		9.7965	0.324	48.540	n = 35
	within		7.259	-31.682	77.455	T = 11
	overall	1528.8	1951.58	116.796	10893.4	N = 385
GDP per capita	between		1828.92	235.17	7269.03	n = 35
	within		742.173	-1676.18	5153.33	T = 11
	overall	22.329	9.161	4.4038	76.12	N = 385
Private investment (% of GDP)	between		7.399	7.009	48.854	n = 35
	within		5.531	4.011	49.594	T = 11
	overall	6.493	1.776	2.12	11.69	N = 385
Domestic food price	between		1.7315	2.474	10.890	n = 35
	within		0.4865	4.941	8.2717	T = 11
	overall	-0.325	.8194	-2.375	1.185	N = 385
Political stability	between		0.763	-1.805	0.946	n = 35
	within		0.323	-1.756	0.595	T = 11
	overall	1.348	1.119	-1.406	5.858	N = 385
Public spending in agriculture	between		0.9687	0.1476	4.334	n = 35
	within		0.5824	-0.802	4.015	T = 11
	overall	13.087	9.231	-0.0599	84.5	N = 385
Food price volatility	between		5.040	5.218	26.481	n = 35
	within		7.776	-2.130	78.233	T = 11
	overall	5.0303	7.1146	-4.6180	72.841	N = 385
FDI	between		4.622	0.4877	21.915	n = 35
	within		5.459	-16.442	55.956	T = 11

Source: Author.

As for undernourishment, data on the domestic food price and the food prices volatility index were drawn from FAO's database. Domestic food price index is an indicator of the relative price of food in a country. Its computation is based on the 2011's International Comparison Program (ICP) from the World Bank and the consumer price index from the International Labour Organisation (ILO). We also use the FAO's data on agricultural land area and total land area to compute the share of

agricultural land in a country. The agricultural land area is the sum area under arable land, permanent crops, and permanent pastures.

The IFPRI's (International Food Policy Research Institute) datasets on government expenditure in different sectors were used to draw data on the percentage of agriculture expenditure in total GDP of country *i*.

The binary dummy variables for droughts and floods were collected from the International Disaster Database (EMDAT), Centre for Research on the Epidemiology of Disasters (CRED).

Although most of our variables have full data, missing values were observed in domestic price index and government expenditure in agriculture. In order to extract a maximum of information from our data and avoid listwise deletion, we use the recent imputation method for time-series cross-section developed by Honaker & King (2010) to impute missing values of these variables. The purpose is not to recreate the individual missing values as close as possible to the true ones but to handle missing data in a way resulting in the valid statistical inference. The advantage of using Honacker and King's method is that, in contrast to standard methods of imputation applying to survey data, it allows for taking into account the tendency of variables which can move smoothly over time, jump sharply between some cross-sectional units like countries, jump less or be similar between some countries in close proximity, and for time-series patterns to differ across many countries. In addition, the method is based on multiple imputations which, compared to single regression (linear interpolation, unconditional mean imputation...), reflects uncertainty in the imputed values. Missing values are imputed through a bootstrapped Expected Maximum (EM) algorithm.

Table 3 reports the descriptive statistics of the data. It shows that on average, almost one in four people suffer from undernourishment in Sub-Saharan Africa during the years 2001-2011.

5. RESULTS

Table 4 reports the results of the estimation of remittances impact on undernourishment in Sub-Saharan Africa with a spatial error model. It is composed of three columns, with columns 1 and 2 indicating the results of the estimation without natural disasters, and column 2 taking into account natural disasters, namely droughts and floods.

Inspection of table 4 indicates that the impact of remittances on undernourishment is statistically significant in Sub-Saharan Africa. However, nutrition responds merely to an increase of remittances. Indeed, a 10 percent increase in remittances per individual leads to a decrease by only 1.17 percent of the proportion of undernourished in the region. As described in Section 3, in most Sub-Saharan African countries, remittances are greatly devoted to consumption, especially to food purchase. However, increasing food consumption does not systematically lead to a huge improvement of nutrition which depends on the calorie of the consumed foods. This is because food consumption depends on many factors such as taste, appearance, odor, status value or cultural preference (Behrman & Deolalikar, 1987; Banerjee & Duflo, 2011). As argued by Banerjee & Duflo (2011), due to ignorance of the real added value of good nutrition, the poorest who are the ones who suffer the most from undernourishment sometimes choose to consume tasty foods rather than nutrient-rich foods.

