Addressing Poverty and Inequality in the Post 2015 Development Agenda

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Fiscal Space, Poverty and Inequality in Africa

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Abstract

The benefit of growth experienced since 2000 in Africa has not been broadly shared. Poverty fell by only 8.0 percentage points between 1990 and 2010 compared to the targeted 28.3 percentage points by 2015. Although income inequality fell by 4.3 percent between 1990 and 2009, Africa remains the second most unequal region globally after the Latin America and the Caribbean region. Fiscal policies play important roles in reducing poverty and inequality through such instruments as taxes, transfers and government spending. Countries with high fiscal space tend to have lower poverty rates than those with lower tax revenue to GDP ratios. Indeed, fiscal space alone tends to account for 16.5% of changes in poverty reduction. Institutions play an important role in increasing fiscal space in Africa. Countries with increasing participatory, transparent and accountable budgetary process tend to have stronger impact of fiscal space on poverty and inequality reduction. Although 29 countries recorded declines in the distributional effectiveness of their fiscal policies over time, the distributional impact rose by 35% or more in countries such as Angola, Mozambique, South Africa and Togo. This paper calls for enhancing the non-extractive revenues by diversifying revenues sources from the extractive sectors and improving progressive taxation in countries with high fiscal space and high income inequality. Heavy investment in quality and accessible education and health services, and social programs are also vital to reduce poverty and inequality in Africa.

Keywords*:* Fiscal space, poverty, inequality and severity index.

Growth and Development Finance Required for Achieving Sustainable Development Goals (SDGs) in Africa

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Abstract

We estimate the additional investment required to meet the Sustainable Development Goals (SDGs), with a focus on SDG 1 on ending extreme poverty by 2030 as well as alternative scenarios of reducing poverty. Ending poverty will be an insurmountable task. Africa requires a double-digit growth rate of 16.6% per year between 2015 and 2030 to end extreme poverty by 2030, which corresponds to an investment-to-GDP ratio and a financing gap to GDP ratio of 87.5 and 65.6% per annum, respectively. However, the estimates on the required growth rates vary widely across sub-regions and levels of development of individual countries. Countries and sub-regions with low initial poverty levels and higher responsiveness of poverty to income will be able to end poverty with lower growth rates and lower development finance. The paper outlines the potential policy implications of our findings.

Oil and Regional Development in Chad: Assessment of the Impact of the Doba Oil Project on Poverty in the Host Region

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Abstract

In 1999, the Chad Government passed Law No. 001/PR/1999, establishing rules for allocating and managing the expected oil income from the Doba Oil project. The oil producing region's share amounts to 5 per cent of royalties, in addition to other benefits related to its status as an oil producing region, in order to mitigate negative effects from the oil project. This paper assesses the poverty profile in the Logone Oriental region, by combining a double difference estimator with propensity score matching methods. Data from two panels of the Survey on Consumption and the Informal Sector in Chad carried out in 2003 and 2011 show that monetary poverty increased in the oil producing region compared to the control regions. No evidence was found that non-monetary poverty decreased in the oil producing region, as large investments in social infrastructure in the region might have suggested. In addition, it was found that household expenditure for temptation goods increased in this region compared with other regions. Finally, spillover effects were observed — the oil producing region's neighboring regions are more likely to experience poverty. These results cast doubt on the effectiveness of the law and of its replication for newly discovered oil fields.

Commodity Dependence and Human Development

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Abstract

This paper explores the relationship between commodity dependence and human development measured by the human development index (HDI). Commodity dependence negatively affects human development through several channels, including the negative secular terms of trade affecting commodity-dependent developing countries (CDDCs), slow economic growth, high macroeconomic instability, and political instability. The paper finds that although the effect of commodity dependence on human development is negative, on average, this relationship is complex. It changes with the level of dependence as well as the type of commodity a country depends on. This negative effect is strongest in countries where commodities account for more than 60% of total merchandise exports.

Addressing Poverty and Gender Inequality Through Access to Formal Credit and Enhanced Enterprise Performance in Nigeria: An Empirical Investigation

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Abstract

Addressing poverty and gender inequality is one of the fundamental targets of the sustainable development goals. Access to finance, however has been identified as one of the ways to enhance to reduce poverty and gender inequality. The main focus of this study, therefore, is to ascertain the impact of access to formal credit on enterprise performance. The study uses Nigerian Enterprise Surveys data for 2010 to construct a direct measure of credit constraint. From propensity score estimations, the results show that access to formal credit matters and has significant impact on enterprise performance indicators. Firms that are credit constrained have significantly lower output per worker, capital per worker, employment of labour and investment in fixed assets for expansion compared to firms that are not credit constrained. This is more pronounced for women-owned enterprises after adjusting for bias in the estimations and controlling for sampling weights. This suggests that one way to support the growth of enterprises in Nigeria is to make access to formal credit less stringent. Also, government and monetary authorities should support credit expansion policies for medium and small enterprises in Nigeria.

Papers: Selected for the 2015 African Economic Conference

Does the Quality of Schooling Matter? Characteristics of Primary Schools and the Intensity of Child Labour in Senegal

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Abstract

This study analyses the relationship between school quality and child labour in Senegal. Unlike previous research that relates child labour primarily to household poverty, economic shocks and market imperfections, this study assesses that the characteristics of school quality and the households' perceptions of the school as being capable of providing their children with a significant advantage can motivate or discourage them in sending them to work. Using a simple theoretical model, the authors show that the choices of households to their children to school or to work are influenced as much by the quality of the schools as by the characteristics of the child and the household. The empirical results obtained confirm the intuition of the theoretical model developed. They indicate that the choices of the households to send children to work in Senegal depend on the characteristics of the education provided in the different regions of the country. More specifically, the increase in the pupil-teacher ratio and the repetition rate appear to be a signal of the poor quality of primary education of the primary schools. They both lead to an increase in the workload imposed on the child in economic and domestic activities.

Keywords: school quality, child labour, poverty, market imperfections, Senegal

JEL: O12, O15, J08, J13, I25

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1. Introduction

While it has always been recognized that broadening access to education should go hand in hand with improving quality, it is not always easy to reconcile these two objectives in sub-Saharan African countries (UNESCO, 1995). Substantial resource constraints, including financial constraints, have led most countries to choose between extending school coverage and improving the quality of education. Widely reiterated in official speeches, the desire to increase the gross primary enrolment ratios to compensate the countries of the South, especially those of sub-Saharan Africa, for lagging behind in the attainment of the objectives of Education For All (EFA) will, in many cases, favour the expansion of education over the improvement of the quality of education, driven in particular by the recommendations of the World Bank (Niang, 2014). Since the World Education Forum in 2000, the issue of the quality of education has again become a major concern in the implementation of education policies in Africa. The low levels of acquisition of knowledge and the high rates of school drop-out have raised awareness among educational authorities that it is not possible to achieve the goal of universal enrolment and for education to fully play its role if it is not designed to provide learners with the social and economic benefits that they are meant to provide (UNESCO, 2005).[2]

According to the UNESCO Education For All (EFA) Global Monitoring Report 2014, Senegal will not be able to achieve universal enrolment until 2070 (UNESCO, 2014). The hindering factors identified mainly relate to teacher availability and lack of interest for schooling in a certain number of households that prefer to involve their children in alternative activities perceived to be more attractive than their schooling in formal educational facilities (UNESCO, 2014).[3]

Numerous studies in the literature refer to the role of the quality of the school in explaining households' decisions concerning their children's schooling (Alderman, Ozarem and Paterno 2001; Lloyd *et al*., 2003; Glick and Sahn, 2006; Marshall, 2011; Nishimura and Yamano, 2013; Bold *et al*., 2015). Bold *et al*. (2015) show, for example, how negatively the parents react to the poor quality of public schools in Kenya by enrolling their children in private schools, which they consider to be of better quality. Further, Marshall (2011) also shows that school quality, as measured by the characteristics of schools and teachers, contributes to explaining school drop-outs in Guatemala.

[2] Education is seen as a tool for reducing poverty and inequalities, and shaping citizens and for sustainable development, among others.
[3] Non-formal work or education (example of the Senegalese Qur'anic schools, or *daaras*).

Although it is widely recognized that the quality of education and the amount of knowledge acquired essentially depends on the school context (UNESCO, 2005; Marshall, 2011), few studies have envisaged that this was likely to have an impact on households' decisions to send their children to work. Indeed, if households are able to distinguish schools according to their type because they consider this criterion to be the determining factor in explaining educational performance (Glick and Sahn, 2006; Marshall, 2011, Bold *et al.,* 2015), then they are just as capable of deciding on either sending their children right away to work or to school according to their assessment of the advantage that the schools available to them can provide their children (Becker, 1962).

Some authors believe that the results obtained by the students at the end of the standardized assessment are the best tools to assess the quality of the schools (Altinok and Bourdon, 2012). Widely disseminated in developing countries, this information is very often used to establish links between the quality of the school and the behaviour of households (Bayer *et al*., 2007; Gibbons *et al*., 2013). But due to their rareness in the context of developing countries, these tests are not used as much in this type of research (Marshall, 2011). In addition, in the context of developing countries where adult literacy rates are relatively low, it is less likely that parents will refer to this type of information when they assess the quality of the schools and make choices for their children (Rosati and Rossi, 2007; Jacob and Lefgren, 2007; Charmabagwala, 2008; Diagne, 2012; Nishimura and Yamano, 2013).

The purpose of this paper is to examine whether the factors generally adopted to improve the quality of primary education in Senegal influence the decisions of households to send their children to work and determine the intensity of domestic or remunerative work that they make them do. Unlike previous studies that explored the impacts of improved educational conditions on the probability of children working or their work participation rate (Guarcello and Rosati 2007, Kazianga *et al*., 2012; Kondylis and Manacorda, 2012; De Hoop and Rosati, 2014), and that generally do not find any impacts of these variables on child labour (Kondylis and Manacorda, 2012, De Hoop and Rosati, 2014), the quality of school input will be analysed both in terms of children's work participation and the intensity of the work that they carry out.

Choosing to focus on the workload assumed by children and not only their strict participation in the labour market is justified because it is possible that improving learning conditions at school does not mean that the children will simply quit their work (Kondylis and Manacorda, 2012; De Hoop and Rosati, 2014), but rather will reduce the work intensity if this work is seen by the household as a cultural and/or socializing dimension that is

complementary to the formal education Diallo, 2001).[4] Moreover, as concerns light work, it is not strictly the quitting of these activities that is problematic, but rather, the intensity (ILO, 2014). It is the high intensity of the work carried out that is either likely to totally destroy their chances of being educated or increase their risk of being expelled from the school system due to poor academic performance as a result of spending too much energy working (ILO, 2014).

The paper is structured into three sections. The first section briefly describes the evolution of Senegal's education policy from the World Conference on Education for All, held in Jomtien, Thailand in 1990 and the World Education Forum held in Dakar in 2000. The second section seeks to understand, on the basis of a simple theoretical model developed, the mechanisms by which "quality of education" can affect the intensity of work performed by children. It then presents the data of the study as well as the empirical estimation strategy chosen to test the hypotheses of the theoretical model. Finally, the third section presents and comments on the results of the estimates.

2. Background

In Senegal, just as in many African countries, a formal education system coexists with a non-formal education system. Formal education includes several levels of study (pre-school, elementary, secondary, technical, higher education). Non-formal education includes literacy, basic community schools, third-type of schools and Arabic education (Franco-Arab schools, Qur'anic schools, etc.). This section briefly describes the educational policy of Senegal before and after the World Education Forum, held in Dakar in 2000. In particular, it will examine the main measures taken by the Senegalese authorities to improve the quality of education in the elementary cycle, which forms the basis of this analysis.

2.1 Educational policy of the 1990s in Senegal: priority on accessing education

The direction of Senegal's educational policy has, over the years, been influenced by a combination of socio-economic, demographic events and a set of recommendations that emerged from international meetings. Following the Jomtien Conference of the 1990s, Senegal's educational policy was implemented in an environment of structural adjustment programmes. Prior to this period, this policy was highly controversial, which led in 1971 to an educational reform, and then in 1981 to the establishment of the Estates General for Education and Training (EGEF). The EGEFs made it possible to identify the shortcomings in the Senegalese education system and was a decisive turning point in the development of

[4] De Hoop and Rosati (2014) refer to the idea of the non-convexity in the child's time constraint because the improvement in the characteristics of the provision of education generally lead to an increase in the rate of school attendance among children without this resulting in a reduction in the child's work participation rate. Admittedly, this assumption can be ruled out if an additional measure, such as the intensity of children's work performed is taken into account.

the educational policies of the country from the 1990s. These last policies were translated into concrete actions through the implementation of two programmes – *Projet de Développement des Ressources Humaines* (PDRH, Human Resources Development Project) 1 and 2 – financed by bilateral and multilateral cooperation, with the World Bank as its main partner (Guèye *et al*., 2009). The PDRH-1 covered the period from 1990 to 1994 and the PDRH-2, from 1994 to 1998. In their implementation, these programmes, in particular PDRH-2, initially aimed at improving the quality of and access to basic education, which was barred; more than half of the applications were not accepted due to an inefficient management of the educational system, which was overlooked in favour of secondary and higher education. Priority should therefore have been given to making education available at the elementary level to satisfy these demands for education and to raise the level of the gross enrollment rate, which was low at that time (58 per cent in 1992).[5] To achieve this, new primary schools were built and the management of resources already employed was optimized (UNESCO, 1995).[6]

The programme also emphasized the involvement of a larger group of partners (parents, communities, the private sector and non-governmental organizations) in managing schools and building classrooms. It also proposed to increase participation of families and civil society in the financing of primary education (UNESCO, 1995). Despite the will shown in educational policies to improve the quality of primary education at this time, it should be noted that, in practice, the actions, undertaken to make the provision of basic education available to all social strata took precedence over quality. This was reflected in the mediocre performance of pupils in the Education System Performance in Francophone sub-Saharan Africa (PASEC) assessement tests in 1996. What emerged from this assessment was that only one-third of the children had become proficient in French and mathematics (Ngom, 2007).[7] Consequently, subsequent education policies, largely inspired by the recommendations of the Dakar Forum (2000s), would focus more on incorporating more quality into previous measures.

[5] The gross enrolment ratio increased to 65 per cent in 1997/1998.

[6] In order for these resources to be optimized, the very high repetition rates (15 per cent on average) had to be reduced, the degraded classrooms had to be rehabilitated, the system of double-flow classes and multigrade classes at the primary level had to be extended. It was also necessary to recruit teachers with a high proportion of assistant teachers (600 out of the 760 teachers to be recruited each year) who had a lower level of qualification than regular teachers and therefore were less expensive than the latter. It was also necessary to expand the production of teaching materials by setting up a viable school publishing system.

[7] Monitoring Report. Education for All. 2008. Education for All by 2015. Will we make it?

2.2 The emerging concept of quality of education in the educational policy of Senegal following the World Education Forum (Dakar 2000)

In Senegal, the imperative to integrate the quality of education into educational policy was realized in the 2000s through the revision of the education and training policy in order to take into account the 6th objective of the Dakar Framework for Action. The objective of quantitative expansion of the sectoral adjustment programme piloted by the Senegalese education authorities in collaboration with the World Bank prior to 2000 had thus combined with the quality of education. The ten-year Education and Training Programme (PDEF) covering the period 2000-2010 redefined the outlines of the new axes on which the State of Senegal and its technical, financial and social partners had to agree in order to give a decisive impetus to the development of the education system in the decade 2000-2010.

The 2000-2010 PDEF was structured around three main axes: accessibility, quality and management of education. An assessment was performed on each of these axes in relation to the different levels of education, and a set of measures was proposed according to the difficulties that emerged. Concerning access to primary education, the PDEF aimed to increase the gross enrolment ratio to 100 per cent by 2010 (Niang, 2014). The way to achieving this was in line with the actions taken to date.[8]

As part of the actions to be taken to improve the quality of education, the PDEF (2000-2010) indicated a set of parameters on which particular emphasis should be placed. In primary schools, in particular, pupil-teacher ratios had to be reduced to reasonable levels in the high enrolment areas.[9] There was also a need to improve teacher training and to provide career opportunities for voluntary teachers to draw them to the teaching profession and to reduce levels of absenteeism. It was also planned to rehabilitate schools, over 50 per cent of which were in a state of disrepair. There was still a need to ensure better access for pupils to textbooks, reduce repetition rates, revise curricula (teaching programmes), extend school medical coverage, and to analyse the possibilities of using local languages as a medium in teaching.

The resources implemented have allowed to achieve progress on these three strategic axes, since many school indicators have been improved.[10] However, this progress does not reveal

[8] These included the construction and rehabilitation of classrooms and resorting to special forms of teaching to optimize the resources (multigrade classes, double-shift classes, etc.) and recruitment of volunteer teachers, etc.

[9] 40 according to PAQUET (2013:34).

[10] The primary completion rate increased from 49.7 per cent in 2006 to 66.2 per cent in 2011, which was still below the target of 85 per cent set for 2010. The graduation rate from elementary school to midde school reached 90.5 per cent, but declined to 88.4 per cent in 2012. The gender parity index was 1.1 in favour of girls (PAQUET, 2013).

that many children remain in school under precarious conditions (temporary shelters, excessive enrolment) and do not benefit from quality education (Niang, 2014). Assessments conducted as part of the National School Achievement Assessment System (NSSRS) revealed that only 50 per cent of learners in elementary school master the basic skills in the basic disciplines of reading, mathematics and life skills (MFEEF *et al*., 2013:13). Thus, investments in education may be seen as vain efforts by some households, causing them to doubt the value of sending their children to school.

3. The impact of the quality of schooling on the intensity of children's work in Senegal

This section aims to highlight the reasons why parents may choose to send their children to school and/or work by developing a simple theoretical model (2.1). It will show that parents make these choices taking into account the characteristics of the child, the household and the ability of the school to provide a value added to the child with respect to his or her own aptitudes. This theoretical model will guide the choice of the empirical estimation strategy (2.2) that will be chosen to test whether the quality of education influences how parents allocate their children's available time.

3.1 The theoretical model on the influence of the quality of school on the decision of the household heads to divide the total available time of the children between work and school

3.1.1 *The theoretical model*

This model is inspired by that proposed by Card and Krueger (1996) on the relationship between school quality, education and relative gained advantages.

Consider a household consisting of a family comprising two persons: an adult and his or her child. The household head maximizes the utility of his/her family U (C, F (E_{is})) where U is a function of a continuous, increasing and strictly quasi-concave utility, C the consumption level of the household, F the function of the production of knowledge and E_{is}, the time that the child belonging to the household i and attending the educational institution s devotes to his/her studies.[11] The two members of the household have the same allocation of working time, equal to 1. Work is the only factor of production that enters the production of the domestic good.

[11] Or the educational institutions of the area s, as will be the case in this empirical study.

It is also assumed that all markets, especially labour markets, function imperfectly (Bhalotra and Heady, 2003; Dumas, 2007, 2013).[12] Thus, there is no possibility of outside work either for the adult or for the child, and it is impossible for the head of the household to resort to external labour. The adult devotes all his or her time to the production of the domestic good *Q* and decides to distribute the time of the child between the production of this good and schooling (*L* + *Eis* = 1 where *L* is the time devoted by the child to the production of the domestic good). The only variable capable of influencing domestic production is therefore the variation in the labour supply of the child and the preferences of the household. The imperfection of the capital and land markets suggests that the level of household consumption depends only on the level of production of the domestic good and on the amount of transfers received *C* = *Q* (1, L) + *Y*, where *Q* represents the function of the production of the domestic good and *Y* the amount of the transfers received.

It is assumed, moreover, that the function of the production of knowledge has a quadratic form (Card and Krueger, 1996) with a c_i component specific to the household *i* and a component q_s related to the quality of the education in the educational institution *s* (or in the area *s*, as in our empirical model), $F(E_{is}) = q_s E_{is} - \frac{c_i}{2} E_{is}^2$. The specific component c_i can be analysed as capturing the differences in the intrinsic aptitudes of children at school (Becker and Tomes, 1976). The programme of the head of household is therefore:

MaxU (*C*, *F* (*Eis*))

S/C $C = Q(1, L) + Y$ (1)

$$F(E_{is}) = q_s E_{is} - \frac{c_i}{2} E_{is}^2 \qquad (2)$$

$L + E_{is} = 1$

The constraint (1) could be rewritten in the form $C = Q(L) + Y$ because the work provided by the adult is fixed and not liable to vary production; only the quantity of work provided by the child is capable of doing so.

The CPOs of this optimization programme are as follows:

$$\text{If } L = 0,\ (q_s - c_i) \succ \frac{\frac{\partial U}{\partial Q} \times \frac{\partial Q}{\partial L}}{\frac{\partial U}{\partial F}} \qquad (3)$$

[12] This analytical framework best corresponds to a situation in developing countries in which child labour is generally carried out within the family and does not result in explicit remuneration (Dumas, 2007).

$$\text{If } L \succ 0,\ (q_s - c_i) \leq \frac{\frac{\partial U}{\partial Q} \times \frac{\partial Q}{\partial L}}{\frac{\partial U}{\partial F}} \qquad (4)$$

Thus, if the difference between q_s and c_i and is sufficiently high, that is, if the head of household considers that the establishments to which his or her household has access are likely to provide a net gain – calculated by taking into account the specific characteristics of the child and of the household – which is higher than the loss of utility that the household experiences by not involving the child in the production of the domestic good, then it will not send the child to work. In this case, the child's work intensity is zero.

If this condition is not met, that is, if the net benefit provided by the quality of the school is insufficient or just sufficient to offset this loss of utility, then the child will engage in work. When the head of the household considers that the gains from school are insufficient to compensate for this loss of utility, then the intensity of the child's work at the maximum, i.e. the child works full-time.

This simple model provides an interesting explanation of the variety of reasons that can guide the choice of the households to send their children work and determine the number of work hours allocated to them. It illustrates, for example, that households in the same school environment may have different attitudes about the work options chosen for their children. Indeed, if q_s is fixed, attitudes to work can vary widely depending on c_i.

Based on the intuitions of this simple theoretical model, the authors will empirically examine whether the factors generally accepted by the education authorities to improve the quality of education in Senegal have an impact on the households' decision-making on sending their children to work and the workload imposed on them. However, it is first necessary to present the data that will be used to this end.

3.1.2 *Study data*

The data that will be used to test the intuitions of the theoretical model presented above come from the Demographic and Health Survey with Multiple Indicators Senegal (EDS-MICS) 2010-2011. They were matched to the data from the statistical yearbooks of 2010 and 2011 of the Ministry of National Education (MEN) of Senegal. These two types of data are representative of the characteristics of Senegal for the phenomenon studied.