Like remittances, the effect of per capita GDP on undernourishment is statistically significant in Sub-Saharan Africa. However, the elasticity is very close to zero. Indeed, a 10 percent increase in GDP per capita leads to a 0.62 percent decrease of undernourishment. This finding supports the literature which underlines that the

elasticity of calorie consumption to income is closed to zero (Behrman & Deolalikar, 1987; Bouis & Haddad, 1992). As described in Section 1, there have been countries that have started to reduce their level of undernourishment well before the growth of their per capita GDP. In addition, countries such as Djibouti, which have had high per capita GDP between 1980 and 2015, have remained for a long time one of the countries with a high level of undernourishment (Figure 1).

One important finding in this study is that the elasticity of calorie consumption to remittances is higher than that of GDP (Table 4). This finding can be explained by the fact that remittances are directly received by families in the home country while the reception of GDP per capita depends on how well income is distributed.

As expected, a high share of agricultural land is significantly associated with a reduction of undernourishment in Sub-Saharan Africa. Indeed, the more is agricultural land, the more is food supply and the less are undernourishment. Credits, as well as private investments, were found to contribute significantly to the reduction of undernourishment in Sub-Saharan Africa. When the share of domestic credits to GDP increase by 10 percent, the proportion of undernourished in the region decreases by 0.65 percent. This result emphasizes the role played by domestic credit (Obilor, 2013) in helping farmers to afford agriculture inputs (fertilizers, tractors...) and improve agricultural production. With respect to private investment, results in Table 4 show that a 10% increase in private investment induces a 0.58% decrease in the proportion of undernourished in Sub-Saharan Africa.

The first column of table 4 shows that official development assistance (ODA) is positively and significantly related to undernourishment in Sub-Saharan Africa. Since this finding might due to a reverse causality between official development assistance and undernourishment, we lagged ODA by one period with the intuition behind it being that current undernourishment can't cause past ODA.

Column 2 shows that ODA has no significant effect on undernourishment when it is lagged by one period. This result raises the question of the effectiveness of aids in fighting undernourishment. According to the literature, there are two theories on the effectiveness of foreign aid: the public interest theory which argues that foreign aids are necessary to fill a financing or investment gap, which in turn will lift countries out of a poverty trap (Sachs, 2005), and a public choice theory which argues that foreign aids are ineffective and possibly damaging to recipient countries (Easterly, 2006; Moyo, 2009). Aid allocation may encourage impoverishing policies since misery resulting from damaging policies leads donors more likely to grant more aid to try and alleviate the impoverished conditions (Williamson, 2010).

Like official development assistance, foreign direct investments (FDI) have no significant impact on undernourishment in Sub-Saharan Africa. Food prices, as well as food price volatility, were also found to have no significant effect on undernourishment in Sub-Saharan Africa.

Likewise, political stability, government expenditure in agriculture, droughts, and floods have no significant impact on undernourishment. The insignificance effect of floods and droughts on undernourishment in Sub-Saharan Africa is not surprising. All the countries in Figure 1 have experienced either a drought or a flood during the period 2000 to 2015. However, only the level of undernourishment in Kenya was affected by these catastrophes (Figure 1).

While droughts and floods have no significant effect on undernourishment in Sub-Saharan Africa, table 4 shows that remittances play a significant role during a period of floods as shown the significant and negative coefficient of the interaction term between remittances per capita and a dummy of floods. This result supports the finding of Combes & Ebeke (2011).

Table 4: Explaining the impact of remittances on undernourishment in Sub-Saharan Africa

	Dependent variable: Prevalence of undernourishment (N=35, T=11)					
	(1)		(2)		(3)	
	β	Elasticities	β	Elasticities	β	Elasticities
Remittances per capita	-0.0697***	-0.1161	-0.0711***	-0.1184	-0.0656***	-0.1093
	(0.0084)		(0.0084)		(0.0087)	
Share of agricultural land	-0.0866***	-0.1879	-0.0921***	-0.2000	-0.0913***	-0.1981
	(0.0324)		(0.0325)		(0.0319)	
Domestic credit (% of GDP)	-0.0503***	-0.0626	-0.0461***	-0.0573	-0.0456***	-0.0568
	(0.0147)		(0.0147)		(0.0144)	
ODA (% of GDP)	0.126**	0.0579				
	(0.0504)					
ODA (t-1)			0.0754	0.0316	0.0635	0.0266
			(0.0493)		(0.0474)	
GDP per capita	-0.0009**	-0.0580	-0.0010***	-0.0654	-0.0010***	-0.0667
	(0.0003)		(0.0004)		(0.0003)	
Private investment (% of GDP)	-0.1382*	-0.1321	-0.1236*	-0.1183	-0.1224*	-0.1171
	(0.0691)		(0.0691)		(0.0672)	
Domestic food price	0.0682	0.0192	0.1085	0.0302	0.1072	0.0298
	(0.3538)		(0.3566)		(0.3445)	
Political stability	0.11	-0.0015	0.1145	-0.0016	0.1292	-0.0018
	(0.7763)		(0.7734)		(0.7522)	
Public spending in agriculture	-0.6419	-0.0371	-0.7282	-0.0383	-0.5469	-0.0316
	(0.5434)		(0.5144)		(0.5328)	
Food price volatility	-0.0660	-0.0370	-0.0498	-0.0279	-0.0560	-0.0314
	(0.0560)		(0.0562)		(0.0552)	
FDI (% of GDP)	0.0097	0.0021	0.0322	0.0070	0.0251	0.0054
	(0.0805)		(0.0801)		(0.0785)	
Drought	1.6088	0.0091	1.6725	0.0095	1.9707	0.0112
	(1.5096)		(1.5224)		(1.5989)	
Flood	0.3484	0.0043	0.3433	0.0042	1.3985	0.0173
	(1.1121)		(1.1185)		(1.1851)	
Remittances x Drought					-0.0085	-0.0018
					(0.0191)	
Remittances x Flood					-0.0375*	-0.0121
					(0.0195)	
Constant	35.7468***		35.865***		35.630***	
Rho	0.556		0.5533		0.5599	
LM Test (Ho : Rho = 0)	9.658		9.6898		9.8897	
R^2	0.2371		0.2296		0.2276	
Ajusted R^2	0.1307		0.1222		0.1147	
Raw R^2	0.8256		0.8237		0.8230	
Ajusted Raw R^2	0.8013		0.7991		0.7971	

*Note: (): Robust standards errors, ***: Significant at 1 % level, **: Significant at 5 % level, *: Significant at 10 % level, W: Exponential distance weights matrix, LM Tests are calculated basing on Baltagi et al. (2007).*

Table 5: Explaining the impact of remittances on undernourishment by income group in Sub-Saharan Africa