Data were collected in the 14 regions of the country (Dakar, Diourbel, Fatick, Kaffrine, Kaolack, Kedougou, Kolda, Louga, Matam, Saint LYess, Sédhiou, Tambacounda, Thiès,

Zinguinchor). In each region, a distinction was made between rural and urban areas. In total, 8,232 households were surveyed (3,087 in urban areas and 5,145 in rural areas) as part of the 2010-2011 (*Enquête Démographique et de Santé à Indicateurs Multiples au Sénégal* (EDS-MICS, Demographic and Health, and Multiple Indicator Cluster Survey), with children representing 45 per cent of the population of the households targeted by the survey.

The data collected were generally on the economic and demographic characteristics of the populations, their health and level of education, as well as women's and children's nutrition, with a special focus on child labour, detailing the nature of the tasks that they undertake and the number of hours they devote to them. In this study, "child worker" refers to a child of primary school age (7 to 12), who has reported that he or she had been engaged in a household or economic activity during the week prior to the survey.

The statistical yearbooks of the Ministry of Education (MEN) contain regional statistical information on the Senegalese education system for the school years 2009-2010 and 2010-2011. This information includes school population, staff, infrastructure, furniture, teaching materials, results, school meal programmes, etc. and is provided for pre-school, and primary and secondary school.

3.2 Empirical strategy on estimating the impact of the quality of education on the intensity of child labour in Senegal

3.2.1 *Empirical estimation strategy*

The theoretical model developed above intuitively suggests that there is a problem of selection in the relationship to be estimated. Indeed, the decision of the head of the household whether to send his or her child to work and/or school and the available time of the child that he or she allocates are not only conditioned by the characteristics of the school, but also by that of the child (age, gender, school skills, productivity of domestic work, etc.), the household to which the child belongs (age, level of education, access to credit, level of wealth, etc.) and by the preferences of the household (for consumption and for the school). As a result, some unobservable characteristics, related both to school conditions and to the child's characteristics (such as aptitudes) and their households (preferences), can condition their participation in work and make the sample for which the intensity of the child's labour is observed non-random. To take this situation into account, the authors will use, as part of the analysis, the method proposed by Heckman (1976). The selection rule dictated by the first-order condition of the theoretical model is then expressed as follows:

$$L^* = 1\left[\left(q_s - c_i\right) \leq \frac{\frac{\partial U}{\partial Q} \times \frac{\partial Q}{\partial L}}{\frac{\partial U}{\partial F}}\right]$$

This method will be combined with the approach proposed by Card and Krueger (1992) to account for the aggregate nature of the data available on the characteristics of primary schools in Senegal. Indeed, these data are aggregated at the regional level, while the information collected from the EDS-MICS survey is individual data at a lower level than those collected on schools. Thus, modelling the impact of these variables on children's characteristics implies processing information that does not characterize the same statistical units. This could generate inefficient standard deviations for the estimated coefficients (Bessoux, 2007). The econometric model is then formally expressed as follows:

$$L_{1ijk} = \delta_1 + \alpha_1 X_{1ijk} + \theta_{1k} S_{1ijk} XD_{1k} + \gamma_1 D_{1k} + \varepsilon_{1ijk} \qquad (1)$$

$$L_{2ijk} = 1\left[\delta_2 + \alpha_2 X_{2ijk} + \theta_{2k} S_{2ijk} XD_{2k} + \gamma_2 D_{2k} + \varepsilon_{2ijk} > 0\right] \qquad (2)$$

$$\theta_{\mathrm{k}} = \phi + \lambda E_k + \mu \qquad (3)$$

In this model, *i, j* and *k* represent, respectively, the individual level, the household and the area of the household's residence indexes; relationship (1) refers to the equation of the intensity of the child's work and relationship (2) refers to their participation (or not) in work. X and E_k represent, respectively, the vectors containing the explanatory variables related to the characteristics of the child, the household to which he or she belong, and that of the primary schools in the area. S and D are dummy variables that respectively take on the value of 1 when the child goes to school and the value 0 if not, and the value of 1 when it relates to the region *k* and the value 0 if not. L_{1ijk} is the logarithm of the number of hours the child worked (as household work or economic activities) and L_{2ijk} is an indicator of the child's participation in different types of work (household or economic).

Finally, the approach suggested by Linzer and Lewis (2005) will be adopted to account for the potential problem of **heteroscedasticity** of the standard deviations due to the fact that the dependent variables in relation (3) are estimated coefficients.

Taking into account the endogeneity of the variable of interest in the first stage of the modelling and the potential problem of child migration between different areas of Senegal

The time constraint of the child in the theoretical model suggests an inverse causal problem between his/her school participation in the current year and his/her participation in work or even between his /her school participation during the current year and the intensity of work he/she performed / (equations (1) and (2)). To remedy this potential problem, in the Heckman model (1976), the school status of the child during the year preceding the survey will be considered a proxy of his/her school participation during the current year. Not only is the child's educational status at $t - 1$ strongly correlated with his/her school status in t, but it is also unlikely that the child's work situation in year t, notably that the intensity of the child's work in this period would determines his or her school attendance in year $t - 1$. It emerges that 56 per cent of the children reported attending school in the year prior to the survey, compared to 62 per cent of the school year that the survey was administered, the correlation coefficient between these two variables being 0.854. In order to take into account possible migration of children and their parents from one area to another, only those households who claimed to regularly reside in the area concerned were considered.

3.2.2 *Inputs of the quality of education in Sengal and their plausible impact on child labour*

A set of inputs has been recognized by the education authorities of Senegal as likely to significantly improve the quality of schools (MEN, 2003). Most often in studies their importance has been revealed for raising the level of educational attainment achieved by children, in particular, in the elementary school. Indeed, the policies relating to improving the quality of education in Senegal rely on achieving certain standards for each of these inputs and for all schools in this country (MFEEF *et al*., 2013:13). These standards apply equally to health, human resources and material means as well as the pedagogical practices. Shown below are the inputs most commonly proposed in the studies carried out in Senegal for which it is possible to generate indicators that could be used to evaluate the validity of the main hypothesis of this paper. Thus, the authors seek to indicate the channels through which these inputs can potentially influence parents' choices when allocating their children's available time.

The health and school meal programmes

The relationship between health and scholastic achievement is well established. Poor health has been shown to affect assiduity, retention, cognitive development and academic performance (UNESCO, 2005). It has also been shown that malnutrition is detrimental to children's cognitive development and that school meal programmes improve cognitive acquisition, particularly in Senegal (Diagne *et al*., 2013). In addition to directly influencing school performance, when the institutions address health and nutritional problems of children, this may reduce the opportunity cost of education and thus increase school

performance and its relationship to work (Kazianga *et al*., 2012), which can encourage increased investment in child education.

The role of teachers

Many studies have identified the major role of teachers in explaining the levels of acquired knowledge obtained by children (UNESCO, 2005) and levels of educational attainment as adults (Card and Krueger, 1992a). Through its capacity to influence educational performance, the quality of the teacher's work is liable to influence the allocation of the child's available time by the head of household between school and work.

The pupil-teacher ratio is generally considered an indicator of class size. According to the general assumption on this subject, the difficulty in educating children grows with class size (Marshall, 2011). Thus, high pupil-teacher ratios are often perceived by parents as a sign of poor quality education (Nishimura and Yamano, 2013). This may lead them to value less the education provided to children. A distinction is also made in the Senegalese context between the different categories of teachers. Professional teachers have the status of civil servants, unlike voluntary teachers, who receive lower and often insecure wages (Niang, 2014). The latter may be poorly motivated and increase their days of absenteeism (BREDA, 2009), which may also be interpreted by households as sign of the poor quality of education.

Children having school textbooks

Textbooks are likely to affect child labour at least at three levels. First, their cost is a heavy burden for poor households who cannot acquire them and who are at risk of having to remove their children from school and put them to work. Second, the curricula provided by the school are mainly contained in textbooks and are therefore directly liable to affect school performance and its relationship to work. Indeed, it could legitimately be stated that a child who has his/her textbooks is less exposed to academic failure than one who does not have any at all. Finally, a child who has textbooks can continue to learn even outside school hours and avoid the idleness that can motivate the choice of parents to send him/her to work.

The impact of repetition on child labour

As a reflection of the quality of the school, the impact of repetition on child labour can be indeterminate. If the passing of children to the next grade is considered by the households as a sign of the improvement of their productivity at work, it is possible that the children who do not pass to the next grade are therefore relatively less productive, and would be less engaged than the children who passed, notably in economic work. If, on the contrary, households consider failing as a sign of the child's aptitude and use this as a basis for selecting and specializing children in work, taking into account their "comparative

advantages", then children who do not pass are less involved in school activities and more involved in work than those who do pass (MEN, 2004:14).

The decentralization policy

Through its educational decentralization policy, Senegal has chosen to involve the local authorities and communities in school management so that they can own the objective to be achieved, i.e. quality education for all (see Law No. 96-07 of 22 March 1996).[13] While the management of schools by the community began slowly at first, from 2010 onwards their involvement grew considerably. This involvement occurs within the school management committees and parent associations (MEN, 2012). By choosing to involve the population in the management of schools, the State aims, among other objectives, to dispel the prejudices of certain strata of the population with regard to formal education. Many communities continue to regard the school as a thing of "Toubab"(the white man) and as an instrument of cultural alienation (MEN, 2012). Others feel that sending their children to school is a costly investment with no guaranteed achievements.[14] Therefore, greater household involvement in school management may lead to an increased emphasis on workplace education and reduced work intensity for their children.

Operationalization of factors of the quality of education selected in the econometric model

The following table presents the quality of school inputs used in the econometric model. It indicates that, on average, nearly one-third of the children enrolled in the different regions of Senegal have participated in a deworming programme and almost half of whom (49.27 per cent) have benefitted from a school meal programme. Although the average pupil-teacher ratio is consistent with the objective of the Programme for Quality, Equity, and Transparency Improvements in Education (PAQUT), there is a disparity in class size across regions. There are also some disparities in the repetition rates at the regional level. The availability of textbooks and the involvement of households in the management of schools are also not uniform across regions.

[13] This law assigns competences in the field of education to the regions, communes and rural communities so that the populations will be responsible for their own destiny.

[14] "*Am sããs mo gën am lisããs*", i.e. the products of the school no longer constitute the reference.

Table 1: Description of the quality of school inputs used in the econometric model

Variables	Average	Standard deviation
% of dewormed pupils	0.3473	0.4690
% of students who have benefitted from a school meals programme	0.4927	0.3100
Pupil-teacher ratio	32.8995	4.9592
Average number of professional teachers per school	5.4539	3.2212
Average number of voluntary teachers per school	1.8443	0.9641
Text book ownership index	1.84e-08	2.9229
Decentralization index	1.03e-08	1.3035
Repetition rate per region in 2009	0.0604	0.0308

Source: Authors' calculation based on data from the statistics yearbook of the Ministry of National Education.

4. Results of estimations and discussions

This section presents and analyses the main results based on the econometric model described above. In the presentation of these results, the focus is placed on the main objectives of this research, which consists in understanding the impact of the quality of school inputs on the decision of households to send their children to work and/or the intensity of work performed. It covers three points. Point 3.1 presents the impact of the individual characteristics of the child and the households on deciding whether to send the child to work and/or to school. Points 3.2 and 3.3 examine the impact of factors of the quality of education on the participation of children in work and on the intensity of the work performed.

4.1 Impact of the characteristics of the child and the household on the participation and/or the intensity of the child's work

In general, the probability of a child being engaged in domestic work as well as the intensity of the work performed decreases together with the age of the head of the household. However, this variable does not seem to influence either the choice of households to engage children in economic activities or the intensity of these activities. On the other hand, an improvement in the education level of the head of the household tends to reduce the

likelihood of the child being involved in domestic work or economic work. Even when performing domestic chores, children work less intensely when the head of household is better educated. This result is consistent with the findings of Ray (2000), that is, the probability of working children in Peru and Pakistan decreases with the number of adults educated in the household.

Also, children's likelihood of being engaged in economic activities and domestic work, as well as the intensity of the work they perform in the latter type of activity, seem to increase with their age. The sex of the child also seems to be decisive in assessing the nature of the activities entrusted to him or her. While boys have a higher probability of being engaged in economic activities, girls have a higher probability of being engaged in domestic work. And when boys and girls are forced to do household chores, girls work longer than boys.

Depending on the nature of the household assets, it appears that owning agricultural land and/or livestock and/or traction animals increases the likelihood that children will be involved in economic work but, in general, has no effect on the intensity of the work performed.[15] This situation confirms the hypothesis of Senegal's market imperfection, especially that of the labour market, which was the framework of analysis in which the theoretical model was realized.

In addition to increasing the probability of children being engaged in domestic work, household ownership of livestock increases the intensity of household chores by children. This is also true in households with traction animals.[16] These two results suggest that there is a kind of substitution between adults and children in domestic and economic activities when the household holds one and/or the other of these types of assets. Adults are more engaged livestock keeping and animal traction work and children in household chores.

Again, contrary to the theoretical studies that consider that households' access to credit is likely to reduce child labour and promote their schooling, it emerges that, as in Islam and Choe (2013), children from households where at least one member is affiliated with a tontine and /or has a bank account have a stronger probability of being engaged in economic work. These results can be explained by the fact that in many cases, households' access to credit or microcredit does not allow them to set up activities that are profitable enough to hire adult workers. The labour market imperfection offers another plausible explanation for this

[15] However, children engaged in economic activities who come from households who own draught animals worked less intensely than those who were engaged in the same type of activity but whose parents did not own such animals.

[16] The ownership of this type of property has no effect on the likelihood of children being engaged in domestic work, but nevertheless, the working hours of children from households with draught animals are longer than children belonging to households that no not own such animals.

phenomenon, especially in the agricultural sector, where the synchronicity of labour needs due the seasonality of the activities may prevent households from engaging in labour exchanges and lead to a rationing in labour supply (Dumas, 2013).

It should be noted, however, the child workers from households with at least one member who is a participant in a tontine or has a bank account, work less intensely than children belonging to households in which no member is a participant in a tontine or has a bank account. Access to credit, therefore, seems to reduce the intensity of child labour.

4.2 The impact of factors of the quality of education on child participation in work

School characteristics of different regions of Senegal do not generally appear to influence the likelihood of children to be strictly engaged in household chores (see Table 3). This result seems logical in that in most regions (except in Kaffrine / urban and in Tambacouda / rural, where school children have a lower probability of being involved in domestic work), especially in rural areas, primary school children have the same probability of being involved in household chores as children who did not attend school. In some areas such as Kaolack/urban, Kedougou, Kolda / rural or Matam/rural, school children have even been more likely to participate in this type of work.

Regarding economic work, in many areas, the school seems to have a negative effect on the probability of children who attended during the academic year 2010-2011 to be engaged in this type of work. Children attending primary schools in rural areas, have recorded in almost all regions of the country, a lower likelihood of being in economic work than those who had not attended school.[17] In contrast, in most urban areas, children enrolled in primary education have the same probability (Dakar/urban, Diourbel/urban, Kaffrine/urban, Louga /urban, Matam/urban, Saint Lyess /urban) or higher (Sédhiou/urban) of being engaged in economic work than those who have not attended school.[18] In Kolda/rural, children's attendance at school seems to have increased their likelihood of engaging in economic activities compared to out-of-school children. However, no quality of school input selected as part of this study seems to have had any influence on the decision of parents to strictly involve their children in one or the other of these activities (see Table 2). These results are consistent with findings from comparable studies (De Hoop and Rosati, 2014).

[17] In nine out of 14 rural areas, school children have a lower likelihood of being engaged in economic activities than those who are not.

[18] Kédougou / rural, Sedhiou / rural, Saint Louis rural and Zinguinchor / rural, school children have the same probability of being engaged in economic activities as those who are not.

Table 1: Impact of factors of the quality of education on children's participation in domestic activities

VARIABLE θ_{1k}	School meals (1)	Deworming (2)	Pupil/teacher (3)	ENS. PROF/ÉCO. (4)	ENS. IND/ÉCO. (5)	Textbooks (6)	DÉCENT. (7)	Repetition (8)
	-0.0151	0.0414	0.0022	0.0109	0.0614	0.0055	0.0277	-1.7009
	(0.2389)	(0.3654)	(0.0059)	(0.0110)	(0.0591)	(0.0183)	(0.0318)	(1.5135)
Control of the household residential area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control of regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.45	0.46	0.46	0.50	Yes	0.46	0.49	0.51
N	28	28	28	28	28	28	28	28

Note: The values in parentheses represent the standard deviations, and *, **, *** refer to significant values of 10 per cent, 5 per cent and 1 per cent, respectively.

Source: Authors using data from the EDS-MICS 2010-2011 of Senegal and data from the Ministry of National Education (MEN) statistical yearbook

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Table 2: Impact of factors of the quality of education on children's participation in economic activities

VARIABLE θ_{1k}	School meals (1)	Deworming (2)	Pupil/teacher (3)	ENS. PROF/ÉCO. (4)	ENS. IND/ÉCO. (5)	Textbooks (6)	DÉCENT. (7)	Repetition (8)
	0. 1745	-0.1606	-0.0055	-0.0130	-0.0292	0.0167	-0.0002	-1.1148
	(0.1602)	(0.2812)	(0.0046)	(0.0089)	(0.0470)	(0.0137)	(0.0262)	(1.1288)
Control of the household residential area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control of regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.49	0.46	0.50	0.55	0.46	0.50	0.45	0.48
N	28	28	28	28	28	28	28	28

Note: The values in parentheses represent the standard deviations, and *, **, *** refer to significant values of 10 per cent, 5 per cent and 1 per cent, respectively.

Source: Authors using data from the EDS-MICS 2010-2011 of Senegal and data from the Ministry of National Education (MEN) statistical yearbook.

4.3 Impact of factors of the quality of education on the intensity of child labour

In some areas, schoolchildren tend to be less involved in economic activities than out-of-school children (Kolda/rural, Louga/urban, Matam/urban, Saint LYess).[19] However, in Kolda /urban primary school children in 2010-2011 showed a higher probability of engaging in economic work than out-of-school children and worked more intensely on average than out-of-school children. But more often than not, children who have attended school have been just as intensely involved in economic activities as those who have not attended school.

Similarly, it appears that children enrolled in most of the regions of Senegal have been generally involved in domestic work less intensely than out-of-school children. Although there has not been an effect on the probability of being engaged in domestic work, it has been observed that in many regions (Dakar/urban, Diourbel/urban, Fatick/urban, Kaolack/rural, Kedougou /urban, Kolda/rural, Matam/urban, Saint LYess, Tambacouda/rural) children enrolled in primary school in 2010-2011 devoted less time to household chores than that assigned to out-of-school children. In only two areas (Sedhiou / Urban and Thiès / rural) have schoolchildren had to engage domestic work for a longer period than did out-of-school children. In all other areas, it was found that children enrolled in primary school worked as intensely as those who did not attend school.

Although the quality of education inputs were not determinative in predicting children's involvement in economic and household activities, some school-related characteristics influenced the choice of households in terms of intensity of the work they have done to their children. Column 3 of Table 4 indicates that the pupil-teacher ratio was a sign that parents referred to in deciding the intensity of the economic work entrusted to their children.

[19] This is true even in Kolda /rural where children who attended school during the academic year 2010-2011 were more likely to be engaged in economic activities.

Table 2: Impact of the quality of education on the intensity of economic activities performed by children

VARIABLE θ_{1k}	School meals (1)	Deworming (2)	Pupil/teacher (3)	ENS. PROF/ÉCO. (4)	ENS. IND/ÉCO. (5)	Textbooks (6)	DÉCENT. (7)	Repetition (8)
	-2.5444	0.7436	0.1018**	0.0740	0.2022	-0.1419	0.0424	1.4801
	(2.2255)	(3.5979)	(0.0503)	(0.1182)	(0.6438)	(0.1783)	(0.3137)	(14.9318)
Control of the household residential area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control of regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.51	0.46	0.57	0.48	0.46	0.48	0.46	0.46
N	28	28	28	28	28	28	28	28

Note: The values in parentheses represent the standard deviations, and *, **, *** refer to significant values of 10 per cent, 5 per cent and 1 per cent, respectively.

Source: Authors using data from the EDS-MICS 2010-2011 of Senegal and data from the Ministry of National Education (MEN) statistical yearbook.

Table 3: Impact of the quality of education on the intensity of domestic activities performed by children

VARIABLE θ_{1k}	School meals (1)	Deworming (2)	Pupil/teacher (3)	ENS. PROF/ÉCO. (4)	ENS. IND/ÉCO. (5)	Textbooks (6)	DÉCENT. (7)	Repetition (8)
	-0.4455	0.0934	-0.0047	0.0054	0.2149	0.0327	-0.1127	7.4106**
	(0.5600)	(0.9065)	(0.0148)	(0.0298)	(0.1418)	(0.0437)	(0.07270)	(3.0597)
Control of the household residential area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control of regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.77	0.76	0.76	0.76	0.80	0.78	0.79	0.84
N	28	28	28	28	28	28	28	28

Note: The values in parentheses represent the standard deviations, and *, **, *** refer to significant values of 10 per cent, 5 per cent and 1 per cent, respectively.

Source: Authors using data from the EDS-MICS 2010-2011 of Senegal and data from the Ministry of National Education (MEN) statistical yearbook.

As expected, a marginal improvement only in this ratio seems to be perceived by households as an indicator of the poor quality of education. This poor quality of education increases the workload of children engaged in economic activities by about 0.10 per cent. Similarly, pedagogical practices and the rate of repetition in particular influence the allocation by parents of the time available for their children with regard to household chores. More specifically, the results show that a marginal increase in this rate tends to increase the intensity of household chores by about 7 per cent (Table 5, column 8). Consequently, it seems that repetition is the basis of households' decision whether to send their children to school or engage them in household chores.

Thus, the current educational policies in Senegal that are aimed at improving the quality of education by reducing the repetition rates and reducing the number of pupils per teacher, although not likely to affect the strict participation of children in work, are compatible with a regression in labour intensity and are likely to reinforce academic achievement.

5. Conclusion

This study aimed to identify the links between the quality of school inputs and child labour in Senegal. This paper contributes to enrich the existing literature on this subject in at least two ways. First, it provides a plausible explanation for previous findings that there is no impact of these inputs on the strict involvement of children in work because, to some extent, this activity can be considered by parents as a complementary activity to formal education.

Second, it goes beyond previous studies by discovering that, even if there is no quality of school input that reduces the strict participation of children in work, some inputs, such as the pupil-teacher ratio and the repetition rate, affect work intensity, i.e. the time the children devote to it. The results also indicate that the imperfect functioning of markets, especially land and labour, contributes to increasing the likelihood of children being engaged in work, especially in economic activities. And parental access to credit helps to alleviate the intensity of work carried out by children. These results draw attention to the need to improve the quality of educational services provided to the populations and to reinforce the policies already implemented by the Senegalese State in order to improve the quality of education. However, care must be taken to ensure that these public interventions contribute to equitable access to quality education for all. Although at the national level, indicators appear to be satisfactory, at the regional level, there are often significant disparities in the provision of educational services to populations. In addition to positively influencing academic achievement, as several studies have already revealed in Senegal, these interventions are also likely to reduce the workload of children, thus freeing time for them to play or review their lessons.

However, this paper neglects an equally interesting aspect that deserves to be taken into consideration and that can also explain the reasons why households send their children to work and/or to school. These are the expectations that parents have of what they will gain in the future by investing their children-s education. These gains are generally dependent on labour market conditions, and in general, households cannot influence them.

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The Nexus of Economic Growth, Inequality and Poverty Reduction: The Role of the Cameroon Labour Market[1]

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Abstract

This paper aims to provide policymakers with an insight into a framework for decision, which is needed to effectively reduce poverty and its monetary and non-monetary dimensions. Specifically, use is made of an exact decomposition analysis that anchors on the Shapley value method, and which investigates the growth and redistribution effects as well as changes due to mobility and sector-specific effects of the variation in both income and non-income poverty dimensions. Growth in mean consumption and household assets accounted for the bulk of the improvement in poverty reduction and the results complement the evidence obtained from the "sectoral decomposition" of poverty in Cameroon, which may indeed have a strong bearing on the sectoral shares of poverty. The redistribution effect had an ameliorating tendency in household asset deprivation among farming households.

Keywords: Growth, inequality, poverty reduction, labour market, Cameroon
JEL: O11, O15, O55, P23

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1. Introduction

In recent times, the drive to eradicate extreme poverty in developing countries has become more urgent given the need to attain the United Nations Millennium Development Goals (MDGs). Many countries in the developing world, including Cameroon, have not been able to achieve these objectives: recent MDG Progress Reports on Africa (e.g. African MDG Report 2014) show that the region is on track to meet only two of the eight MDGs — the goals related to universal primary education and gender parity at primary level of education. In contrast, insufficient progress has been made with respect to the poverty and hunger goals. The limited inclusiveness of economic growth, low growth and inequality elasticity of poverty are key factors in explaining the slow progress on these particular goals. The environment and health goals are the least likely to be met even, though some appreciable progress has been recorded in recent times.

In Cameroon, between 1996 and 2001 the incidence of poverty retreated by 13.1 percentage points, the depth by 5.1 points and severity by 2 points. In 2007 the incidence, depth and severity of poverty stood at 39.9 percent, 12.3 percent and 5 percent respectively (National Institute of Statistics, 2008). Poverty affected rural areas more acutely than urban areas. A similar situation occurred regarding inequality.

Growth is traditionally considered to be the main engine for poverty reduction. The 2003 Poverty Reduction Strategy Paper (PRSP) and the 2009 Growth and Employment Strategy Paper (DSCE) show that the Government of Cameroon had made poverty reduction its main priority. With the third Cameroon household survey (2007) reporting the poverty rate at 39.9 percent (higher than the objective of 37.1 percent set by the government in the PRSP), only real growth in excess of 5.7 percent from 2009 onwards could have enabled poverty to be halved by 2015 (INS, 2008).

Economic growth in Cameroon had been irregular from 1960 to 2007 (Kobou et al., 2008). Table A1 in the appendix describes the growth path of the country in terms of sector contribution. The growth achieved between 2001 and 2007 was mainly driven by the service sector, with telecommunications growing at more than 25 percent per year. These performances led to a modification of the GDP structure, with the sector growing from 40 percent of GDP in 2001 to more than 45 percent in 2007. The contribution of this sector to growth was greater than that of the primary and secondary sectors combined. The secondary

sector, with an annual growth rate of 0.2 percent, was held back by the petroleum sector and the weak performance of the manufacturing sector. Despite the multiplication by four of crude oil prices between the end of 2003 and 2007, extractive industries witnessed a negative growth rate (-4.4 percent on average per year) due to the fall in petroleum production. Meanwhile, the manufacturing sector was witnessing take-off problems because of difficulties linked to infrastructure, the low level of demand, imperfections of the credit market and the low competitiveness in the subregional market (National Institute of Statistics, 2008). As for the primary sector, where the greatest numbers of poor assets are found, it registered 3.9 percent average annual growth.

The simultaneous occurrence of positive growth and stagnating poverty would imply that inequality increased significantly. Surprisingly, this was not the case; inequality dropped marginally over the whole period. The growth rate recorded during the period did not widen inequalities; on the contrary, inequalities reduced over a long period, as was seen in the drop of the Gini index during the 1996-2007 period. In fact, this index that stood at 0.416 in 1996, dropped to 0.404 in 2001 and then to 0.390 in 2007. It is, however, interesting to note that inequality reduced more sharply in urban areas, with a lower Gini index in 2007 than that of the national level; unlike in 1996 and 2001. It is doubtful whether programmes that had been conceived in the primary sector to improve the incomes of rural populations through an increase in agricultural output as well as the growing service sector translated into welfare improvements. Generally speaking, living and housing conditions have improved to some extent, in terms of some non-income indicators. Based on Table A2 in the appendix, there are indications that there were significant improvements and catching up in non-income indicators, such as primary school enrolment, use of good drinking water, child health, improved sanitation etc., between 1990 and 2008.

Since households get their basic income from some form of economic activity, information regarding the labour market takes on a special meaning for the study of living conditions and the informal labour market is of particular concern.[2] It would be necessary for policymakers to go beyond the question of whether the rates of growth or changes in these income and non-income indicators have been higher for some members of society than others, and indeed to ask whether some members of society have failed to reap any growth at all.

[2] Employment is widely perceived to be among the most important channels through which growth may translate into poverty reduction. This is especially important when these households have few assets to depend upon.

In Cameroon, the labour market is characterized by the preponderance of the informal sector: the rate of informality stood at 90.5 percent in 2010, compared with 90.4 percent in 2005. The structure of employment by institutional sector shows that the agricultural informal sector is dominant, employing 53 percent of active occupied persons, followed by the non-agricultural informal sector (37.5 percent). The formal private sector employs only 3.7 percent of this population and the public sector 5.8 percent. With regards to the sector of activity, more than half (53.3 percent) the active occupied persons are employed in the primary sector. The industry sector employs 12.6 percent of active persons, while the tertiary sector employs 34.1 percent of workers (11.1 percent in trade and 23 percent in the services) (National Institute of Statistics, 2011). Generally the service and, to a small extent, industrial sectors host the formal sector workers (public and private). The majority of informal sector workers are in agriculture, the primary sector or the trade sector. For the trade sector, they include non-agricultural bosses, non-agricultural self-employed workers and informal sector waged workers.

Great efforts have been made in the past concerning the labour market and poverty reduction in Cameroon (The World Bank, 1995; Abessolo, 2001; Abessolo and Ebollo, 2003; Njinkeu et al., 1998; Merceron et al., 2007; Epo and Baye, 2012; Baye, 2004, 2006a; 2006b; Fambon et al., 2010; National Institute of Statistics, 2002; 2008). Several other studies attempted to link poverty, inequality and growth (Government of Cameroon, 2003; Baye, 2006a; 2006b; Baye and Khan, 2008; Fambon, 2010). Baye and Khan (2008) found that in urban areas, the effects of growth and inequality in accounting for the fall in urban poverty were greater than their corresponding effect in the rural areas.

Knowledge on how poverty varies by socio-economic characteristics such as employment status, occupation and activity sector is vital for policy, but unfortunately still under-explored in Cameroon. Such poverty variation must take into account poverty as measured by income and non-income dimensions of deprivations, such as access to public goods and household assets. Against this background, this study explores how different forms of employment are related to poverty and to poverty reduction in Cameroon. The ensuing objective is to empirically determine the role and importance of the labour market in the poverty-growth-inequality relationship. Specific objectives are to: (1) determine the nature of income and non-income pro-poor growth in the labour market; (2) decompose the Foster-Greer-Thorbecke (FGT) class of poverty changes into growth and redistribution effects on one hand and into constituent parts that indicate intrasectoral gains versus intersectoral shifts in

population on the other hand, using the Shapley value theoretical framework and; (3) formulate policy recommendations on the basis of the findings. The rest of the study is organized as follows: section two discusses and provides some evidence of linkages between economic growth, poverty and inequality. Section three presents a review of empirical literature on labour market and poverty reduction, while section four provides the data and discusses the method of analysis. Section five presents the findings of the study, before section six concludes the study with some policy issues.

2. Growth, inequality and poverty reduction

A number of studies have determined that inequality plays an important role in the income-growth poverty relationship (e.g. Ravallion, 1997; Bourguignon, 2003; Adams, 2004; Fosu, 2008). Growth has traditionally been considered the main engine for poverty reduction. However, achieving high overall income growth can be one important way of achieving high income growth for the poor, but only if the poor are able to share in this growth. Even in such situations, the income growth of the poor will be higher if that growth is accompanied by pro-poor distributional change — in other words, a reduction in inequality. Such reductions in inequality immediately raise the incomes of the poor, and they are also expected to permanently increase the poverty impact of future growth and to help promote overall income growth in many circumstances. Thus, it is empirically demonstrated that an increase in inequality limits growth and benefits allocated to the poor, as well as their capacity to actively participate in the economy and support growth (Thorbecke and Charumilind, 2002; Nissanke and Thorbecke, 2005). Therefore, not only high and broad-based growth, but also pro-poor distributional change, can be powerful drivers of pro-poor growth to effectively fight poverty.

The critical role of income distribution in poverty reduction is spelled out in great detail in the seminal studies of Datt and Ravallion (1992) and Kakwani (1993), inter alia. To further underscore the crucial nature of inequality in the poverty growth relationship, Fosu (2008, 2009, 2010a, 2010b, 2010c) derived and estimated an analysis of covariance and other interactive models. The first four of these studies are on African economies, while the last one employs a global sample of developing countries. The results from the studies provide further support for the important role of inequality in the poverty growth transformation. Although they find that decreasing inequality tends to be poverty reducing generally, the studies also observe that in certain cases, a perverse outcome might emerge. In very low-income

countries, for instance, reducing inequality could actually raise poverty, mainly because more individuals, especially those on the margins, are likely to fall below the poverty line due to such policy action (Fosu, 2014).

For these countries, therefore, the inequality elasticity of poverty could actually be negative. Such a finding further reinforces the notion that a country-specific approach, guided by a more general framework, be pursued. The nature and response of the labour market in the above interactions is important. Firstly, in the context of examining the inequality-growth relationship, labour-demand responses during the growth episode of an economy will often shape and influence the private distributional consequences of growth. A typical example of this response on the basis of cross-country evidence has been the advent of skills-biased shifts in labour demand, where domestic economies have witnessed a disproportionate increase in the demand for skilled, relative to unskilled, workers during periods of economic growth. The non-neutrality of response to economic growth in the occupational labour-demand function is critical to understanding how economic growth can, and does, have distributional and poverty consequences. Lastly, it is entirely possible that high levels of initial income inequality are in large part located within the labour market. Put differently, high levels of initial wage inequality in a society may be precisely the labour-market expression of how initial income inequality impacts on growth-poverty elasticities. Labour-market-driven wage and income from the formal as opposed to the informal economy, for example, may be the key determinant of initial income inequality in a society.

3. Employment, growth and poverty reduction: A brief review

The level of employment, quality of jobs and access by poor individuals to decent earnings opportunities is crucial in determining poverty reduction. Unfortunately, there is insufficient research on how employment relates to poverty reduction.

Studies have demonstrated that the sectoral pattern of growth will affect the extent of poverty reduction (Loayza and Raddatz, 2006; Islam, 2004). At the country level, Ravallion and Datt (2002) link sectoral value added growth to poverty changes in India. They find that growth in agriculture helped reduce poverty, while growth in the manufacturing sector had not been pro-poor. Elsewhere, Loayza and Raddatz (2006) present cross-country empirical evidence that analyses, firstly, the differential poverty-reducing impact of sectoral growth at various levels of disaggregation, and, secondly, the role of unskilled labour intensity in such

differential impact. In trying to understand why the growth of some sectors contributes to poverty alleviation more than growth in others does, one explanation is that a sector's labour intensity determines its impact on poverty reduction, even in the presence of free labour mobility. Thus, the nature of production methods within the sector is viewed as the portal linking the labour markets, growth and poverty reduction.

Other studies provide opposite views concerning the contribution of agriculture to poverty, implying that under certain conditions the effectiveness of growth in reducing poverty may be hampered. For instance, Satchi and Temple (2006) show how dualism (created by frictions rather than by institutionally set wages) may play an important role in how the growth pattern translates into rises in employment and wages, and that while growth in agriculture potentially increases poverty, urban growth reduces poverty. Other policy-oriented research has reached similar conclusions. For example, a World Bank (2005) study on 11 countries found evidence that access to non-farm rural employment and informal urban employment eased the poor's participation in the growth process.

Furthermore, other papers have concentrated on understanding the role of employment or productivity in shared growth. The World Bank (2005) found that in three of the 14 countries studied, pro-poor growth was associated with more labour-intensive growth. In a related analysis, Islam (2004) uses a cross-country sample of 23 developing countries to find out whether the employment intensity of growth in manufacturing contributes to explaining poverty reduction, but finds that results are not robust to the inclusion of per capita GDP growth. Prasada Rao et al. (2004) find that the significance of output per worker in explaining poverty reduction is not robust to the inclusion of the log of GDP per capita, or the estimation period.

Kakwani, Neri and Son (2010) make two important contributions to the literature, the first being a new measure of pro-poor growth. This measure provides the linkage between growth rates in the mean income and income inequality. The second contribution develops a decomposition methodology exploring linkages between three dimensions; growth patterns, labour-market performances, and social policies. Other studies have also determined the extent to which growth is associated with changes in employment (the quantity of jobs) or productivity (the quality of jobs), and the relationship between these changes and poverty reduction (Coxhead and Warr, 1995; Fane and Warr, 2002; Datt and Ravallion, 2002).

In relation to the new line of enquiry, where the distributional effects of growth are taken into account in trying to locate the potential role of the labour market in poverty reduction, Gutierrez et al. (2007) attempt to supplement the analysis of labour intensity and sectoral growth patterns with a more nuanced assessment of how demographic shifts in general, and labour supply and labour mobility in particular, may be important in understanding

Generally, it is important to note that most of the existing studies point to the fact that the sectoral growth pattern and its employment and productivity profile matter for poverty alleviation. The notion of segmented labour markets needs to be properly handled. Segmentation can occur along different lines: by economic sector, formal or informal.

Secondly, the idea that an initial unequal distribution of income and endowments will modulate both the level and nature of sectoral employment creation and therefore economic growth is important. For example, it may be the case that the pattern of agricultural growth and employment creation, while labour-intensive in nature, does not necessarily lead to significant reductions in poverty given an initial unequal distribution of land ownership. Contrary to most studies, we thus extend the analysis, focusing not entirely on the income dimension of well-being but also on non-income dimensions of poverty. We pay closer attention to how the nature of labour-market responses to poverty reduction are intermediated through impacts on the distribution of income and the relative importance of mobility between sectors and sector-specific effects.

4. Data and methods of analyses

4.1 Nature of data

In order to better understand growth-labour-market dynamics, Cameroonian Household Surveys conducted in 2001 and 2007 with sample sizes of 10,992 and 11,392 households respectively were used, since they were broadly comparable in design, sample size and methodology. In the data sets, we selected a range of questions relating to expenditure information and monetary variables.

For purposes of inter-temporal harmonization to render both data sets more comparable, the nominal incomes or expenditure obtained from the survey were converted or deflated into real values using the national consumer price index. The year 2007 is considered as the base year and a deflator of the consumer price index for each year is obtained by dividing every

consumer price index by the 2007 consumer price index. Household expenditure per adult equivalent for each year is then divided by the corresponding estimated consumer price index deflator. These consumer price indexes were obtained by calculating the geometric mean of monthly consumer price indexes for the months in which the 2007 and 2001 surveys were conducted. The results were 195.60 and 177.75 for 2007 and 2001 respectively, relative to a base year of 1996. For the non-income measures of poverty such as household asset endowments computed from both household consumption surveys, we also render them more comparable by pooling or merging them before running the polychoric principal component analysis. This implies that for the two years, the same weights are used to construct non-income welfare composite indices, thus rendering them comparable over time (2001 and 2007).

5. Method of analyses

5.1 Measurement of well-being and polychoric principal component analysis (PCA)

The indicator used to measure household welfare is the annual household average consumption per consumption unit standardized by a cost-of-living index or expenditure-per-adult equivalent. As concerns the non-income dimension, it is now generally accepted that well-being and poverty are multidimensional concepts, and cannot be measured adequately by a single indicator (Sen, 1988). The case for looking at the incidence of growth in non-income indicators is therefore strong (OECD-DAC, 2004).

To obtain a measure of non-income dimensions of well-being, we constructed composite indices on household assets to reflect household access to a range of physical assets and services, including human capital, by using the polychoric principal component analysis (PCA) method. The polychoric PCA technique is especially appropriate for discrete data (binary and ordinal). The primary critique that can be raised for the PCA method is that the use of dummy variables in the PCA is not justified: it is only suitable for continuous data. It was developed for the samples from multivariate normal distribution (Hotelling, 1933; Anderson, 2003; Mardia et al., 1980), and most of the theoretical results, including the implicitly used consistency of the estimates of the factor loadings, were derived under the normality assumption (Kolenikov and Angeles, 2009). If there are several categories related to a single factor, such as access to hygienic facilities or the materials used in roofing, dividing the variable into a set of dummy indicators or binary options as suggested by Filmer and Pritchett (2001) leads to poor results. Given that the variables used in this study are not continuous, Pearson's correlation principle

does not produce adequate results. This correlation is replaced by the polychoric correlation adapted to categorical variables obtained via the polychoric PCA (Kolenikov and Angeles, 2009). The detailed method on how to calculate the polychoric correlations using the maximum likelihood method is discussed in Olsson (1979).

Modalities used to construct the indices are defined at both the individual and household levels and Table 3 of the appendix indicates how variables used to construct the various indices dictate welfare. Indices computed at the individual level were summed and collapsed across households to obtain aggregate score at the household level. The various indices were normalized to be between 0 and 1 by subtracting the individual value from the minimum value observed in the data set then dividing by the range to address the problem of difference scales of the values. The indices also help us to analyse non-income poverty and inequality over time and over subgroups, as in the case of income poverty based on expenditure or consumption measure of household income. Table A3 presents leading eigenvectors from the first PC eigenvalue decomposition of the correlation matrix, precisely the weights on the asset variables. Regarding the coding of variables, several categories of a discrete variable (referred to as an ordinal variable) are arranged in order from the worst to the best situation. For example, these might be: different levels of education (no education, primary, secondary, higher, professional or advanced degree) or, in the context of welfare studies, the variables take a ladder scale (from 1 to 4, where 1 is the most miserable person, and 4 is the happiest person), different construction materials used in the building (no roof is worse than a straw roof, which in turn is worse than a wooden roof, and a cement roof is better than all of these). Binary data are viewed as a special case of ordinal data with only two categories (e.g. having a television set is better than not having one).

6. Growth-inequality decomposition of changes in poverty

Early approaches (Datt and Ravallion, 1992; Kakwani, 1993; Shorrocks and Kolenikov, 2001; Boccanfuso and Kabore, 2003; National Institute of Statistics, 2002; and Baye, 2006) attempted to decompose the rate of change of a poverty measure between two periods into growth and inequality components to unveil the link between economic growth and poverty. Recently, the idea has shifted to the estimation of the elasticities of poverty with respect to growth and inequality, following further development in Kakwani (1993). Despite the intuitive notion that employment matters for poverty reduction, there is insufficient empirical research in this area. While there is broad consensus that not all growth spells have the same impact on poverty,

there have been relatively no attempts to systematically integrate the labour market into the relationship between economic growth, inequality and poverty reduction. The extent to which income inequality may dissipate some of the gains from growth to poverty reduction is widely expressed in Datt and Ravallion's (1992) decomposition methodology. It also allows the interactions to be examined between income growth, inequality and poverty reduction across segments of the labour market (i.e., how shifts in income distribution may have ameliorated the impact of economic growth on poverty reduction via the labour-market portal).

Computing the growth and redistribution components of changes in deprivation based on the labour market might be more informative to policymaking, since the MDG 1 target on productive employment and decent work for all emphasizes the importance of employment for reducing poverty. Deprivation is a situation where households suffer from poverty because they are not sufficiently endowed with a particular asset, be it monetary or non-monetary. Shapley (1953) proposed the Shapley decomposition rule, which is a concept in cooperative game theory. The Shapley value for player (factor) *k*, denoted by $C^{sh}k$ (*k, v*), is defined as the weighted mean of player (source) *k*'s marginal contribution $v(S \cup \{k\}) - v(S)$ over the set of coalitions, $S \subseteq K - \{k\}$ *and* $k / \in S$. Given by:

$$C_k^{sh}(k,v) = \sum_{s=0}^{n-1} \sum_{\substack{S \subseteq K-(k) \\ |s|=s}} \frac{s!(n-s-1)!}{n!} [v(S \cup \{k\}) - v(S) \quad \text{.....(10)}$$

where *n* is the total number of factors, *S* is a subset of players in the universal set $K = 1, 2, \ldots, n$, *s* is the number of sources in subset *S*, *k* is an individual factor and $\frac{s!(n-s-1)!}{n!} i$ is the relevant probability. Assuming a deprivation cut-off point *Z* for an endowment, the change in poverty/deprivation between the initial and final periods noted by *t* and *t* + *n* is:

$$\Delta P = P(U_{t+n}, L_{t+n}) - P(U_t, L_t) \text{.....(11)}$$

where *U* (•) is the mean value of the income source, *L*(•) the Lorenz curve of the income source and *P* the poverty status in terms of the source.