Variables	Dependent variable: Prevalence of undernourishment (N=35, T=11)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Remittances per capita	-0.0637***	-0.0687***	-0.0695***	-0.0701***	-0.0702***	-0.0717***	-0.0701***	-0.0676***	-0.0725***	-0.0748***
	(0.0082)	(0.0082)	(0.0082)	(0.0083)	(0.0084)	(0.0088)	(0.0083)	(0.0085)	(0.0089)	(0.0087)
Share of agricultural land	-0.0579*	-0.0906***	-0.0883***	-0.0888***	-0.0897***	-0.0918***	-0.0883***	-0.0878***	-0.0876***	-0.0964***
	(0.0318)	(0.0314)	(0.0316)	(0.0317)	(0.0317)	(0.0318)	(0.0316)	(0.0315)	(0.0321)	(0.0324)
Domestic credit (% of GDP)	-0.0634***	-0.0447***	-0.0459***	-0.0452***	-0.0467***	-0.0459***	-0.0446***	-0.0458***	-0.0461***	-0.0544***
	(0.0149)	(0.0142)	(0.0143)	(0.0142)	(0.0143)	(0.0145)	(0.0142)	(0.0142)	(0.0144)	(0.0150)
ODA (t-1)	0.0859*	0.0491	0.0693	0.0666	0.0681	0.0595	0.0619	0.0636	0.0710	0.0667
	(0.0465)	(0.0474)	(0.0473)	(0.0473)	(0.0473)	(0.0473)	(0.0473)	(0.0469)	(0.0478)	(0.0485)
GDP per capita	-0.0008**	-0.0010***	-0.0010***	-0.0011***	-0.0011***	-0.0011***	-0.0011***	-0.0010***	-0.0010***	-0.0015***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Private investment (% of GDP)	-0.1014	-0.1066	-0.1268*	-0.1231*	-0.1219*	-0.1124*	-0.1069	-0.1158*	-0.1233*	-0.1295*
	(0.0660)	(0.0663)	(0.0667)	(0.0669)	(0.0667)	(0.0669)	(0.0670)	(0.0662)	(0.0679)	(0.0691)
Domestic food price	0.0939	0.1338	0.0731	0.1057	0.0833	0.1567	0.1746	0.1386	0.0887	0.0602
	(0.3345)	(0.3369)	(0.3391)	(0.3410)	(0.3401)	(0.3442)	(0.3407)	(0.3368)	(0.3474)	(0.3602)
Political stability	0.5859	0-.0841	0.0624	0.1479	0.0346	-0.1239	-0.0169	-0.0506	0.0579	0.0269
	(0.7387)	(0.7311)	(0.7387)	(0.7439)	(0.7401)	(0.7425)	(0.7426)	(0.7334)	(0.7515)	(0.7762)
Public spending in agriculture	-0.6929	-0.5657	-0.5088	-0.5634	-0.5106	-0.5051	-0.5648	-0.5923	-0.5103	-0.6019
	(0.5204)	(0.5238)	(0.5275)	(0.5286)	(0.5286)	(0.5308)	(0.5279)	(0.5251)	(0.5338)	(0.5440)
Food price volatility	-0.0734	-0.0551	-0.0569	-0.0549	-0.0535	-0.0597	-0.0540	-0.0610	-0.0557	-0.0642
	(0.0539)	(0.0544)	(0.0549)	(0.0549)	(0.0549)	(0.0549)	(0.0561)	(0.0546)	(0.0557)	(0.0559)
FDI (% of GDP)	0.0497	0.0293	0.0269	0.0269	0.0229	0.0239	0.0264	0.0217	0.0231	0.0282
	(0.0773)	(0.0771)	(0.0778)	(0.0780)	(0.0778)	(0.0776)	(0.0779)	(0.0776)	(0.0787)	(0.0798)
Income group dummy	7.4186***	3.1167*	1.4974	1.6662	-1.5382	-4.7098**	-3.0513	-2.0966	0.4128	2.1485
	(1.9926)	(1.7891)	(1.7989)	(1.9888)	(1.7857)	(1.8199)	(1.8793)	(1.9387)	(2.0274)	(2.7653)
Remittances x Decile 1	0.2415									
	(0.2515)									
Remittances x Decile 2		-0.0535								
		(0.0458)								
Remittances x Decile 3			-0.0389							
			(0.0410)							
Remittances x Decile 4				-0.1383*						
				(0.0791)						
Remittances x Decile 5					-0.0015					
					(0.0226)					
Remittances x Decile 6						0.0126				
						(0.0166)				
Remittances x Decile 7							0.0002			
							(0.0266)			
Remittances x Decile 8								-0.0108		
								(0.0171)		
Remittances x Decile 9									0.0057	
									(0.0156)	
Remittances x Decile 10										0.0412*
										(0.0243)
Constant	33.402***	35.335***	36.154***	36.167***	36.366***	36.233***	35.538***	35.950***	36.059***	37.826***
	(3.9763)	(3.9613)	(3.9756)	(3.9997)	(3.9928)	(4.0186)	(3.9966)	(3.9545)	(4.1164)	(4.1807)
Rho	0.5391	0.5552	0.5509	0.5501	0.5543	0.5543	0.5565	0.5577	0.5489	0.5592
R^2	0.2841	0.2257	0.2216	0.2271	0.2248	0.2360	0.2284	0.2221	0.2244	0.2178
Raw R^2	0.8374	0.8229	0.8218	0.8233	0.8227	0.8253	0.8237	0.8218	0.8226	0.8200

*(): Robust standards errors, ***: Significant at 1 % level, **: Significant at 5 % level, *: Significant at 10 % level. W: Exponential distance weights matrix.*

Inspection of interaction between per capita remittances and income group dummies in table 5 indicates that the impact of remittances is statistically different in the income decile 4 and 10. Moreover, remittances have less effect on calorie consumption in decile 10 than decile 4.