Adopting the P_α class of poverty measures (Foster et al., 1984), the change in poverty by an income source can be expressed as:

$$\Delta P_\alpha = P_\alpha(U_t(1+G), L_t + R) - P_\alpha(U_t, L_t) = V_\alpha(G, R) \text{.....(12)}$$

where *G* is the growth factor and *R* is the redistribution factor. Inspired by the procedure proposed by Shorrocks (1999) and applied in Baye (2006a), the contributions of growth C_G^{sh} ,

and redistribution C_R^{sh} of changes in deprivation by an endowment is given by Equations 12 and 13, respectively:

$$C_{\alpha G}^{sh} = \frac{1}{2}\left[P_\alpha(U_{t+n}, L_{t+n}) - P_\alpha(U_t, L_{t+n}) + P_\alpha(U_{t+n}, L_t) \_ P_\alpha(U_t, L_t)\right] = \ldots\ldots(13)$$

where $P_\alpha(U_{t+n}, L_{t+n}) - P_\alpha(U_t, L_{t+n})$ is change in poverty by an income source if inequality is constant and equal to that of the terminal period and $P_\alpha(U_{t+n}, L_t) - P_\alpha(U_t, L_t)$ is change in poverty by an income source when inequality is considered constant and equal to that at the initial period.

$$C_{\alpha R}^{sh} = \frac{1}{2}\left[P_\alpha(U_{t+n}, L_{t+n}) - P_\alpha(U_{t+n}, L_t) + P_\alpha(U_t, L_{t+n}) \_ P_\alpha(U_t, L_t)\right] = \ldots\ldots(14)$$

where $P_\alpha(U_{t+n}, L_{t+n}) - P_\alpha(U_{t+n}, L_t)$ is change in inequality while maintaining growth to that of the terminal period and $P_\alpha(U_t, L_{t+n}) - P_\alpha(U_t, L_t)$ is change in inequality with growth maintained at the initial period. Overall change in poverty by an endowment can then be expressed as the sum of the growth and redistribution components as in Equation 15:

$$\Delta P_\alpha = C_{\alpha G}^{sh} + C_{\alpha R}^{sh} \ldots\ldots(15)$$

7. Sectoral decomposition of changes in poverty

The "sectoral decomposition" of changes in poverty on the other hand assesses the relative gains to the poor within specific sectors and the contribution of changes in the distribution of the population across these sectors. Based on the standard approach of Ravallion and Huppi (1991), aggregate change in poverty/deprivation between the initial and final periods noted by t and t + n periods and assuming two sectors can be decomposed into intrasectoral effects, population shifts and interaction effects. This illustrates the relative importance of changes within sectors versus changes between them, such as due to the between-sector population or workforce shifts.

Intuitively, the intrasectoral component represents the change in poverty attributable to changes in poverty rates, holding the population share constant at the initial level. In other words, this is the change in poverty that would have occurred if the population shares in each sector had not changed. The intersectoral (population shift) component represents the change in poverty attributable to changes in population shares in each sector, holding the poverty level within a sector constant. Depending on how sectors are defined, this component represents poverty changes resulting from people shifting either physical

locations between poor and rich areas (e.g., between urban and rural areas or between regions) or shifting employment sectors.

This interaction element (Ravallion and Huppi, 1991) is what the Shapley decomposition eliminates by re-attributing more meaningfully. The goal here is to account for the overall change in poverty, ΔP_α, in terms of changes in poverty within subgroups, $\Delta P_{\alpha k} = P_{\alpha k,t+n} - P_{\alpha k,t}$, $k \in K$, and the workforce shifts between subgroups, $\Delta f_k = f_{k,t+n} - f_{k,t}$, $k \in K$. The Shapley value contributions (see Shorrocks, 1999; Baye, 2006b) of the within-sector effects (Equation 17) and between-sector workforce shift effects (Equation 18) as the weighted means of their marginal contributions to $\Delta P\alpha$ are presented as follows:

$$\Delta P_\alpha = \phi_W^S(2,v) + \phi_B^S(2,v) \quad \text{.....(16)}$$

Where the Shapley within-sector effects component, W, is

$$W = 0.5 \sum_{k \in K} \left[f_{k,t} + f_{k,t+n} \right] \Delta P_{\alpha k} \quad \text{.....(17)}$$

While the Shapley between-sector workforce shift effects, B, is

$$B = 0.5 \sum_{k \in K} \left[P_{k,t} + P_{k,t+n} \right] \Delta f_{\alpha k} \quad \text{.....(17)}$$

8. Empirical illustrations

In this section, empirical questions on the relationship between growth, distribution and poverty are answered while highlighting the role of the labour market and employment. First, how much of an observed change in poverty can be attributed to the changes in the distribution of income, as distinct from growth in average incomes? Second, how does a change in aggregate poverty reflect intrasectoral gains/losses versus intersectoral movement of the labour force? This paper focuses on both income and non-income aspects of well-being.

Based on the income poverty line, we determine a non-monetary welfare cut-off point for household human and physical assets or capital. According to Carter and May (1999, 2001) and Carter and Barrett (2006), this point corresponds to a level of assets that, on average, generates a non-poor level of expenditure or income. A non-parametric regression framework DAD4.6-R (see Duclos et al., 2010) was used to explore the relation between expenditure and each asset type to determine the cut-off point. In particular, non-parametric regressions offer several useful applications in distributive analysis.

Table 1: ***Growth and redistribution effects of changes in poverty, headcount, 2001–2007***

Sector of employment of household head	Change in poverty due to growth	Change in poverty due to inequality	Total change in poverty
	Expenditure per adult equivalent		
National	-0.029 (0.006)	-0.023 (0.008)	-0.053 (0.008)
Formal sector employment	-0.041 (0.009)	-0.039 (0.012)	-0.081 (0.011)
Agriculture	-0.060 (0.008)	0.022 (0.009)	-0.038 (0.013)
Worker in the informal private sector	-0.077 (0.011)	-0.038 (0.012)	-0.116 (0.014)
Others	-0.086 (0.015)	-0.007 (0.020)	-0.093 (0.023)
	Human asset		
National	0.377 (0.006)	-0.023 (0.003)	0.335 (0.007)
Formal sector employment	0.393 (0.011)	-0.026 (0.007)	0.345 (0.015)
Agriculture	0.342 (0.010)	-0.012 (0.005)	0.318 (0.012)
Worker in the informal private sector	0.380 (0.012)	-0.031 (0.006)	0.324 (0.014)
Others	0.395 (0.018)	-0.026 (0.009)	0.344 (0.023)
	Physical asset		
National	0.007 (0.002)	0.020 (0.005)	0.025 (0.007)
Formal sector employment	-0.007 (0.001)	0.013 (0.007)	0.004 (0.008)
Agriculture	0.019 (0.006)	0.012 (0.007)	0.031 (0.012)

Worker in the informal private sector	-0.020 (0.003)	-0.015 (0.008)	-0.037 (0.010)
Others	-0.014 (0.004)	0.011 (0.014)	-0.004 (0.017)

Note: The national poverty lines are 269,443 franc CFA per adult equivalent; physical asset (normalized scores) of 0.3012 and human asset (normalized scores) of 0.1581. Figures in parentheses represent standard errors.
Source: Constructed by author using the second and third Cameroon household consumption surveys.

One such application is the estimation of the relationship between household assets and expenditures per adult equivalent. In this context, a non-parametric regression of household assets and expenditures does not impose an a priori functional form between the two variables. The national income poverty line of 269,443 franc CFA per adult equivalent corresponded to a physical asset (normalized scores) of 0.3012 and human asset (normalized scores) of 0.1581.

Our discussion on how poverty changes are attributable to the growth and redistribution components is based on Table 1, which presents the exact decomposition results due to Shapley. The decomposition exercise indicates the relative importance of changes in the level of mean household income/expenditure and assets and the change in their distributions in explaining the observed changes in monetary and non-poverty dimensions or deprivation

There are indications in Table 2 that out of all the national headcount poverty indices or poverty incidence, only the income poverty indicator shows a significant decrease during the period 2001-2007. The headcount index, for instance, fell by 6 percentage points, from 37.3 percent in 2001 to 31.3 percent in 2007, while for the household assets, human and physical capital deprivation or poverty rose by 33.5 percentage points and 2.5 percentage points, respectively (Table 2). Thus, overall in Cameroon, the decline in poverty between 2001 and 2007 was fuelled by monetary poverty.

By components, distributional neutral growth accounted for a slightly greater part of the monetary poverty reduction than distributional shifts. A similar tendency is captured in all the labour segments where the growth effect dominated poverty reduction except for households engaged in agricultural activities, in which inequality rather promoted poverty. The might be due to unequal land distribution.

However, the rise in national deprivation in household human assets was championed by the growth effect, as opposed to the distribution component, which had a dampening effect. Similar effects are echoed for households working in all the labour sectors, though farmers again experienced a meagre effect of distribution-reduced poverty. Physical assets deprivation at the national level was mainly, though marginally, propelled by the distribution component and this effect was also acute for informal non-agricultural workers. Nevertheless, except for informal agriculture workers, the growth effect of physical asset deprivation was negative for the formal sector and informal non-agricultural workers including others classified as students, unemployed and retired persons. This is an indication that growth in physical assets helped in ameliorating deprivation.

Generally, the decomposition of income and non-income poverty changes indicated that the growth components overwhelmingly dominated the redistribution components both at the national level and in various labour subsectors. The exception was farmers, where the redistribution effect had an ameliorating tendency in household asset deprivation.

Table 2: ***Evolution of the headcount index (P_0)***

Sector of employment of household head	Initial population share	Initial poverty estimate	Final population share	Final poverty estimate	Difference in poverty index 2001vs 2007
	2001		**2007**		
	Expenditure per adult equivalent				
National	1	0.373 (0.005)	1	0.313 (0.055)	-0.053 (0.008)
Formal sector employment	0.290 (0.005)	0.162 (0.009)	0.190 (0.004)	0.080 (0.007)	-0.081 (0.011)
Agriculture	0.356 (0.005)	0.584 (0.009)	0.384 (0.005)	0.545 (0.009)	-0.038 (0.013)
Worker in the informal private sector	0.224 (0.004)	0.336 (0.011)	0.344 (0.005)	0.220 (0.008)	-0.116 (0.014)
Others	0.128 (0.003)	0.329 (0.016)	0.080 (0.002)	0.235 (0.017)	-0.093 (0.023)

	Human asset				
National	1	0.422 (0.005)	1	0.757 (0.004)	0.335 (0.007)
Formal sector employment	0.290 (0.005)	0.384 (0.010)	0.190 (0.004)	0.730 (0.011)	0.345 (0.015)
Agriculture	0.356 (0.005)	0.461 (0.009)	0.384 (0.005)	0.779 (0.007)	0.318 (0.012)
Worker in the informal private sector	0.224 (0.004)	0.429 (0.011)	0.344 (0.005)	0.754 (0.008)	0.324 (0.014)
Others	0.128 (0.003)	0.384 (0.016)	0.080 (0.002)	0.729 (0.017)	0.344 (0.023)
	Physical asset				
National	1	0.315 (0.005)	1	0.341 (0.005)	0.025 (0.007)
Formal sector employment	0.290 (0.005)	0.059 (0.004)	0.190 (0.004)	0.064 (0.006)	0.004 (0.008)
Agriculture	0.356 (0.005)	0.676 (0.009)	0.384 (0.005)	0.707 (0.008)	0.031 (0.012)
Worker in the informal private sector	0.224 (0.004)	0.166 (0.008)	0.344 (0.005)	0.129 (0.006)	-0.037 (0.010)
Others	0.128 (0.003)	0.154 (0.011)	0.080 (0.002)	0.150 (0.013)	-0.004 (0.017)

Note: The national poverty lines are 269,443 franc CFA per adult equivalent; physical asset (normalized scores) of 0.3012 and human asset (normalized scores) of 0.1581. Figures in parentheses represent standard errors.
Source: Constructed by author using the second and third Cameroon household consumption surveys.

In general, although knowledge of the extent to which observed changes in poverty are due to changes in redistribution — as distinguished from growth in average incomes — is critical to public policy and debate on poverty reduction, under-resource constraint factors contributing to changes in poverty due to variations in the within- and between-sector or labour mobility effects are also important. Table 3 presents the results emanating from Shapley-based sectoral decomposition. Of the closely 6 percentage points decrease in national monetary poverty, and the rise in human and physical capital deprivation or poverty

by 33.5 percentage points and 2.5 percentage points of the headcount index between 2001 and 2007 respectively, the between-sector effects tend to reduce poverty among workers in the formal sector by allowing monetary poverty to decline by 1.2 percentage points and non-monetary poverty by 5.5 percentage points, with a negligible effect on household physical assets. This drop in poverty due to intersectoral effects is attributable to decline in the workforce share in the formal sector from about 29 percent in 2001 to 19 percent in 2007, which signifies net outmigration (Table 2). A similar effect of a reduction in both monetary and non-monetary poverty was experienced by workers classified as students, unemployed and retired persons where there was a decline in population share.

For workers involved in agriculture and informal non-agriculture, Table 2 observes that the share of the workforce increased from about 35.6 percent to 38.4 percent and from 22.4 percent to 34.4 percent between 2001 and 2007, while Table 3 observes that between-sector effects in these sectors contributed positively to income poverty (1.5 percentage points), human asset poverty (1.7 percentage points) and physical asset poverty (1.9 percentage points) in agriculture, with similar rises in informal non-agriculture. These observations indicate that migrants in these sectors tend to fuel poverty. The significant increase in the poverty rate between 2001 and 2007 can be traced back to the adoption of the International Monetary Fund (IMF)/World Bank (medium-term) structural adjustment programmes (SAPs) from 1988, in response to the 1986 crisis. The SAP measures that were designed to achieve macroeconomic stability also compounded the effects of the crises on the welfare of households. As noted by Baye et al. (2002), Cameroonian authorities tried to cope with the budget deficits engendered by the crisis by down-sizing public expenditures through restructuring public and semi-public enterprises and freezing recruitment in the public services in the early 1990s, which led to staff redundancies and increased unemployment in the formal sector. Most workers tended to move into the informal sector.

Table 3: Decomposition of change in total poverty headcount ratio, P_0, into intrasectoral effects and intersectoral population shifts between 2001 and 2007

Sector of employment of household head	Intrasectoral effects	Intersectoral population shifts
	Expenditure per adult equivalent	
Formal sector employment	-0.019 (0.002)	-0.012 (0.003)
Agriculture	-0.014 (0.004)	0.015 (0.006)
Worker in the informal private sector	-0.033 (0.004)	0.033 (0.004)
Others	-0.009 (0.002)	-0.013 (0.003)
	Human asset	
Formal sector employment	0.083 (0.003)	-0.055 (0.006)
Agriculture	0.118 (0.004)	0.017 (0.007)
Worker in the informal private sector	0.092 (0.004)	0.070 (0.005)
Others	0.036 (0.002)	-0.026 (0.004)
	Physical asset	
Formal sector employment	0.001 (0.001)	-0.006 (0.003)
Agriculture	0.011 (0.004)	0.019 (0.007)
Worker in the informal private sector	-0.010 (0.003)	0.017 (0.003)
Others	-0.001 (0.001)	-0.007 (0.002)

Note: The national poverty lines are 269,443 franc CFA per adult equivalent; physical asset (normalized scores) of 0.3012 and human asset (normalized scores) of 0.1581. Figures in parentheses represent standard errors.
Source: Constructed by author using the second and third Cameroon household consumption surveys.

9. Concluding remarks and policy implications

This paper attempted to investigate the characteristics of poverty in the period 2001-2007, how poverty evolved over this period and the factors explaining its various changes via the labour-market portal in Cameroon. Specifically, the paper developed an exact decomposition analysis that anchors on the Shapley value method, and investigated the growth and redistribution effects, as well as changes due to mobility and sector-specific effects of the variation in both income/expenditure and non-income poverty dimensions. The Shapley procedure adopted tended out to be a unified conceptual framework that is amendable to most kinds of decompositions in distributive analysis and free of hazy concepts such as residual or interaction terms.

Generally, the decomposition of income and non-income poverty changes indicated that the growth components overwhelmingly dominated the redistribution components both at the national level and in various labour subsectors. The exception was farming households, where the redistribution effect had an ameliorating tendency in household asset deprivation.

The between-sector effects of both agricultural and informal sector workers played a worsening role by increasing poverty in these sectors. Thus, the shifting of the active population from the formal sector coupled with the movement of students, unemployed and retired persons towards agriculture and informal non-agricultural sectors aggravated poverty in those sectors.

The main policy implication we put forward from this study is the necessity to design pro-poor policies for workers in the informal sector and household heads undertaking farming activities, including those in self-employment. Special schemes that encourage poor workers to acquire necessary skills or upgrade their skills are needed. The informal economy should be nurtured and not forgotten. For instance, provide the poor in agriculture with more to work with, since they are often poor because they lack not only land, but also water, other inputs, knowledge of best practices, access to product markets, protection against risk, and access to financial services. This could be encouraged through the creation of a bank to finance small and medium-sized enterprises (SMEs) in Cameroon, while the farm sector could also be

improved in terms of productivity. There is further need to improve household access to assets, in particular land. Poor outcomes of land due to current tenancy regimes hint at the importance of improving not only the distribution of land but also the complementary access to agrarian inputs and credits. Improving credit allocation generally requires moving away from supply-driven mechanisms, and improving and broadening microcredit practices. Programmes that promote investments in the non-farm sector should be further encouraged, since diversification out of agriculture could help mitigate rural vulnerability and poverty. There is urgent need to improve access to rural infrastructure, focusing on increased public investment in roads between farms and markets.

Lastly, products should be designed to help raise the productivity of the self-employed. Many more of the poor in developing countries are self-employed than wage employees. The current operational state of local councils cannot support development. Thus, government policy towards decentralization needs to be stepped up in order to give powers to the local authorities, who should be able to recognize that most of the poor people living in their jurisdictions have no choice but to earn their livelihoods from street activities and other such self-employment activities. They should therefore adopt a more positive policy stance — or at least a less negative one — towards this group of people.

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Appendices

Table A1: Sectoral GDP average annual growth trends (%)

	2000	2001	2002	2003	2004	2005	2006	2007
Primary sector	4.0	3.7	3.7	3.5	4.4	2.7	3.0	5.9
Agriculture	4.0	3.7	4.7	3.4	4.3	3.0	2.4	4.4
Livestock	3.8	8.6	2.6	2.0	4.8	4.4	1.9	4.9
Forestry and forest products	4.5	-9.3	-4.5	9.0	6.0	-5.2	13.0	26.9
Fishing	3.5	12.7	2.9	2.3	2.1	4.6	1.7	2.0
Secondary sector	2.1	1.0	0.8	0.5	-0.2	-0.9	1.8	-0.8
Extractive industries including hydrocarbons	-8.2	-3.9	-4.3	-4.9	-9.1	-9.4	7.6	-5.4
Manufacturing industries	8.7	3.4	3.0	2.4	2.3	2.0	-0.6	0.5
Electricity, gas and water	5.0	1.2	-4.6	7.2	6.9	2.1	3.3	4.5
Building, construction and public works	2.1	3.9	5.7	4.3	8.4	1.1	4.0	0.5
Tertiary sector	9.0	8.5	7.3	7.4	6.6	3.0	3.5	5.0
Trade	7.4	13.8	7.3	10.5	7.2	2.6	1.7	0.8
Repair services	4.3	5.1	6.1	6.5	4.4	0.6	1.6	0.8
Hotel and restaurants	10.3	7.7	8.1	6.0	5.6	3.4	2.6	11.0
Transport	18.4	9.5	9.8	2.8	3.1	-10.5	1.7	1.5
Post and telecommunications	45.6	0.3	16.7	35.5	25.3	51.4	25.2	17.2
Other services (private)	5.5	3.6	5.7	3.7	4.7	1.3	1.7	7.4
Public services	8.0	6.4	5.9	3.1	6.9	0.4	2.9	5.5
GDP growth rate	4.2	4.5	4.0	4.0	3.7	2.3	3.2	3.4

Source: National Institute of Statistics (2008)

Table A2: Non-income welfare indicators

Indicators	1990/ 1991	2006/ 2008
Primary school enrolment, net (%)	69.5	88.3
Primary school completion rate (% of relevant age group)	54.1	72.7
Infant mortality rate (per 1,000 live births)	91.7	82.3
Under-five mortality (per 1,000 live births)	149	131
Child immunization rate, DTP3 (% of children aged 12-23 months)	48	84
Malnutrition prevalence (% of children under 18 months)	18	17
Access to an improved water source (% of population)	49	70
Access to improved sanitation (% of population)	39	51
Good lighting source (% of population)	37	48
Life expectancy (years)	55	61

Source: World Bank Development Indicator, 2010

Table A3: Polychoric PCA loadings and scoring coefficients (asset weights)

Variable	Loadings/Weight
Individual level (human capital)	
1. Sick during last two weeks	0.208
2.Appreciation of health status	0.102
3. Type of health centre consulted	0.346
4. Sector consultation	0.211
5. Can read/write a simple phrase	0.627
6. Level of education	0.623
Household level human capital	
1. Distance from household to the nearest public primary school	0.434
2. Distance from household to the nearest private primary school	0.211
3. Distance from household to the nearest health district centre	0.310
4. Average time needed to arrive at the nearest public primary school	0.499
5. Average time needed to arrive at the nearest private primary school	0.425
6. Average time needed to arrive at the nearest health district centre	0.490
Household level (physical assets)	
1. Source of water supply	0.279

2. Source of lighting	0.302
3. Energy for cooking	0.301
4. Type of toilet facility	0.292
5. Roof material	0.314
6. Wall material	0.242
7. Floor material	0.324
8. Possession of cell phone	0.275
9. Possession of TV	0.312
10. Possession of refrigerator	0.311
11. Possession of radio	0.181
12. Possession of pressing iron	0.297

Source: Computed by author using the pooled second and third Cameroon household consumption surveys.

Economic growth, employment and poverty in Cameroon

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Abstract

The aim of this research is to examine the importance of the labour market (through employment) in the transmission of economic growth to poverty reduction in Cameroon. For this reason, the authors first calculate the employment intensity of growth. Then, they integrate it in a model to establish the link between this intensity and poverty reduction. The results show that employment is sensitive to economic growth but is not conducive to poverty reduction. Policies targeting poverty reduction must consequently take care of the quality of employment.

Keywords: Labour market, economic growth, poverty, employment.
JEL Classification: J40, O47, E24

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1. Introduction

Economic growth remains a major challenge to development even in new development theories such as Sen's functioning/capabilities theory (1999), where the emphasis is more on the opportunities a society offers to individuals than on income. But knowing the economic growth mechanisms that improve living conditions, especially those of the poor, is essential for economic policymaking. These mechanisms vary from one context to another. In some contexts, economic growth spreads automatically to the point where it is possible to predict the rate of change in poverty following a 1 per cent change in GDP. Such evidence was derived from cross-cutting analyses between countries (Dollar and Kraay, 2005), time series analysis (Ravallion and Datt, 2002) or household survey results (Bibi, 2005). It soon became clear that not only was the extension of the effects of growth not the same from one country to another, but that there were countries where poverty was absolutely insensitive to economic growth (Dollar and Kraay, 2005). Cameroon belongs to the latter category because it experienced an average growth rate of 5 per cent between 2001 and 2007 and the poverty rate remained almost constant over the same period, decreasing from only 40.2 per cent to 39.9 per cent.

Transmission through the reduction of inequalities follows the triangular growth-inequality-poverty relationship developed by Bourguignon (2003). The concept of pro-poor growth developed by Kakwani and Pernia (2000) translates this relationship algebraically. The general idea is that growth can reduce poverty if it is accompanied by a reduction in inequality. In the context of Cameroon, the work of Baye (2006) applied a variety of decomposition methods (Shapley, 1954, Datt and Ravallion, 1992) to show that, between 1996 and 2007, the change in poverty was essentially due to economic growth with respect to the distributional impact. Although this is worthy of consideration, the channel of transmission through inequality remains too vague to be transposed into economic policies because it does not provide information on what caused the variations in inequalities and/or incomes of the poor.

The Government of Cameroon relies heavily on the labour market for transmitting the effects of growth because it is from this market that the poor derive the bulk of the resources needed to improve their living conditions. Thus, in the Growth and Employment Strategy Paper (GESP), the Government aims to reduce the monetary poverty rate from 39.9 per cent in 2007 to 28.7 per cent by 2020 and to 10 per cent by 2035. To achieve this goal, it aims to increase

the annual growth rate to around 5.5 per cent over the 2010-2020 period and to reduce under-employment from 75.8 per cent to less than 50 per cent by 2020.

In order to support the Government in implementing this strategy, this research explores the importance of the labour market, through employment, in transmitting economic growth to poverty reduction. It will examine the interaction between growth, employment and poverty over a given period of time. To this end, two practical objectives are assigned to this study: (i) determining the employment intensity of economic growth at the global and sectoral level; (ii) determining the contribution of employment intensity in sectors of activity to the change in monetary poverty. These targets will be achieved through the Kapsos (2005) method of calculating the employment intensity of economic growth, and the Loayza and Raddatz model (2009), which makes it possible to link the employment intensity of economic growth (global and sectoral) and poverty reduction.

The rest of the paper is organized as follows: Section 2 reviews the literature on the interactions between growth, employment and poverty. Section 3 defines the framework for empirical research. Section 4 is devoted to methodology. Section 5 presents and discusses the findings, and Section 6 concludes by focusing on implications of economic policy.

2. Review of the literature

As part of the literature review, answers are sought to the following two questions: Why do the sectors experience different growth rates in the same economy? And why does sectoral growth have different effects on poverty?

In relation to the first question, most growth models (Barro, 1991) envisage an aggregation of growth at the national level. This orientation is not suitable for the pursuit of the objectives here because the labour market is often segmented (Mark and Vallée, 1996) and its different sectors grow at different rates for reasons explained by three types of models.

The first type consists of models of the dualistic economy, which recognize only two economic sectors whose growth rates depend on the phases of development. At the first stage, the agricultural sector has a very high growth rate because it has to provide capital to the industrial sector. In the second stage, the growth rates of the two sectors are reversed because agriculture plays a subsidiary role. Considering only these two sectors reduces the scope of these models. Moreover, empirical studies, even in African countries such as Côte

d'Ivoire, Ghana and Zimbabwe, have opted to establish short-term interactions and a long-term relationship between agricultural growth and industrial growth (Blunch and Verner, 1999). This is contrary to the assumptions of the dualistic economy.

The second type consists in the multi-sectoral models of post-Keynesian growth (Kaldor, 1956), where income distribution determines demand, which is the essential element of growth through saving and investment. A disaggregation of these macroeconomic variables in a multisectoral model by Araujo and Teixeira (2010) shows that the growth rate of each sector of activity is essentially determined by the rate of growth of its demand, its profits and its investments.

The third type consists in the neoclassical, multisectoral growth models, which consider that all sectors of an economy can be grouped into three sectors for the sake of homogeneity, including the agricultural, manufacturing and service sectors. The production growth of each sector is guided by the principle of the rationality of the producer, who must maximize the profitability of production and minimize the factor costs. Roe, Smith and Saracoglu (2009) further explain that the profitability of production in each sector depends on maximizing the utility function of consumers constrained by their budget and prices. But for the agriculture and manufacturing sector that export their products, profitability also depends on external prices. Nevertheless, the most detailed results are those of Jensen and Larsen (2004) using the Walrasian equilibrium system on the constant elasticity of substitution (CES) function. They demonstrate that the growth of a sector depends on two types of factors, exogenous and endogenous.

The exogenous factors are investment, population growth, productivity and demand, including external and governmental demand. The endogenous factors include, notably, elasticity of substitution between capital and labour, and factor productivity.

With respect to the second question, which concerns the differential transmission of the effects of sectoral growth to poverty reduction, the literature suggests that this transmission can occur through income or employment. Depending on the transmission by income, there are three types of explanation: according to the approach of maximizing profits, wages are inversely proportional to the marginal productivity of labour; i.e. as it increases, there is a decline in labour demand and wages also decrease (Gary, 2004). According to the technical

progress approach, the multisectoral model of Aghion (2002) shows that sectoral growth is related to the respective sector's innovations, which determine the factor productivity. There may be changes in the inter- or intra-workers' income inequality according to whether workers are qualified or not. According to the efficiency wage models (Kugler, 2002), wages are determined by total factor productivity and staff turnover; hence, positions where there is a high turnover of staff are the most remunerated. Although worthy of consideration, the transmission of growth through salaries is barely measurable since several factors other than those related to rationality affect salaries; for this reason, this salaries option is not included in this research.

The transmission of sectoral growth to poverty reduction through employment is the most relevant channel and can be explained in two ways. From the point of view of endogenous growth in Schumpeter's sense, Aghion and Howitt (1992) show that when growth is mainly driven by technical progress, the process can generate a high level of unemployment during periods when new technologies replace old ones. But in the long term, growth is conducive to employment (Ericksson, 1997). Using a multisectoral growth model where total factor productivity differs across sectors, Ngai and Pissarides (2005) show that growth leads to a restructuring of the economy with two types of consequences on employment: (i) there is a transfer of labour from high-growth sectors of technology to low-growth sectors; and (ii) there is also transfer of the labour from sectors with a high labour productivity rate to sectors with a low labour productivity rate.

3. The framework of empirical research

The framework of empirical research discusses the econometric approaches and presents the profile of sectoral growth, employment and poverty in Cameroon over recent years.

3.1. Discussion on the econometric approach

Four main approaches can be used to quantify the sectoral growth differential with respect to poverty.

The longitudinal data approach of Ravallion and Datt (2002) and Montalvo and Ravallion (2009) argues that if growth influences poverty, it must be related to a poverty index (P) and average income (μ), or preferably consumption. Therefore, the proposed econometric model explains the logarithm of poverty indices of the FGT class ($log\ P_{\alpha t}$) at period *t* by μt and $log\ P_{\alpha t-1}$. Since the elasticity of $log\ P_{\alpha t}$ with respect to μ_t can, rather, reflect the effect of variations in

inequality on poverty, the authors propose to replace *log Pat* by *log Pat**, which is a relative measure of poverty. In this light, the poverty line is a percentage of μ, rather than a fixed value as in the case of the absolute measure of poverty (Pαt). In order to identify transmission mechanisms, control variables such as wages and labour productivity are introduced into the model. Results in India show that growth in the services sector has been more favourable to poverty reduction than growth in agriculture or manufacturing (Ravallion and Datt, 2002). Considering the same sectors in China, it was, on the contrary, growth in agriculture that was more pro-poor (Montalvo and Ravallion, 2009). Despite its relevance, there is a lack of annual data on the model variables to be applied in Cameroon.

The hypothesis defended by Thorbecke and Jung (1996) is that, in reality, the sectors of an economy interact. As a result, the growth of a sector has direct and indirect effects on household incomes. The direct effects result from the contribution of the labour force to the production process. Indirect effects are the result of increased demand for goods and services from households where growth has taken place. On the basis of this hypothesis, the authors propose a method based on the Social Accounting Matrix (SAM), where the sectors are in 2 to 2 interaction. In their main equation, the variable to be explained is the variation of poverty in a sector 'I', following an increase in production in a sector 'j'. The variation of poverty depends on the elasticity of poverty in relation to the average household income of the group 'i' as a result of the increase in production in the 'j' sector, the multiplier linking the production sectors to the different groups of households and the change in productivity of sector 'j' in relation to income of sector 'i' (dx_j/y_i). The results obtained in Indonesia show that growth in the agriculture and services sectors contributes more to poverty reduction than growth in the industrial sector. However, this can only be achieved when measures to support growth, such as improving the human capital of the poor through vocational training, are implemented. This methodology was not used because of the difficulties in building a recent SAM in the context of Cameroon.

Kapsos (2005) develops an approach based on the calculation of employment elasticity. This model captures the percentage change in the number of people employed in an economy as a result of a change in production as measured by GDP. The overall elasticity is expressed here as a weighted average of sectoral elasticities. Hence, the level of change in total employment depends on sectoral variations in employment. As a result, a large share of investment in labour-intensive sectors will increase employment and thus reduce poverty. This model does

not directly link economic growth to poverty. Indeed, it is based on the idea that employment is at the heart of the process of poverty reduction. The authors refuse to fully adhere to this logic because if jobs created are underpaid, they will not contribute to poverty reduction. Nevertheless, this methodology is used to estimate the employment intensity of economic growth (global and sectoral).

More recently, Loayza and Raddatz (2009) propose to quantify, using a multisectoral model, the mechanisms through which the sectoral composition of growth associated with its labour intensity affects wages and consequently poverty. The proposed modelling includes two main equations. The first, which estimates the effect of sectoral growth on poverty reduction, can be explained by the annual variations in the poverty rate by country ($\widehat{h}_j$). The explanatory variables are the annual rate of change in production by sector and country ($\widehat{y}_{ij}$) and the annual percentage change in the sectoral share of GDP per country ($\widehat{s}_{ij}$). Applying this model to a sample of 52 countries around the world, the results show that growth in agriculture, manufacturing and construction significantly reduces poverty, as opposed to mining and services. To explain these differences, the second equation estimates annual changes in poverty rates as a function of sectoral growth weighted by labour intensity. The results show that the sectors where growth contributes most to poverty reduction are more labour-intensive.

As a result of the discussion of these econometric proposals and due to the lack of longitudinal data as well as of a recent SAM in the context, the two-stage relationship between growth and the labour market will be analysed. First, the employment intensity levels of growth are estimated by using the Kapsos method (2005). Second, these intensities are integrated into the second equation of Loayza and Raddatz (2009).

3.2. Profiles of growth, employment and poverty in Cameroon

Following Cameroon's independence and as a result of strong growth in the oil sector, the country recorded a rapid economic take-off, resulting in a nearly two-fold increase in its GDP per capita in 15 years. The average annual growth rate of GDP per capita estimated at 1.2 per cent between 1960 and 1966, increased to 3.4 per cent between 1967 and 1974, and then to 9 per cent between 1980 and 1985 (World Bank, 2011). This phase was also marked by a change in the productive structure of the economy. On average, over the 1976-1985 period, the

industrial sector's GDP share (27 per cent) grew by almost 8 percentage points over the previous decade (19.2 per cent). At the same time, the share of agriculture (estimated at 31.1 per cent over the 1965-1975 period) and services (49.7 per cent) decreased by 3 and 5 percentage points, respectively (Chauvin, 2012). These economic performances were supported by formal employment and the improvement of the living conditions of the population.

The fall in the terms of trade in the early 1980s, followed by reaching the "peak oil" point in 1985, and the consequent deterioration of fiscal balances contributed to plunging the country into a deep economic crisis until the mid-1990s. This period was marked by a sharp deterioration in per capita income and revealed a major break in the country's growth regime. The Structural Adjustment Programmes (SAPs) adopted to stop this crisis and aimed at the recovery of the domestic situation and the improvement of growth outlook were supported by severe measures, which have profoundly affected employment. This has gradually evolved from a situation in which the State was the main provider of decent and salaried employment to a situation in which the private sector had to take over.

The State, the main investor, has stopped its ambitious public investment programmes whose achievements had not been as successful as expected. As a main consequence many unemployed people have been left behind. A widespread privatization process was initiated, together with deregulation at the private sector level, which also resulted in many redundancies (Njikam et al., 2005). Between 1984 and 1991, private companies dismissed almost 21 per cent of their staff. Indeed, the decline in purchasing power associated with wage cuts and personnel cuts in the public sector, and the elimination of various subsidies, resulted in a sharp rise in economic and social problems. Several companies filed for bankruptcy and turned to the informal sector to avoid taxes. Cameroon is witnessing an era of job insecurity and instability. Since the devaluation of the CFA franc in 1994, Cameroon's economy has been growing at rates higher than 2 per cent. But the trajectory of this economy is marked by profound changes in its structure of production. These changes are characterized by an informalization of activities and jobs, and by the dynamism of sectors of activity.

With regard to the informalization of the economy, national statistics indicate a predominance of informal employment and activity in Cameroon. According to the 2006 national accounts, the contribution of the informal sector to the total value added of the Cameroon's economy

amounts to about 48.8 per cent, against 37.8 per cent for the formal sector and 13.4 per cent for the non-market sectors. This significant contribution of the informal sector to overall value added is primarily due to the tertiary and primary sectors, whose share of informal value added is 28.8 per cent and 27.3 per cent, respectively. In terms of employment, the informal sector is the largest provider of employment in Cameroon. It is as high as 90.5 per cent of total employment,[3] compared with 5.8 per cent in the public sector and 3.7 per cent in the formal private sector (INS, 2011). The results of the employment survey (phase 1) show that the informal agricultural sector is predominant, accounting for 55.2 per cent of total employment and 72.9 per cent of rural jobs, while the non-agricultural informal sector comprises 35.2 per cent of total employment and 67.4 per cent of urban employment. Based on their distribution by non-agricultural sector, these results highlight the preponderance of informal production units in industry (45.8 per cent), followed by commerce (28 per cent) and services (26.2 per cent). However, only 64.4 per cent of the value added allocated for the remuneration of employees comes from the informal sector, compared with 20.4 per cent from the formal sector and 15.2 per cent from the non-market sectors. This reflects the low level of labour compensation in this sector. It also contains virtually all of the disadvantages in terms of working conditions, poorly paid work, job insecurity and underemployment.

Regarding the dynamism of the sectors of activity, it is important to indicate that over the 2006-2007 period, the tertiary sector's share of Cameroon's GDP increased by 3.5 percentage points compared to that of the sector over the 1996-2005 period, and reached 49.3 per cent. At the same time, the shares of the agricultural and industrial sectors decreased by 3 percentage points and 0.5 percentage points, respectively (World Bank, 2011). Cameroon's economy is driven by the dynamism of the less productive tertiary sector and the primary sector dominated by subsistence agriculture. In terms of absorption of labour, statistics from the National Statistical Institute (NSI) showed that the primary sector employs more than half of the workforce in Cameroon, followed by the tertiary sector.[4] The strong economic performance achieved by the tertiary sector over the past decade, particularly through trade and telecommunications activities, has enabled it to achieve the largest increase in the share of workforce. As a result, in 2010, it employed 34.1 per cent of the workforce, compared to 30.2 per cent in 2001. But this share of the workforce remains well below that of the primary

[3] The employment rate of the informal sector was estimsted at 90.5 percent in 2010, which is greater than that of 2005, which was estimated at 90.4.

[4] According to the analyses of the National Statistics Institute, these two sectors (primary and tertiary) are the biggest providers of informal employment in Cameroon's labour market.

sector, which was 53.3 per cent in 2010, after a drop of 7 percentage point from 2001. As concerns the secondary sector, its share in the employed workforce increased from 9.1 per cent in 2001 to 12.6 per cent in 2010. National statistics show that during this period, Cameroon's oil exports declined in volume and that Cameroon made a slight advance in the more labour intensive processing industry, which explains the drop in the share of the secondary sector in GDP associated with an increase in employment in the same sector.

In addition to these changes, the rate of urbanization has advanced considerably and is today, it exceeds 50 per cent. However, this trend remains poorly controlled due to the pressure of the rural exodus, especially of the unskilled worker, which accentuates the burden of the informalization of the economy, resulting in the persistence of underemployment and poverty.

Cameroon household surveys carried out in 1996, 2001 and 2007 show that income poverty decreased by 13.1 percentage points over the 1996-2001 period and stabilized at around 40 per cent between 2001 and 2007. However, the performance of Cameroon's economy with respect to the standard of living of the population remains highly insufficient compared to the real potential of the country and to that of the other countries that have experienced a level of development comparable to that of Cameroon in 1960. This is the case, for example, of Republic of Korea and Tunisia, which have improved the living conditions of their populations through rapid and sustained economic growth.

4. Methodology

4.1. Methods of calculating employment intensity

Two approaches are often presented. The first approach is arc elasticity, calculated as the ratio between relative changes in employment and economic growth. It shows great instability when calculated year after year (Islam, 2004). To compensate for this limit, Kapsos (2005) developed an approach that allows to calculate the employment elasticity of economic growth based on an econometric estimate. Two models are available for this purpose.

The first model aims to evaluate the effect of a change in economic growth on total employment, on the one hand, and the effect of a change in total growth on sector employment, on the other. Its econometric expression is presented as follows:

$$\ln E_t = \alpha + \beta_1 \ln Y_t + \beta_2 \ln(Y_t) \times D_t + \beta_3 D_t + \eta_t \quad (1)$$

Where, Yt is the per capita GDP of year t, and Dt is a dummy variable introduced to significantly reduce the volatility of the calculated elasticities. It takes the value 1 when economic growth records positive rates and 0, otherwise (Kapsos, 2005). Ht is the residual term and Ln is the natural logarithm. The dependent variable (lnEt) has two meanings. It represents, on the one hand, the logarithm of total employment and on the other hand, that of the employment of each sector of the economy. This study will consider the three main sectors that characterize Cameroon's economy: the primary sector, the secondary sector, and the tertiary sector. This model will allow to calculate four elasticities: the elasticity of total employment in relation to total growth, and the elasticities of sectoral employment in relation to total growth.

The second model aims to assess the influence of a change in the growth of each sector on employment in such sector. This model makes it possible to calculate three sectoral elasticities. It is presented as follows:

$$\ln E_t = \alpha + \beta_1 \ln V_t + \beta_2 \ln(V_t) \times D_t + \beta_3 D_t + \eta_t \quad (2)$$

Where E_t represents the employment of each sector and *Vt* is the value added of each sector. Dt and *ηt* have the same meaning as in the first model. This model makes it possible to calculate the employment elasticity of each sector in relation to its growth. In each model, the value of the elasticity is equal to the sum of the coefficients β_1 and β_2.

4.2. Methods of determining the contributions of sectoral employment intensity to change in poverty

To determine the contributions of sectoral employment intensity of economic growth to the change in poverty, the model of Loayza and Raddatz (2009) will be used. The purpose of this model is to determine how the structure of an economy's production, and specifically the sectoral composition of the economy's growth, affects its ability to reduce poverty. It combines poverty reduction (reflected in the increase in wages), with the sectoral composition of growth, and with the sectoral employment intensity.

The equation of the theoretical model is formulated as follows :

$$\hat{w} = \sum_i s_i \hat{y}_i + \left(\frac{\varepsilon - 1}{\varepsilon}\right) \sum_i \left(l_i - s_i\right) \hat{y}_i \tag{3}$$

Where $\hat{w}$ is the rate of annual salary, $\hat{y}_i$ is the rate of growth of the sectoral added value, s_i is the share of the sector *i* of total production, l_i is the share of employment of the sector *i* out of total employment and *i* indicates the sectors.

Assuming that the increase of salaries and poverty reduction have a linear relationship ($\hat{h} = \theta_0 + \theta_1 \hat{w}$), Loayza and Raddatz (2009) show that the change in poverty can be expressed as a function of sectoral growth.

$$\hat{h} = \theta_0 + \theta_1 \sum_i s_i \hat{y}_i + \theta_2 \sum_i \left(l_i - s_i\right) \hat{y}_i \tag{4}$$

To estimate the effect of employment intensity of sectoral growth on poverty reduction, Loayza and Raddatz (2009) developed the following regression equation:

$$\hat{h}_t = \theta_0 + \theta_1 \hat{y}_t + \theta_2 \sum_i \left(\frac{l_i}{s_i} - 1\right) s_{it} \hat{y}_{it} + \varepsilon_t \tag{5}$$

Where $\hat{y} \cong \sum_i s_i \hat{y}_i$ is the rate of GDP growth per capita, $\frac{l_i}{s_i}$ is employment intensity of sector *i*.

$\hat{h}_t$ represents the annual change in the poverty rate. Given that the annual poverty rates in Cameroon cannot be observed directly, the authors generated them on the assumption that the incidence of poverty is negatively associated with the per capita GDP growth rate (Naiya and Manap, 2013). To calculate these poverty rates, the method developed by the World Bank and the Asian Development Bank was used. This method had already been used by the Islamic Development Bank in its occasional paper published in June 2010 and by Naiya and Manap (2013). According to this method, the poverty rate is calculated on the basis of the GDP growth rate per capita, based on the elasticity of poverty growth and also based on poverty rates (generated from national surveys).

The growth elasticity of poverty used to generate annual poverty rates is the same as the one used by the International Monetary Fund in its 2003 country report (IMF, 2003). This elasticity was used to assess Cameroon's capacity to achieve the Millennium Development Goals. The value of this elasticity is -0.7.

Before performing the estimates, the authors conducted Phillips-Perron stationarity tests, White's heteroskedasticity tests, and Breusch-Godfrey residual autocorrelation tests. The significance of the coefficients and that of the model will be determined respectively through the Student's individual test and the Fisher test.

5. Results and discussion

5.1. Data and preliminary tests

The data used in this study are secondary sources and are mainly obtained from the World Development Indicators of the World Bank and the Global Employment Trends of the International Labour Organization. The period of study extends from 1991 to 2013. The choice of this period is conditioned by the availability of data on employment in Cameroon.

The Phillips-Perron unit root test performed on the variables taken individually indicates that the authors' series are stationary in level (table 1). However, the Breusch-Golfrey and White tests indicate, respectively, the presence of autocorrelation of errors and heteroskedasticity in each of the models. After correcting these autocorrelation problems (starting from the integration of the autoregressive process in the regression model using Eviews software) and heteroskedasticity (using the White method), the results indicate the lack of estimation bias. The results show that the values of the adjusted regression coefficient are all close to 1. This indicates a good predictive power of each model. In addition, the probabilities associated with Fisher statistics indicate the overall significance of each model.

Table 1: Results of the Phillips-Perron stationary tests

Variables	Test value	p-values
Logarith of the primary sector employment (LN_EMPL_PRIM_)	-3.532843	0.0604
Logorith of the secondary sector employment (LN_EMPL_SEC_)	-4.515584	0.0086
Logarith of the tertiary sector employment (LN_EMPL_TERTIAIR_)	-3.851728	0.0328
Logarith of total employment (LN_EMPL_TOTAL_)	-3.281624	0.0954
Logarithm of GDP per inhabitant	-5.371696	0.0016
Logarithm of value added of the primary sector (LN_VA_PRIM_01)	-4.269190	0.0175
Logarithm of value added of the second sector (LN_VA_SECON_)	-3.101607	0.0419

Logarithm of value added of the tertiary sector (LN_VA_TERTIAIR_)	-3.852878	0.0337
Change in poverty (VPOV)	-2.306239	0.0235
Growth rate of GDP (Y)	-2.306239	0.0235
Employment intensity (INTENSITE)	-7.373198	0.0000

Decision: All of the series are stationary in level.
Source: Authors.