This result can be explained by the fact that, over a certain level of income, household receiving remittances may prefer to devote a high share of the money to others uses, namely education, health, investment, rather than consumption since they have sufficient resources to afford food. For instance, in Niger and Ethiopia, the countries in which the income per individual is low, households receiving remittances spend more than 50% of received money on consumption while those of Kenya and Côte d'Ivoire, two of the countries with high per capita GDP, devote less than 40% of received money on consumption (Section 2). The effect of remittances on undernourishment is also low in countries with very low GDP per capita, decile 1-3, comparing to countries in decile 4. The possible explanation for this finding is that counting the high costs of international migration, individuals in low-GDP countries are less able to migrate and send money thereafter. As shown in table 6, the countries in deciles 1-3 are the most affected by undernourishment and, at the same time, they are the smallest receivers of remittances.

Table 6: Prevalence of undernourishment and remittances per capita by income decile

Decile	Proportion of undernourished	Remittances per capita
1	35.789	5.377
2	29.358	13.124
3	25.861	21.263
4	24.355	16.564
5	23.016	34.868
6	19.334	59.845
7	21.679	34.199
8	20.297	71.575
9	20.043	76.922
10	13.468	55.718

Source: Author.

6. CONCLUSION

The aim of this paper was to highlight the impact of remittances on undernourishment in Sub-Saharan Africa. Our findings reveal that remittances contribute to the reduction of undernourishment in the region. This result is explained by the fact that the money sent by migrants is mainly devoted to consumption in most Sub-Saharan Africa countries. However, the increase in remittances only results in a small increase in calorie consumption. This result supports the literature which argues that calorie consumption reacts very little to an increase in income. Remittances were also found to be a hedge against flood in Sub-Saharan Africa.

The study also controls for others variables that may affect the prevalence of undernourishment. Like remittances, GDP per capita, domestic credit, as well as private investment, were found to contribute to a reduction of the proportion of undernourished in Sub-Saharan Africa. In others words, the more are domestic credits and private investments, the less is undernourishment in Sub-Saharan Africa. The share of the agricultural land area in the total land area also plays a significant role in the reduction of undernourishment in the region. Having a high share of agriculture land enhances the availability of food which can be afforded with a minimum income. This minimum income is provided by the distribution of income, under low inequality of income, and the reception of money from migrants. Regarding official development assistance, our results show that they have no significant effect on undernourishment in Sub-Saharan Africa.

The impact of remittances has also been analyzed in different income deciles. The results show that remittances have a lower impact in lower income deciles and higher income deciles whereas the impact is higher in intermediate income deciles. Since migration is costly, people in low-income countries are less able to sustain it, which leads to low migration in these countries. As a result, remittances are less important in countries of low-income deciles, which are at the same time the countries suffering the most from undernourishment. Regarding the people in the countries of higher income deciles, they spend more money received from migrants on education, health, and investments than on consumption. This explains the low impact of remittances in countries of higher income deciles.

This research contributes more generally towards a broader view of the benefits of the money that migrants send to their home countries. Governments and international organizations fighting undernourishment in Sub-Saharan Africa should take into account these benefits and also encourage domestic credits as well as private investments.

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Impact des transferts de fonds des migrants sur la sous-alimentation en Afrique subsaharienne : analyse à partir d'un modèle spatial

Résumé - Cet article évalue l'impact des transferts de fonds des migrants sur la sous-alimentation en Afrique subsaharienne. Menée sur un panel de 35 pays, l'étude couvre la période 2001-2011. La méthode d'estimation adoptée est celle des moments généralisés sous l'hypothèse de présence d'un coefficient spatial autorégressif. Les résultats montrent que les transferts de fonds des migrants contribuent à une réduction de la sous-alimentation en Afrique subsaharienne. Cependant, l'effet, bien que statistiquement significatif, reste minime. Les résultats montrent également que l'impact des transferts est plus prononcé dans les pays qui se situent dans les déciles de revenu intermédiaire.

Mots-Clés
Migration
Transferts de fonds
Sous-alimentation
Modèle spatial
Afrique subsaharienne