5.2. Employment intensity of economic growth

Table 2 shows that economic growth has a positive and significant effect on the volume of total employment and sectoral employment in Cameroon. These results were obtained by estimating the coefficients of equation 1. From this table, it can be seen that a change in the GDP logarithm of 1 per cent leads to a change of 2.998 per cent in the employment logarithm. This change is mostly stimulated by the tertiary sector (3.828), followed by the primary sector (2.833). The secondary sector has less influence on the change in total employment. These differences in potential employment in the sectors of activity are similar to the shares of the contributions of these sectors in the informal economy. Indeed, national statistics show that the primary and tertiary sectors account for the largest share of employment and activity in the informal sector.[5]

The interaction variable (lnPIBxDt), which measures the effect of the GDP logarithm during expansion periods on the employment logarithm, indicates all of the non-significant coefficients as a whole, with the exception of that of the sector secondary. The negative sign of the latter (-0.178) indicates that during periods of expansion, growth in the secondary sector has not driven jobs. Indeed, the period of economic expansion in Cameroon, far from being driven by a true policy of industrialization with a strong capacity of employment, is driven by the development of the extraction activities as well as those of services and trade. In 2010, according to the INS (2011), the secondary sector in Cameroon reached 12.6 per cent of the total workforce, a much lower share than that of the tertiary sector (34.1 per cent).

[5] See section 3.2 (para. 5) for the statistics on the contribution of the sectors of activity to the informal economy in Cameroon.

Table 2: Influence of GDP growth on employment (total and sectoral)

	Primary sector	Secondary sector	Tertiary sector	Total
Constant	-4.009	153.231	-11.727**	-4.706
LnPIB	2.833*	0.776*	3.828*	2.998*
lnPIBxDt	-0.037	-0.178*	0.007	-0.046
Dt	0.24	1.220*	-0.065	0.303
R^2 adjusted	0.973	0.988	0.981	0.976
Fisher statistic	143.11*	419.84*	210.57*	162.57*
Durbin Watson	2.033	2.365	1.984	2.045

Notes: * indicates a significance of 10 per cent.
** indicates a significance of 5 per cent.
Source: Authors.

An estimation of the coefficients in equation 2 indicates that sectoral growth has the same effect on sectoral employment (table 3), but in proportions that are different from those observed for total employment. Employment in the primary sector is more sensitive to change in value added of the sector. A change in the value added of the primary sector of 1 per cent leads to a change in the primary sector employment rate of 2.290 per cent. This result reflects the real situation in the country, because the primary sector is dominated by subsistence agriculture,[6] which is more labour-intensive. Overall, sector jobs are all sensitive to changes in sectoral value added. However, the sensitivity of the secondary sector is the lowest (0.205), following that of the tertiary sector (1.126). This low sensitivity of employment in the secondary sector is related to the production structure of this sector; it is mostly made up of extractive activities, characterized by low capacity for job creation.

Table 3: Influence of sectoral value added growth on sectoral employment

	Primary sector	Secondary sector	Tertiary sector
Constant	-16. 34124	8.529*	-18.24115*
LnVA	2.290*	0.205**	1.126083*
lnVAxDt	-1.515*	0.070	0.026950
Dt	10.019*	-1.572	-0.560607
R^2 adjusted	0.431	0.97	0.910
Fisher statistic	72.198*	170.281*	75.464*
Durbin Watson	1.93	1.981	1.928

Notes: * indicates a significance of 10 per cent. ** indicates a significance of 5 per cent. Source: Authors

[6] This subsistence agriculture is predominantly practised in family farms.

With respect to elasticity calculations (based on the elements in Tables 2 and 3), the results indicate that a 1 per cent growth leads to an increase in total employment of about 2.95 per cent. This confirms the real situation of the country, because, with a real growth rate of 3.1 per cent that was recorded over the 2000-2010 period in Cameroon, the share of employed persons aged 15-64 increased by 66.2 per cent (in 2001) to 80.2 per cent (in 2007) before decreasing to 73.8 per cent in 2010 (ILO, 2012).

Table 4: Calculation of elasticities

	Employment in the primary sector	Employment in the secondary sector	Employment in the tertiary sector	Total employment
GDP	2.796	0.598	3.835	2.952
Sectoral added value	0.775	0.275	1.153	-

Source: Authors.

The calculation of sectoral elasticities shows that, unlike employment in other sectors of activity, employment in the tertiary sector is more sensitive to changes in GDP and to changes in the value added of services (3.83 and 1.15, respectively, for sensitivity to changes in GDP and changes in the value added of the tertiary sector). This sensitivity of employment in the tertiary sector is followed by that of employment in the primary sector (2.78 and 0.77, respectively, for sensitivity to changes in GDP and changes in value added of the primary sector), and finally that of the secondary sector (0.60 and 0.28 respectively). These results reflect the good economic performance achieved by the tertiary sector over the past decade, notably through trade and telecommunications activities, which enabled it to achieve the largest increase in the share of the workforce. Thus, in 2010, it employed 34.1 per cent of the workforce, compared to 30.2 per cent in 2001. As regards the secondary sector, its share of the employed workforce increased from 9.1 per cent in 2001 to 12.6 per cent in 2010 (World Bank, 2011). In addition to these statistics, it can be observed that employment volumes in the sectors of activities are more sensitive to GDP growth than to growth in sectoral value added.

5.3. Employment intensity and poverty in Cameroon

The results in table 5 (obtained from equation 5) indicate that change in GDP influences the change in monetary poverty. Indeed, a change in 1 per cent of GDP leads to that of poverty of 0.7 per cent but in the opposite direction. And yet, these results indicate that employment intensity has no effect on the change in poverty in Cameroon. Therefore, having a job is not necessarily a guarantee of a better standard of living. With the active employment rate

increasing from 66.2 per cent in 2001 to 73.8 per cent in 2010 (after reaching the 80.2 per cent threshold in 2007), worker poverty, far from improving, experienced a slight increase, from 37.9 per cent to 38.3 per cent between 2001 and 2007. ILO (2012) explains that this poverty may be linked to the structure of jobs. This structure is dominated by informal jobs (about 90 per cent), generating poor working conditions, accompanied by low wages and followed by a predominance of precarious activities. In 2010, one-quarter of the workers were in a situation of professional instability in Cameroon, with a more marked trend in rural areas. According to ILO, one of the consequences of this phenomenon is linked to the lack of social protection policies. Indeed, as in most developing countries, the lack of a system of workman's compensation in Cameroon leads many unemployed workers to carry out economic activities to survive, with adverse consequences for the standard of living. These categories of employment, far from contributing to poverty reduction, rather increase the risks of future poverty; hence, the persistence of poverty in the country despite economic growth.

Table 5: Influence of employment intensity on poverty

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	3.89E-17	2.85E-17	1.365586	0.1889
GDP	-0.700000	2.75E-17	-2.55E+16	0.0000
Employment intensity	1.69E-17	1.42E-17	1.191610	0.2489
Fisher statistic	1.49E+33***			
Durbin Watson	2.152021			

Notes: * indicates a significance of 10 per cent.
** indicates a significance of 5 per cent.
Source: Authors.

5.4. Discussion of results

As a result of this study, two types of complementary information emerge. First, this study presents the performance of the sectors of activity in Cameroon, notably through their capacity to absorb manpower. The results indicate a similarity between sectoral growth rates and their capacity to absorb manpower, since the sectors with the most favourable growth rates are also those with the highest employment intensity. Second, it shows the influence of employment intensity on poverty. The main result is that employment intensity does not have a significant influence on poverty reduction in Cameroon. This result is contradictory to that obtained by Kapsos (2005) on a sample of 139 countries taken around the world. Kapsos (2005) reports that increasing employment leads to a reduction in poverty.

These results raise questions about the sectoral composition of employment. Although the economic growth achieved during the decade of 2000 drove jobs, they were not productive jobs. Statistics from the National Statistics Institute in 2010 show that 90.5 per cent of the employed workforce is in the informal sector. Specifically these informal jobs have a high proportion of underemployment (70.5 per cent). ILO in 2012 also indicated that the poverty rate of workers in Cameroon (38.5 per cent) is close to that of household poverty (39.9 per cent). This result shows that having a job does not guarantee a decent standard of living, because of the precariousness of these jobs and the low level of wages. The World Bank (2011) indicates that Cameroon's economy is driven by the dynamism of the less productive tertiary sector and the primary sector dominated by subsistence farming on family farms. The lack of protection for the unemployed, which characterizes the labour market in Cameroon, forces the unemployed to take refuge in informal jobs to ensure their survival needs.

On the basis of this information, it appears, therefore, that Cameroon's development policies must target inclusive growth strategies, rather than seek high rates of economic growth. If high growth rates allow to increase employment volumes, not all of these jobs are productive. The increase in the supply of decent jobs and the introduction of measures to protect the unemployed through unemployment benefits are some measures that can reduce the continuation of informal employment among youth of working age, as well as the level of national poverty.

6. Conclusion

The main objective of this study was to examine the importance of the labour market in the transmission of economic growth to poverty reduction in Cameroon. The study used the Kapsos (2005) method of calculating the employment intensity of economic growth and the Loayza and Raddatz (2009) model, which makes it possible to link the employment intensity of economic growth (global and sectoral growth) and poverty reduction. The results show that the employment intensity of global and sectoral growth is higher in the tertiary sector, followed by the primary sector. Jobs in the secondary sector are less sensitive to economic growth. Moreover, unlike economic growth that has a significant influence on poverty in Cameroon, employment intensity has no effect. This lack of effect may be due to the nature of the jobs created because the sectors of Cameroon's economy have a very large share of informal jobs.

Based on these different results, it can be observed that although Cameroon has certainly experienced a revival of economic growth in recent years, this growth, stimulated by the dynamism of the non-productive sectors, proved insufficient to create decent jobs and to reduce poverty. This growth has positively stimulated job creation, but the latter was more concentrated in the informal sector, with very little influence on poverty. Based on these observations, the authors recommend that the Government of Cameroon develop policies that would promote inclusive growth, notably through increased investment in the productive sectors of its economy as well as strengthen social protection strategies, in particular those for the unemployed.

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Distributional effects of access to basic services on household welfare in Togo

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Abstract

Developing countries do not have a de facto progressive tax policy and an effective tax administration to alter the post-tax distribution of income. The provision of basic services is then important to allow a significant reduction of inequalities and combat poverty. However, basic services can help in the fight against poverty and reduce inequalities only if they disproportionately benefit the poorest. This paper aims to analyze the distributional effects of basic services on welfare in Togo. Unlike previous studies, it first makes use of a structural equations model (SEM) to account for the multidimensional aspect of welfare and simultaneities in its dimensions. Then BIA analysis is performed. The results indicate that access to basic services is pro-rich in Togo. The results also indicate that basic services are much more progressive in rural areas than in urban areas.

Keywords: welfare, basic services, inequality, multidimensional, progressivity.
Code JEL: D63, H41, I38.

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1. Introduction

Despite Togo's strong performance in the field of economic growth, the poverty rate in the country has gone down only marginally. Between 2006 and 2011 for example, the rate of growth of Togo's real GDP was more sustained than that of demographic growth, resulting in a 6 per cent increase in income per inhabitant over the period (IMF, 2013). However, the rate of poverty went down only marginally between 2006 and 2011, dropping from 61.7 per cent to 58.7 per cent according to the two QUIBB surveys (questionnaires on basic indicators of welfare) carried out during the years in question. Furthermore, there are major inequalities between the rural and the urban areas. In the rural environment, the poverty rate is still very high, having gone down by only 1.7 points, from 75.1 per cent to 73.4 per cent, over the period concerned.

In order for economic growth to bring about a reduction in inequality and poverty, the provision and accessibility of basic social services for the whole of the population, in particular the most deprived groups, proves to be indispensable for at least two reasons. Firstly, in the context of the developing countries, it is difficult to set up a redistributive fiscal policy owing to the ineffectiveness of the tax administration and the predominant part taken by the informal sector (Davoodi, Tiongson and Asawanuchit, 2003). Secondly, the use of basic services entails a transfer in kind to the beneficiaries, which would make it possible to reduce poverty and inequality. This explains why basic services are most often subsidized by public funds.

However, the public provision of basic services is able to bring about a reduction in poverty and inequality only if the actions of the State are of disproportionate benefit to the least privileged groups. In addition, as the poor strata of the population are at a disadvantage in the sphere of access to the basic social services that might help them to escape from poverty, the State seeks to target them in the provision of these services. It is thus important to examine the targeting of the poor in the distribution of the benefits of basic services. The present article attempts to give an answer to the following question: what are the effects of the accessibility to basic services on the distribution of household welfare in Togo?

The general objective of the present article is to analyze the distributional effects of the capacity for access to basic public services on the welfare of households in Togo, in its multiple interdependent dimensions. More specifically, the aim is: (i) to analyze the interdependences between the various dimensions of household welfare in Togo; and (ii) to analyze the progressivity of the basic public services available in the country.

Several studies have examined the distributional effects of public expenditure, notably Demery (2000), Sahn and Younger (2000), Kamgnia et al. (2008), Gaddis and Demery (2012), Adams and Alabi (2014), Karim (2015), and Okafor and Ichoku (2015), analyzing the impact of public expenditures in the fields of education and health on the different strata of the population. However, few of them have considered the particular context of Togo. The present study seeks to eliminate this shortcoming by taking a different approach from that of most of the earlier analyses, that utilized income or consumption as the indicator of welfare, which however does incorporate other dimensions. The present article is essentially distinct from the earlier studies both in its approach and in its methodology. Firstly we have opted for a multidimensional analysis framework of welfare on the basis of the capabilities approach of Amartya Sen. Secondly, we use the structural equations model (SEM) with latent variables in order to take account of the interdependences between the dimensions of welfare. The rest of the article is organized as follows: Section 2 describes the theoretical framework of the analysis of welfare; Section 3 describes the methodology selected; Section 4 presents the results of the analysis and finally Section 5 reports on our conclusions.

2. Theoretical framework of the analysis of welfare

In the literature on the subject, different approaches to welfare can be observed, notably the welfarist or monetary approach, the approach based on essential needs, the approach based on primary goods and the capabilities approach. The present article adopts the framework of the capabilities approach (Sen, 1981), which lays stress in its definition of poverty on the relations between resources and those who possess them. Sen emphasizes the complexity of the relationships of individuals to goods, between individuals (social relations) and of individuals to their environment (institutions, standards, customs, etc.). This triple level of relationships places the individual at the centre of the concerns, both at the level of development and at the level of the study of poverty.

Sen (1987) formalizes the capabilities approach in the sense of being able to do or to be. Let us consider z_i as being the vector of the goods possessed by the individual *i*. These goods have, in turn, characteristics $c(z_i)$ which enable the individual to attain certain functionings noted as $b_i = f_i(c_i(z_i))$ where f_i, the utilization function, characterizes the capacity to "make use of" or the utilization of the goods. Thus, the entirety of the "capabilities" is the total of the possible cases b_i that the individual can achieve by using any one of the possible cases of f_i at his disposal.

Conversion of resources into means of achieving welfare based on the functionings is dependent on the utilization function. Consequently, the resources are no longer considered as an end in themselves, but they remain just as vital. While the possession of these resources does not guarantee that the person who possesses them will achieve the desired level of welfare, their absence reduces considerably the possibility for the individual in question to widen the total of his capabilities. Several factors present in the utilization function may prevent the individual from achieving his aspirations: (i) heterogeneity of persons (physical, mental or sexual characteristics); (ii) diversity in the environment (climate factors, endemicity of infectious diseases, pollution); (iii) disparities in the social environment (nature of the social relationships and public services); (iv) prospect relativity (status of the person in society, social life, response to certain standards); and (v) distribution within the family (rules on sharing in force in a family).

The individual characteristics imply a transformation of resources into capabilities that will differ from individual to individual. Thus, two individuals do not necessarily transform the characteristics of the same asset into an identical capability.

The social environment is also a determining factor in the process of conversion. A society whose rules are discriminatory towards a particular group also imposes this transformation. Let us consider a man and a woman who each have the same income. In our society, women may not make free use of their money to buy what they want, being obliged to seek the approval of their husband. From the point of view of the monetary approach, the man and the woman have the same level of welfare since they both have the same resources at their disposal. However, the social rules which restrict women reduce their space for exercise of their capabilities.

The capabilities approach also grants an important place to the problem of choice, which applies not only to the utilization function, but also to the shift from the space of the potential functionings to the space of the completed functionings. Thus, starting from the same resource, such as a bicycle, an individual may choose between several utilization functions (for example, travelling around, pursuing sports or exchanging the bicycle for another asset). Similarly, the individual does not develop all of the functionings to which he may lay claim. He expresses preferences by choosing this functioning and not that one. The capabilities approach thus measures welfare in terms of what a person actually succeeds in accomplishing with the resources available to him or her, taking account of his or her personal characteristics and of external circumstances.

It can easily be determined that in the capabilities approach, a certain number of elements of welfare cannot be observed; the specific characteristics c_i that enable an individual to transform assets into functionings, the conversion function f_i specific to each individual, the total of conversion functions from which the individual may choose, and consequently the totality of these capabilities themselves. The only input that is observable, and even then only partially, is the vector of the assets possessed by the individual. This observation is only partial to the extent that one may only observe the material or physical goods possessed by an individual but not the intellectual capacities or or the social inputs that he or she is capable of combining to make use of these assets in an appropriate manner. The structural equations model with latent variables thus appears as a suitable framework to conceptualize the capabilities approach.

3. Methodology

In order to analyze the distributional effects of access to basic services on household welfare, the method selected is that of benefit-incidence analysis (BIA). In order to take account of the multidimensional character of the welfare and the interdependence of its dimensions, we use the structural equations method (SEM) with latent variables. This section describes, in turn, the SEM and BIA methods as well as the data sources used.

3.1 The structural equations method (SEM) with latent variables

3.1.1 *Reason for selecting the SEM method*

Several methods have been used in the literature covering this subject to grasp the multidimensional character of welfare. One may refer, among others, to the fuzzy sets method (Cheli and Lemmi, 1995); the distance function method (Deutsch and Silber 2005); the entropy measures approach (Deutsch and Silber 2005); the inertia method (Klasen, 2000); the factorial analysis (Sahn and Stifel, 2000); the multiple indicators and multiple causes method (MIMIC) (Di Tommaso, 2007); and the structural equations method with latent variables (SEM) (Wagle, 2005; Krishnakumar and Nagar, 2007).

We selected this latter method for our research because unlike all the others, the SEM method makes it possible to take account simultaneously of the interdependences of the dimensions of welfare and of the exogenous factors which may influence them. While the different dimensions of welfare cannot be measured directly, it is possible to represent them by latent variables which reveal themselves through a number of fulfilments. At the same time, these latent dimensions mutually influence each other. It is thus important to specify these interactions explicitly in the form of a structural model.

Once the choice of the model for measuring multidimensional welfare has been made, it is important to determine the dimensions of welfare to be used.

3.1.2 *Choice of the dimensions of welfare*

Alkire (2008) considers that the choice of the dimensions of welfare is based on at least one of the following five criteria: (i) existing data or arbitrary convention; (ii) assumptions on what individuals value; (iii) public consensus; (iv) participatory deliberative processes; and (v) empirical evidence. Three dimensions have been selected in the present article: wealth, health and access to public goods. This choice is supported not only by criteria (i) and (iii) above but also by the fact that the development strategies of Togo place their emphasis on health and basic social services.

The first dimension is wealth, represented by a synthetic index that considers several aspects related to quality of life, such as the possession of certain consumer durables. The second dimension relates to access to public goods and services. It captures the capacity of households to access services which depend primarily on public expenditures on economic and social infrastructures. These are public utility services such as access to water, to education, to electricity, to telephone services, and to sanitation and health services. As for the third dimension, access to housing, this is measured by the characteristics of the dwelling, such as for example, the materials used for the walls, roof, floor, the number of persons per room, and so on.

In our model, the public expenditures assigned to public services are not perceived solely as investments likely to generate economic growth, but also and above all as being able to have a direct influence on household welfare. For example, the building of hospitals makes it possible in the medium term to improve human capital, but also offers households the possibility of easier access to basic health care, which in itself represents an improvement in welfare. Several other variables, both exogenous and endogenous, may be considered as potential determinants on one or another of these three dimensions of welfare. One might reference the level of education, size of the household and area of residence (urban/rural). Table 1 describes these three dimensions together with the indicators and exogenous variables likely to influence them.

Table 1: List of variables and indicators

Dimensions and variables	Indicators or endogenous variables
Dimension 1: Wealth	Ownership of a car
	Ownership of a motorcycle
	Ownership of a radio
	Ownership of a television
	Ownership of a mobile telephone
	Ownership of a refrigerator
	Ownership of a computer
	Ownership of a fan
Dimension 2: Access to public goods	Access to drinking water, to electricity, to sanitary facilities, to a fixed-line telephone, to education, to health services, to public transport, to the food market
Dimension 3: Access to housing	Materials used for the walls, the floor, the roof, number of persons per room
Exogenous variables: sociodemographic characteristics	Size of the household, level of education of the head of household, residential environment, sex of the head of household, age of the head of household

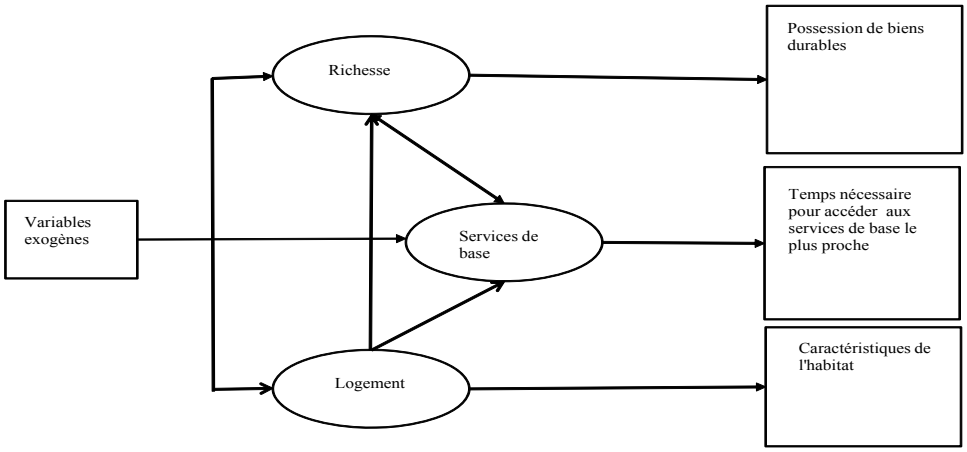
Source: Table created by the author

3.1.3 *The theoretical model*

Figure 1 presents the interrelations between the variables of the model. In particular, it is possible to see the latent dimensions or variables such as the index of wealth, the index of access to public goods and the index of access to housing, as well as the indicators which are observations on the ability of each household to be fulfilled in the different dimensions. For example, a household with a high index of access to public goods has a high capacity of accessing electricity, health care, and so on. Similarly, a rich household has more likelihood of possessing consumer goods. The third category of variables shown in this figure has to do with exogenous variables. This relates to a group of variables linked to the sociodemographic characteristics of individuals and likely to affect their abilities to be fulfilled in each dimension. For example, the urban areas are generally better provided with economic and social infrastructures than the rural areas.

We assume that wealth affects access to public goods and that these two dimensions have an impact on access to housing. Thus the level of wealth of a household may have an influence on its possibilities for accessing public goods, and the converse is also true. Similarly, these two dimensions probably have an impact on the access to housing of the household in question.

Figure 1: Theoretical model of multidimensional welfare



Source: Author

Inspired by the model of Wagle (2005) and of Krishnakumar and Ballon (2008), the present model comprises two sets of equations. The first represents the structural model and considers each latent variable as being a function of exogenous factors and possibly of the other latent variables. The second, also known as the measurement model, relates each category of endogenous variables to the corresponding category of latent variables. The model takes the following form:

$$\begin{aligned} f &= Bf + \Pi x + \varepsilon \\ y &= \Lambda f + u \end{aligned} \qquad (1)$$

where:

f is a vector of latent variables of dimensions (3×1) containing f_1, f_2 and f_3, which are respectively the index of access to public goods, the index of wealth and the index of access to housing. x is a vector $(q\times1)$ of exogenous variables. Let m_1, m_2 and m_3 be the numbers of indicators corresponding respectively to the index of access to public goods, the index of wealth and the index of access to housing, with $m = m_1 + m_2 + m_3$, y being the vector $(m\times1)$ of the indicators. Π is the matrix $(3\times q)$ of the coefficients of the exogenous variables, B the matrix (3×3) of the coefficients of the latent variables

covering their variables and Λ the matrix of the factorial weights emphasizing how the faculties in each dimension affect the fulfilments. ε and u represent respectively two vectors (3×1) and $(m\times1)$ of error terms. With the relations defined between the latent variables, the matrix B should take the following form:

$$B=\begin{bmatrix} 0 & b_{12} & b_{13} \\ b_{21} & 0 & b_{23} \\ b_{31} & b_{32} & 0 \end{bmatrix}$$

In the présence of qualitative variables ordered as in our case, continuous response and non-observable variables y_j^* are introduced, for each indicator y_j with $j=1,\ldots,m$. If it assumed that the variable y_j takes the value $K+1$, for $0,\ldots,K$, it will then be linked to each response variable y_j^* in the following manner:

$$y_j = k \; si \; \gamma_k^j \leq y_j^* < y_{k+1}^j \qquad (2)$$

where:

$k=0,\ldots,K$, $\gamma_0^j=-\infty$ and $\gamma_{K+1}^j=+\infty$. The γ_k^j represent the threshold parameters for each indicator j.

When the indicator is a binary variable, as in our case, the response function becomes as follows:

$$y_j = \begin{cases} 1 \; si \; y_j^* \geq 0 \\ 0 \; si \; y_j^* < 0 \end{cases} \qquad (3)$$

Taking account of this reaction function, the measuring model in expression (1) may be re-expressed as follows:

$$y_j^* = \lambda_j f + u_j \quad \text{avec } j=1,\ldots,m. \qquad (4)$$

where:

λ_j represents the factorial weight associated with the indicator j. The following hypotheses may also be advanced:

$E(\varepsilon)=0,$

$E(u)=0,$

$V(\varepsilon)=\Phi(3\times3),$

$V(u)=\Psi(m\times m).$

It is also assumed that ε is non-correlated with x and u, while u is non-correlated with x and f. In addition, if I is the matrix of identity having dimensions (3×3), $I-B$ is a nonsingular matrix.

These hypotheses serve to determine the matrix of covariances/correlations of the observed variables y and x as a function of θ, θ being a structure containing all of the

vectors and matrices of the unknown parameters of the model, namely B, Π, γ, Φ and Ψ. It will be possible to estimate the model after verification of its identification.

Assuming that the distribution of f conditional upon x follows a normal multivariate law, it is then sufficient to consider only the first and second order moments to estimate the model. The estimation method follows the three-stage procedure of Muthén (1983; 1984), described by Krishnakumar and Ballon (2008). This approach uses weighted least squares to minimize the following adequacy function:

$$F = \left[\hat{\sigma} - \sigma(\theta)\right]' \Omega^{-1} \left[\hat{\sigma} - \sigma(\theta)\right] \tag{5}$$

where:

$\hat{\sigma}$ is the vector of the estimates of $\sigma(\theta)$, obtained from the autocorrelations between the elements of f. $\sigma(\theta)$ is the vector corresponding to the theoretical covariance matrix. Ω is the optimum weighting matrix. Here it represents a convergent estimator of the asymptotic covariance matrix of $\hat{\sigma}$. The minimization of equation (5) then corresponds to an estimation by generalized least squares (GLS).

3.2 The BIA method

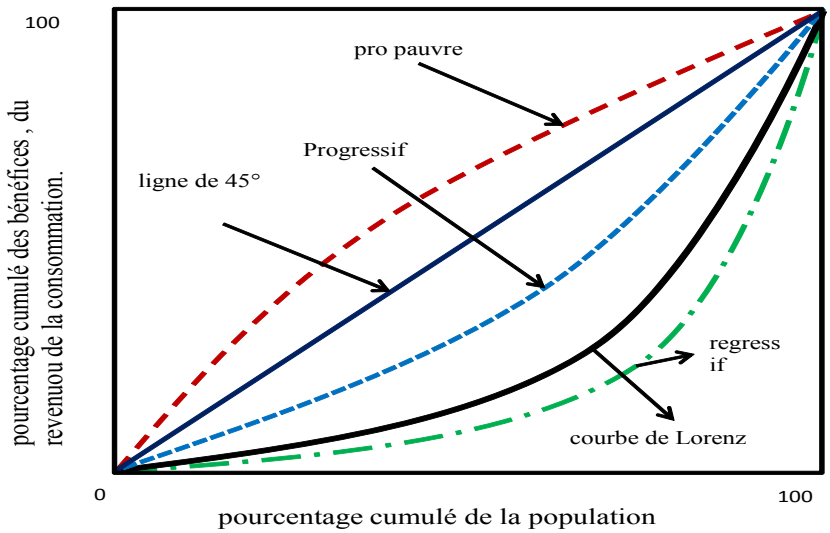
Benefit-incidence analysis (BIA) makes it possible to identify the beneficiaries of a public service by describing, in particular, the way in which public expenditures affect the welfare of the different groups of individuals or households (Demery, 2000; 2003). Davoodi, Tiongson and Asawanuchit (2003) distinguish five stages in implementing the BIA.

The first stage consists in obtaining the average unit cost of the provision of a public service, by dividing the public expenditures allocated to that service (after deduction of recovery costs and of direct payments that may be made by the users of the service) by the total number of users benefiting from it. The latter are then considered the beneficiaries.

The second stage consists in defining the average benefit drawn from the public expenditures in a service as being the average unit cost of the provision of the service. This hypothesis assimilates the transfers in kind from the public expenditures to the welfare of the individuals as measured by their income or consumption. This is a very strong hypothesis. However, the alternative as applied in Younger (1999) is complex and requires a survey to be carried out. The issue in this case is to estimate a demand function for the public services and to derive the benefits from the users' consent to pay as summarized in the demand curve.

In the third stage, the population of users is ordered in accordance with a defined measure of welfare (generally household income or expenditure), from the poorest to the richest, and aggregated into groups of quintiles or deciles. Within the context of the present research, a multidimensional index of welfare (wealth index as described in Section 3) is used to form the groups of quintiles. The fourth stage consists in deriving the distribution of the benefits by multiplying the average benefit derived in stage 2 by the number of users of the service in each consumption group. Finally, the last stage comprises comparing the distribution of the benefits obtained with a certain number of reference distributions. This generally involves using the Lorenz curve and the concentration curve illustrated in Figure 2. The benefits are considered pro-poor if the relevant concentration curve is located above the 45-degree straight line. Such a concentration curve results from a negative concentration coefficient. It is concave in shape, which implies that the first quintile is greater than the fifth. This means that the benefits from the public expenditures are disproportionately allocated to the poorest quintile in absolute terms and relative to their proportion in the total population. By analogy, the benefits are considered pro-rich if the fifth quintile is larger than the first or if the concentration curve of the benefits is located below the 45-degree straight line. That corresponds to a positive concentration coefficient. The benefits are described as progressive in relative terms if the concentration curve is located below the 45-degree straight line but above the Lorenz curve (Demery, 2000). They are described as regressive if the concentration curve is located below the Lorenz curve.

Figure 2: Lorenz curve, concentration curve and analysis of progressivity



Source: Davoodi, Tiongson and Asawanuchit (2003), p. 14.

Several studies have examined the distributional effects of public expenditures: Filmer (2003); Castro-Leal et al. (1999); Sahn and Younger (2000); van de Walle (1998); Kamgnia et al. (2008); Gaddis and Demery (2012); Adams and Alabi (2014); Karim (2015); and Okafor and Ichoku (2015). The public expenditures relating respectively to health, to education, to the provision of drinking water and to infrastructures have been the most thoroughly documented. But these studies are based on a monetary approach to welfare whereas it is nowadays agreed that welfare covers other dimensions than income or consumption. Furthermore, they analyze the impact of these expenditures taken individually, but there is an interdependence between the various dimensions of welfare which should be taken into consideration. For example, access to education may influence access to health and vice versa.

Unlike the studies referred to above, we have based our analysis on a multidimensional approach to welfare which takes account of the interdependences between its dimensions, using the SEM model.

3.3 The data

The data used in this study derive from the QUIBB survey (questionnaire on basic indicators of welfare) undertaken among the households by the Directorate-General for Statistics and National Accounts (DGSCN) in 2011. This survey covering 5 532 households representative of the population of Togo on the national scale was carried out using a two-part investigation. In the first part, a sample of area-frame units comprising enumeration areas was selected. In the second part, a sample of households was selected from among the area-frame units already selected, the same number of households being selected in each area-frame unit. The survey had the objective of providing the elements necessary to the assessment of poverty, such as for example the sociodemographic information (makeup of the household, level of education, etc.) as well as the characteristics of the dwelling, possession of consumer durables and access to basic infrastructures.

Version 5 of the Mplus software (Muthén and Muthén, 2007) was used to make the estimations of the SEM model and to derive the indices of welfare. The progressivity was then analyzed using version 2.3 of the DASP (distributive analysis stata package) tool. The DASP modules are used to estimate the majority of the indices and curves in the field of distributive analysis. They also make it possible to use several databases, carry out most of the best-known decomposition procedures and systematically supply statistics taking account of the investigation plan. For more detail on the DASP tool, Araar and Duclos (2013) may be consulted.

4. Results of the analysis

In this section, comprising three subsections, we will firstly propose some descriptive statistics on access to basic public services, and we will then analyze the interdependences between the dimensions of welfare, before turning to our analysis of the progressivity of access to basic public services.

4.1 Descriptive statistics

Figures 4, 5 and 6, shown in the annex, present some descriptive statistics drawn up by gender and residential environment having to do with the variables of access to basic public services. Generally speaking, it may be observed that there is no notable difference in the access to basic public services as a function of gender, whereas the differences related to the residential environment are more significant. This finding is explained by the indicator selected to measure the access to public services as a function of the time needed to access the closest service, and reflects the fact that the rural areas are less well provided with basic infrastructures than the urban areas.

4.2 Analysis of the interdependence of the dimensions of welfare

Before turning to the interpretation of the results, it is beneficial to verify the quality of the model used, which is evaluated by the comparative fit index (CFI), the Tucker-Lewis index (TLI) and the root mean square error of approximation (RMSEA), which are given in Table 2. The values of the CFI and TLI indices are 0.94 and 0.95 respectively, which is synonymous with a good match. Similarly, the value of the RMSEA error, estimated at 0.04, remains lower than 0.06 and the R^2 values are high, denoting a high-quality match (Hu and Bentler, 1999; Steiger 2007).

In addition, Table 2 shows the results of the structural model, indicating that wealth has a positive and significant effect on the capacities to access public goods and housing. Similarly, the capacities to access public goods have a positive influence on the capacities to access housing. However, the relationship between access to public goods and access to wealth is not a reciprocal one. In fact, contrary to our assumptions, access to public goods has no effect on household wealth. This could be explained by the indicators selected to measure access to public services, which are all relative to the aspect of the "offer" related to these services. For example, a health centre located near a household may indeed increase the capacities of the household to take care of itself, but that will have no effect on the level of wealth of the household in question if it does not utilize these services.

The residential environment, the marital status and the level of education of the head of household are the exogenous variables that have a significant impact on the index of wealth. Outside these three exogenous variables, the capacity to access public goods is influenced by gender and by the size of the household. Thus, as an example, the fact of being female or of residing in a rural environment reduces the index of access to public goods relative to the fact of being male or of residing in an urban environment. These results can be explained, on the one hand, by certain customary norms which do not confer autonomy of decision on women in the utilization of public services. On the other hand, they are also explained by the fact that the urban environments are better provided with public infrastructures than the rural environments. By contrast, the housing index is influenced only by the residential environment, the size of the household and gender.

Table 2: Results of the structural model

Variables	Wealth f_1*		Public goods f_2*		Housing f_3*	
	Coefficient	Standardized coefficient	Coefficient	Standardized coefficient	Coefficient	Standardized coefficient
f_1* **Wealth**	-	-	0.251*	1.61*	0.792*	0.933*
f_2* **Public goods**	-	-	-	-	0.395*	0.072*
f_3***Housing**	-	-	-	-	-	-
z_1 **Envirn't**	-0.153*	-0.027*	-0.123*	-0.137*	-0.125*	-0.026*
Z_2 **Size of household**	-0.003	-0.001	-0.036*	-0.04*	-0.042*	-0.009*
Z_3 **Sex**	-0.010	-0.002	0.047**	0.052**	0.074*	0.015*
Z_4 **Age**	0.001	0.000	0.002**	0.003**	0.002	0.000
Z_5 **Marital status**	-0.170*	-0.03*	-0.029**	-0.032**	0.028	-0.006
Z_6 **Level of education of the head of household**	-0.315*	-0.055*	0.041	0.046***	-0.001	0.000
R^2	0.98		0.66			0.99
CFI	0.94					
TLI	0.95					
RMSEA	0.04					

The asterisks *, **, *** indicate a 1 per cent, 5 per cent and 10 per cent significativity respectively
Source: Author's estimates

4.3 Analysis of progressivity

The analysis of the progressivity of the public services was carried out using the concentration curve and the Lorenz curve relative to the indices of wealth and of access to public goods. Part (a) of Figure 3 indicates a progressivity in access to public goods in Togo, the concentration curve of access to public services being below the 45-degree straight line but above the Lorenz curve. This means that in 2011, public services in Togo, overall, enabled a redistribution of the welfare of the rich strata for the benefit of the poor strata of the population, thus indicating the effective targeting of the poor at whom the public policies were aimed.

However, the convex shape of the concentration curve of the index of access to public goods indicates its pro-rich character. In other words, the rich benefit more than the poor from the public expenditures allocated to basic public services, which gives an indication of a problem of access of the vulnerable strata to basic public services.

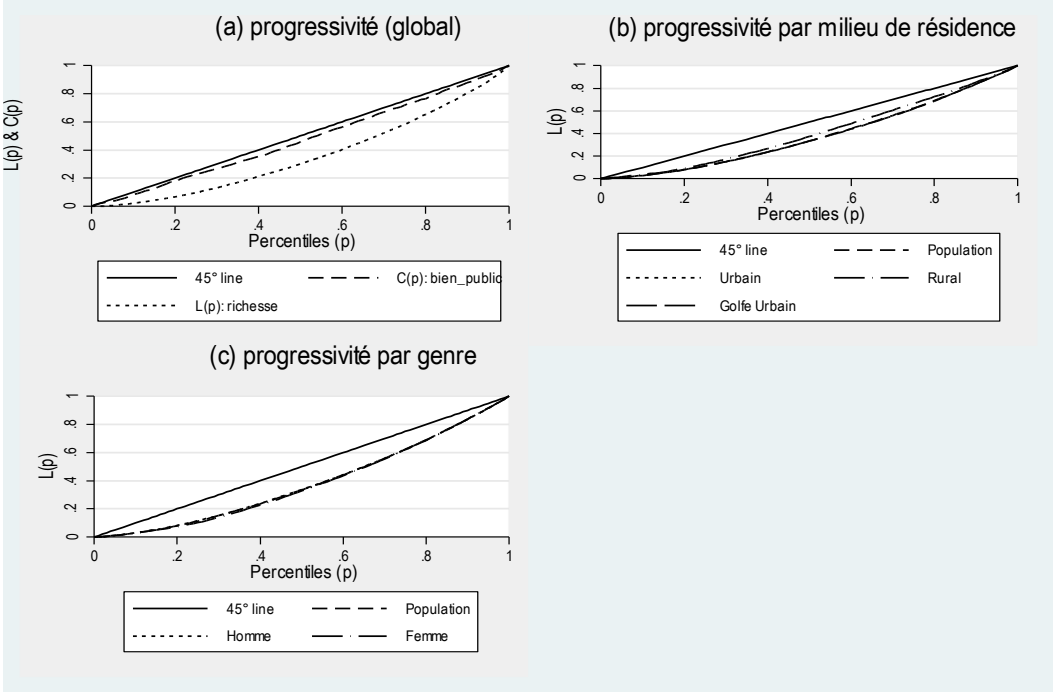
These results differ slightly from those that are generally found in the African context, in which certain services such as primary education are pro-poor (Sahn and Younger 2000; Kamgnia et al., 2008; Gaddis and Demery, 2012) whereas other services such as higher education (Kamgnia et al., 2008; Gaddis and Demery, 2012) are regressive. Such a divergence in the results may be explained by the methodological approach adopted. Contrary to the studies cited above, we have adopted a multidimensional approach to welfare which takes account of the interdependence of its dimensions.

Consequently, the results of our study suggest that in order effectively to combat inequality and significantly reduce poverty in Togo, measures have to be taken to improve the access of the most disadvantaged strata to basic social infrastructures. For example, in the area of access to health care, the situation of the poor can be improved by universal health insurance coverage. The creation of public infrastructures in the rural environment, where the poverty rate is highest, would also make it possible to improve the access of the poor to basic public services.

A disaggregated analysis by residential environment (urban, rural) and by gender of the head of household is also presented in Figure 3 (Part b and Part c). The analysis by residential environment shows that access to public services is more progressive in the rural environment than in the urban one, while the analysis by gender does not reveal a significant difference between men and women in this area. These results are in line with those of Sahn and Younger (2000), who analyzed the progressivity of health and education

services in Africa. They determined that in Mauritania, Guinea, Madagascar and Uganda the services provided in the rural environment were more progressive than those provided in the urban environment, without, however, detecting a significant difference between men and women in this area. These results suggest that the provision of basic services in the rural environment would cause a more progressive redistribution of welfare than would be the case for service provision in the urban environment.

Figure 3: Analysis of the progressivity of basic public services by gender and by residential environment



Source: Author's estimates

5. Conclusion

The present article took as its objective to analyze the progressivity of the services funded by public expenditures in Togo. To that end, we made use of the structural equations model (SEM) with latent variables so as to conceptualize the Sen capabilities approach to welfare and to take account of the interdependence of the dimensions of welfare. Three dimensions were selected, namely wealth, access to public services and access to housing, to analyze the interdependences of the dimensions of welfare in Togo. The results of the analysis showed that wealth has a positive influence on access to public goods and that these two dimensions have an impact on access to housing. A further outcome is that these dimensions are affected by gender, the residential environment or the size of the household. The Lorenz curve and the concentration curve of the indices relating to access

to public goods and to wealth were used to understand the progressivity of the benefits of public goods. The results showed that the benefits of public expenditures allocated to public services were progressive but pro-rich and that access to public services was more progressive in the rural environment than in the urban one. These conclusions suggest that that in order effectively to combat poverty and inequality in Togo, the emphasis must be placed on improving the accessibility of the poor to services funded by public expenditures. Given that the poor populations in Togo live primarily in the rural environment, measures are needed to improve rural populations' access to the goods funded by public funds, notably through the building of public infrastructures in the rural environment. Since women also form part of the disadvantaged strata in Togo, it is necessary to take targeted actions to promote their access to public services. That could take the form of public funding of infrastructures that are exclusively used by women.

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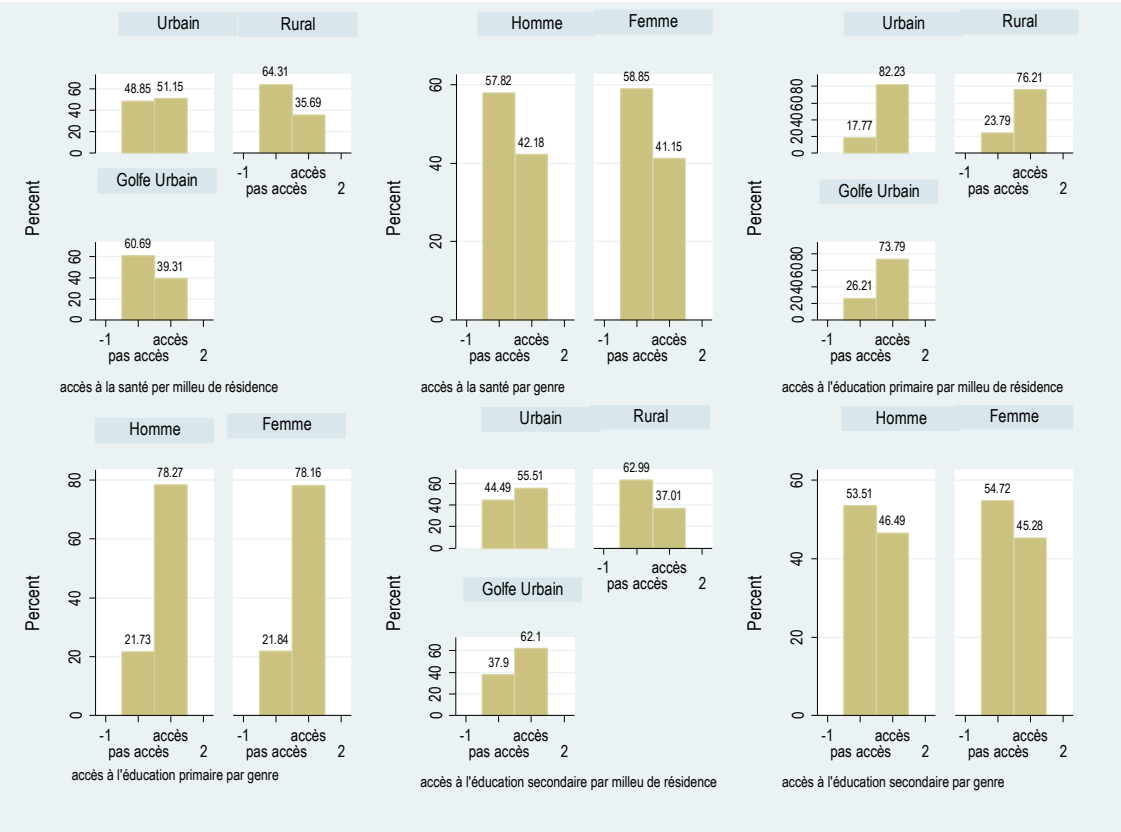
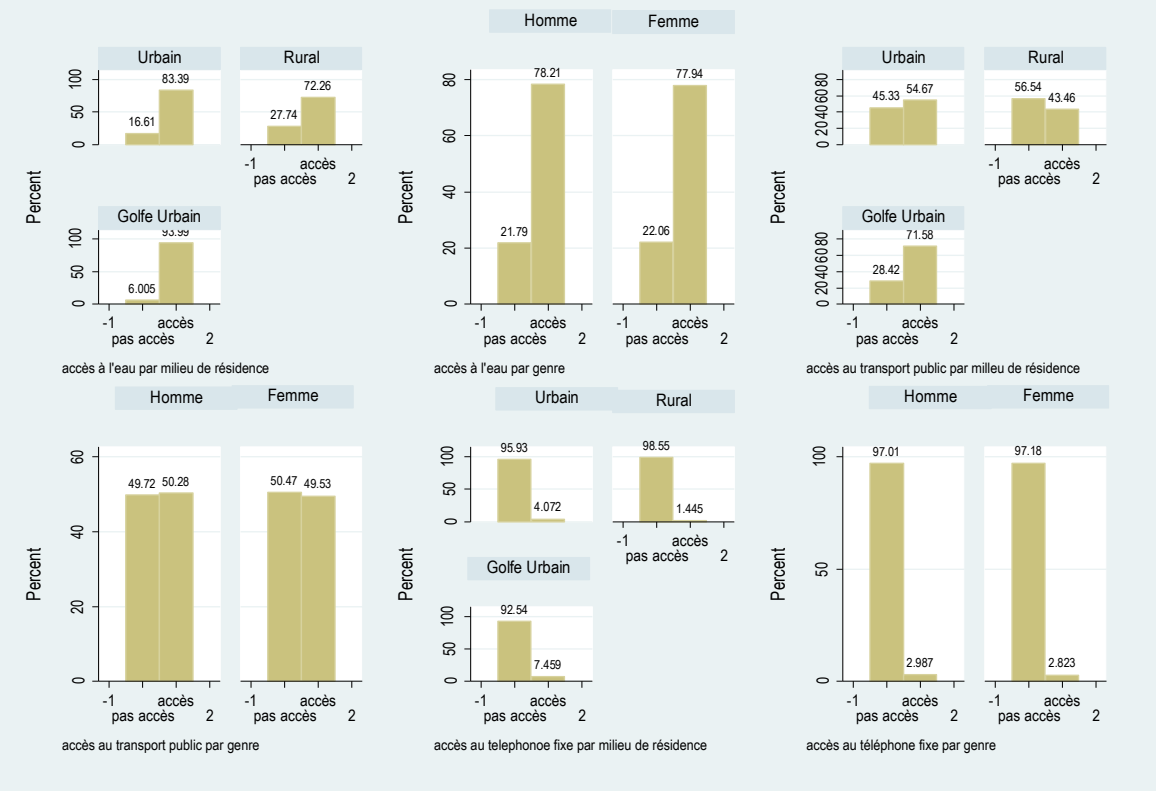
ANNEX

Figure 4: Access to health, primary education and secondary education by gender and by residential environment



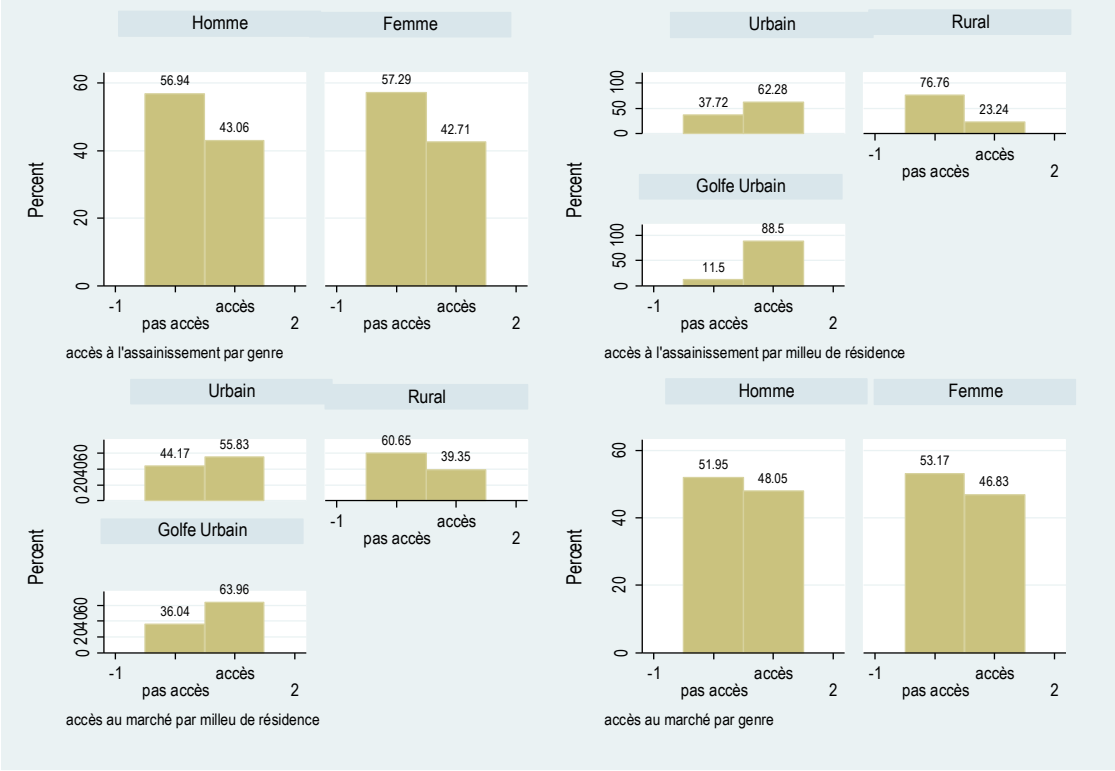
Source: Author's estimates

Figure 5: Access to water, public transport and fixed-line telephone by gender and by residential environment



Source: Author's estimates

Figure 6: Access to sanitation and to the food market by gender and by residential environment



Source: Author's estimates

Livelihood Strategies and Household Resilience to Food Insecurity: the Case of Niger

Ruben DJOGBENOU

Abstract

Food insecurity is a major issue in the landlocked West African country of Niger. Following a series of food crises, actions to address food insecurity have been introduced.

Although the concept of resilience has been raised in the literature, few applications have been made in the context of food insecurity. To our knowledge, no study has focused on measuring resilience to food insecurity in the context of Niger.

This paper contributes to the literature through its use of a quantitative approach to measure the level of resilience to food insecurity in Niger. The data are drawn from the Niger National Survey on Living Conditions and Agriculture 2011.

The findings show that the least-resilient households are the poor agricultural households (-0.09) and the nomadic cattle-breeder households (-0.16). The results also show high inequalities in the distribution of the resilience index and support the introduction of policy measures to facilitate the access of the least-resilient households to basic social services.

Keywords: Niger, livelihood strategy, resilience, food insecurity.
JEL: Q12, Q18, I32, I38.

1. Introduction

1.1 Issues

Niger is a landlocked West African country of 16 million people. According to the World Bank, its population is growing at an annual rate of 3.3 percent, and the country is ranked among the fastest-growing in the world in terms of population. Such rapid population growth contributes to the spread of poverty in the country. According to the International Fund for Agricultural Development (IFAD), nearly 63 percent of the total population lives below the poverty line and 34 percent lives in extreme poverty. This picture is even worse in rural areas, where 66 percent of the population lives under the poverty line and 36 percent in extreme poverty. The recent political instability combined with high inequality, weak infrastructure and extreme weather conditions has exacerbated poverty in Niger.

The driving sector of Niger's economic performance is agriculture. According to the World Food Programme, almost 82 percent of the country's population makes a living through farming activities. Since the early 2000s, Niger has been hit by negative agricultural and weather events. In 2001-2002, Niger suffered from strong price inflation. This was followed, in 2004-2005, by severe drought and a locust invasion that prompted a severe food security crisis. Only two years later, in this general instability, Niger was hit by the price increase of foodstuffs at the regional level. Recently, in 2009-2010, Niger faced a pastoral crisis with price increases. This was due to poor harvests along with unpredicted flooding that naturally led to a severe food security crisis that affected around 3 million people in both urban and rural areas. Then in 2012-2013 the Sahel region faced a severe crisis coupled with general political instability, while poor harvests in 2011 resulted in cereal deficits that prompted 20 percent of the population to fall into food insecurity in 2012. This sorrowful picture of apparently successive food crises has contributed to the high level of malnutrition in the country. According to the World Food Programme, around 10 percent of children under 5 years of age suffer from acute malnutrition, while a total of 44 percent suffer from chronic malnutrition. Food insecurity is therefore a major topical concern in Niger.

Food security has become a widely discussed issue in the literature. Recently, the focus has been on the various mechanisms that households could use to cope with economic shocks affecting their food security. At present, the coping strategy of households depends on their capabilities, their assets (including material and social resources) as well

as the different activities they develop (Alinovi et al., 2010). Dercon and Krishman (1996) add that household livelihood strategy is also part of the coping strategy of households. For them, households belonging to different socioeconomic groups have different strategies to earn their own living. These differing responses result in different levels of resilience to food insecurity.

In order to add to the existing literature, this study investigates livelihood strategies and household resilience to food insecurity in Niger, as it is becoming important that policymakers take these issues into account while implementing their food strategies.[1]

In this framework, the core assumption is that households belonging to different socioeconomic groups (small farmer households versus non-farmer households for instance) require different interventions. Consistent with this assumption, this study intends to reply to the following three main research questions. Is there any structure in the grouping of households in Niger? What is the level of resilience to food insecurity in each livelihood group? What are the policy implications for empowering households?

1.2 Objectives

This paper focuses on identifying the major determinants of the livelihood strategy in Niger, which is crucial to improving the response mechanisms related to food insecurity and poverty in Niger. More specifically, firstly we develop a cluster analysis to determine the structure of households in Niger. This cluster analysis allows us to construct livelihood strategy groups in Nigerien households. Secondly we build a resilience index by livelihood strategy groups to measure the level of resilience to food insecurity in Niger.

1.3 Contribution

Many empirical studies have focused on measuring resilience in various contexts, yet to our knowledge no study has investigated household resilience to food insecurity in Niger. As food insecurity is a real issue in the country, our study is a major contribution to understanding the "resilience" aspect of food insecurity in Niger. From another perspective, this study is policy-relevant since it informs the efforts of authorities to address food insecurity in Niger.

The remainder of the paper is organized as follow. Section 2 explores the existing

[1] For instance, in Niger, the IFAD works to improve food and nutrition security in rural households and to

literature on resilience to food insecurity. Section 3 presents the methodology adopted to compute the resilience index in the case of Niger. Section 4 shows the main results. Conclusions and policy implications are presented in section 5.

2. Literature review

The purpose of this chapter is to present the theory on resilience. As the literature on the concept of resilience is very broad and diverse, we intend to give a short summary of its theoretical considerations.

2.1 Defining resilience

2.1.1 *Etymology*

Resilience comes from the Latin *resilientia*, used in metallurgy to reflect the ability of a metal to return to its initial state after a shock or continuous pressure. Etymologically, resilience therefore means the ability to withstand and recover from significant and persistent adversity.

Resilience was originally a physical concept, which was later adopted by the social sciences, including psychology and economics

2.1.2 *Some authors' definitions of resilience*

a) Rutter (1990): Positive role of individual differences in the response of a person to stress and adversity.
b) Fonagy et al. (1993): Normal development in difficult conditions.
c) Cowen et al (1996): Exceptional adaptation despite exposure to significant stress.
d) Allen (1998): Ability to withstand the negative effects of internal and environmental vulnerabilities.
e) Masten and Coatsworth (1998): Manifest competence in the context of major obstacles to adaptation/development.
f) Manciaux et al. (2001): The ability of a person or a group to develop well, to continue to plan for the future in spite of "destabilizing" events, difficult living conditions, severe trauma.
g) Virginia B. et al. (April 2003): Resilience is the ability of individuals and systems (families, groups and communities) to overcome adversity or risk. This ability evolves with time; it is reinforced by protective factors in individuals or their environment; it contributes to the maintenance of good health.
h) Tisseron (2007): Resilience is both the ability to withstand the trauma and to rebuild after this trauma.

Given the diversity of definitions, Anaut (2005) defines resilience as:

- Normal development in difficult conditions
- A process by which an individual interacts with his environment to produce a given change
- The capacity to successfully integrate into society despite adversity that bears a significant risk of a negative outcome
- Exceptional adaptation despite exposure to significant stress

Anaut (2005) states that the concept of resilience can be approached from very different, sometimes divergent, considerations, hence the need to clarify the operational definition of resilience used in any research.

2.1.3 *The polysemous characteristic of resilience*

Kaplan (1999) distinguishes four main elements in the definition of resilience:

- The relationship between resilience and results
- The conceptualization of resilience
- The definition and operationalization of resilience factors that influence the results
- The perception of resilience

Manciaux et al. (2001) note that all proposed definitions are related to cultural considerations and therefore vary between societies and also from one era to another. They conclude that it is probably impossible to find a consensus among researchers as to the precise definition of the concept.

However, a majority of researchers agree to define resilience as a combination of two necessary and distinct dimensions: significant adversity and positive adaptation (Luthar, 2003). Psiuk (2005) characterizes it as a two-stage process: confrontation of the trauma and positive reconstruction. There must be a clear and substantial presence of risk to differentiate the resilience from normal or normative development (Luthar and Chichetti, 2000; Rutter, 2005). Any measure of resilience thus requires observing the **manifestation of its dimensions**.

2.1.4 *A multidisciplinary concept*

The concept of resilience spans several sciences. It generally refers to the ability of an organization, group or structure to adapt to a changing environment. It can be used as follows:

Thermodynamics: the ability of a material to maintain a temperature for the duration

Economy: the ability to resume growth after suffering a shock

IT: the ability of a system or network architecture to continue to operate in the event of failure

*Governance (*risk management and social): this combines the previous approaches by addressing the group and the collective more than the isolated individual

Armament and aerospace: the level of ability of an embedded system fault tolerant to continue to operate in degraded mode in a hostile environment

*Zoology***:** the reproductive capacity of an animal species in a hostile environment, which is capable of sudden expansion if the environment improves.

2.2 Resilience factors

Characteristics associated with the resilience process have been identified as factors of resilience. Resilience appears as a multidimensional concept stemming from the interaction between the individual and its environment, including internal factors relative to the individual (individual factors: psychical structure, personality, defensive mechanisms, etc.) and external factors (family or community factors: characteristics of the social and emotional environment). We distinguish between risk factors and protective factors.

2.2.1 *Risks factors*

A risk factor is "an event, organic or environmental condition which increases the probability of a person developing emotional or behavioural problems" (Fortin and Bigras, 2000 in Theoret et al., 2003, p.15).

Gunby (2002) gives a threefold classification to risk factors:

- **Chronicity:** the risk factor is either chronic and minor or sporadic and major;
- **Proximity:** the risk factor can be proximate and direct or distant and indirect;
- **Control:** can the risk factor be controlled by the person or not?

For Anaut (2003), these factors may include biological, personal, relational (family problems) and social (socioeconomic problems or professionals) components. Other researchers such as Manciaux et al. (2001) define a number of risk factors such as "abuse, extreme poverty, social isolation, chronic illness, mental disorder or parental alcoholism, drug abuse, etc."

2.2.2 *Protective factors*

Lemay (1999) defines a protective factor as a biological, social, emotional or sociocultural condition that fosters the growth of a person. Gunby (2002) distinguishes four types of protective effects:

1. **The "protector-stabilizing effect":** maintains the competence of the subject despite the stressed presence of risk

2. **The "protector-amplifier effect":** improves or enhances the degree of competence in a context of adversity

3. **The "protector-reactive effect":** promotes a high degree of competence, but is increasingly ineffective as adversity intensifies

4. **The general protective effect:** always guarantees a higher degree of skill.

Garmezy and Masten (1991) and Anaut (2003) consider three protective factors: individual factors such as temperament, self-esteem, empathy, thought, social and cognitive skills; family factors such as family warmth, cohesion and interest from the vicinity; and extra-familial factors such as social safety network and successful experiences. These three factors improve self-esteem, self-efficacy and open new possibilities for the subject. It is necessary to clarify that resilience should not be confused with the protective factors: it was born from the interaction between protective and risk factors.

2.3 Resilience versus vulnerability

The interaction between risk factors and protective factors may lead to either resilience or vulnerability. An individual facing significant adversity will either confront or avoid the situation: it is the coping or adjustment strategy that represents, according to Folkman and Lazarus (1984), "the set of cognitive and behavioural efforts, to manage specific external or internal demand, assessed as testing or exceeding the individual resources."

There are two steps in the cognitive evaluation of the situation:

1. A first evaluation of the primary risk factors which enables, through a perceived stress, a stressful situation to be identified and its characteristics (severity, risk, ambiguity) to be assessed

2. After this initial evaluation, the individual will perform a second evaluation which enables the resources (protective factors) to deal with the situation (control, social resources) to be determined.

Vulnerability is the lack of the protective factors in front of the risk factors. Thus it is a lack of protection, a situation of insecurity and exposure to risk, shocks and stress. It has two aspects: an external aspect shown by the risks, shocks and stress to which the subject may be exposed and an internal aspect that is being defenceless, causing an inability to face the risk without suffering damaging losses. The internal aspect helps account for individual variability; it is therefore related to a reduction in the subject's protective factors. Conversely, resilience is the successful resistance of the subject, which continues to grow and increase its skills in an adverse situation (Anaut, 2003). In other words, protective factors act as resilience "mediator mechanisms". In this sense, resilience does not mean invulnerability, invincibility or insensitivity but evokes the idea of flexibility and adaptability. It is variability in the same individual in the course of its development, which explains that a subject is not resilient to everything at all times. Furthermore, a system can be at once resilient and vulnerable.

2.4 Empirics on resilience to food insecurity

Not many studies focus on quantitative measures of household resilience to food insecurity. Figure 1 shows a short synthesis of studies on the subject.

In the literature, the main issue is that resilience is not directly observable. For the purpose of this study, in general we identify two procedures to handle the problem.

Alinovi et al. (2008, 2010) suggest a strategy in which resilience is modelled as a multidimensional latent variable. They use data from the Kenya Integrated Household Budget Survey and include six (6) components:

- Social safety nets
- Access to public services
- Assets
- Income and food access
- Stability, and
- Adaptive capacity

Table1: ***Empirical approaches to resilience measurement***

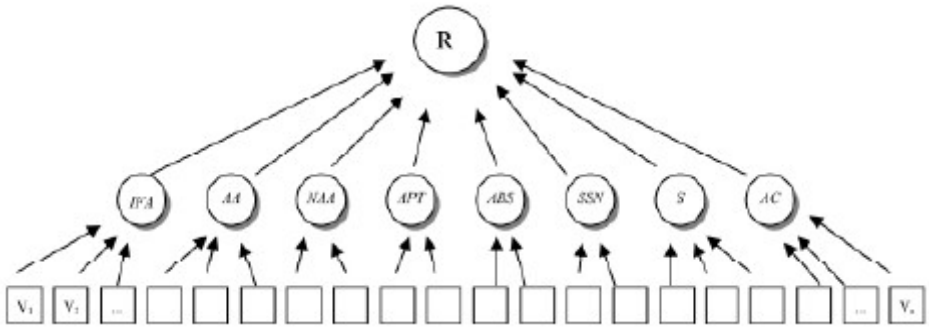
Author(s)	Alinovi *et al.* (2010) Alinovi *et al.* (2008)	Mulat and Negussie (2010)	Keil *et al.*(2008)	Carter *et al.* (2006)
Resilience Definition	Resilience as a latent variable based on several pillars: (i) social safety nets, (ii) access to public services, (iii) assets, (iv) income and food access, (v) stability and (vi) adaptive capacity	Resilience considered as a latent variable based on (i) access to food, (ii) liquid assets (iii) education and (iv) social capital	Resilience defined as variation in basic consumption due to a shock	Resilience defined as households' incapacity to smooth their consumption by depleting their assets stock
Measurement Technique	Two Stage Factorial Analysis and CART	Principal Component Analysis	Principal Component Analysis	Livestock Assets
Separability of Measurement and	NO	YES	YES	YES
Data Requirement	Cross Sectional Data	Panel Data or more period to apply A-B estimator)	Panel and Recall Data	Panel Data

Model for Determinants Detection		Static and Dynamic Panel Model $\Delta R_{it} = \Delta R_{i,t-1}\varphi + \Delta x_{it}\beta + \Delta H_{it}\gamma + \Delta\varepsilon_{it}$ $R_{it} = \alpha + X'_{it}\beta + H'_{it}\gamma + \varepsilon_{it}$	Tobit model $\begin{cases} y_i^* = \beta_0 + \sum_{j=1}^{k}\beta_j x_{ij} + \varepsilon_i \\ DRI_i = \min(y_i^*, 1) \end{cases}$	$\ln\left(\frac{A_{2i}}{A_{0i}}\right) = x_i\beta + \sum_{j=1}^{4}(Q'_{ji})\beta'_A + \sum_{j=1}^{4}\left[(Q'_{ji}\Theta_i)\beta'_\Theta + (Q'_{ji}\Theta_i L_i)\delta'_L + (Q'_{ji}\Theta_i K_i)\delta'_K\right] + \varepsilon_i\beta_\varepsilon + F_i\delta_F + \omega_i$
Resilience to what?	General Resilience: to idiosyncratic and covariate shocks	General Resilience: to idiosyncratic and covariate shocks	Specific Covariate Shocks	Specific Continuative or Punctual Covariate Shocks

Source: Ciani and Romano (201

In practice, all those components are treated as latent variables, because they are not directly observable. Thus, Alinovi et al. (2008, 2010) suggest a two-stage process to measure resilience to food insecurity (Figure 2).

Figure 1: Household resilience index estimation procedure



Source: Alinovi et al. (2010)

In the first stage, some observed variables (drawn from the survey data) are used to estimate a first set of latent variables using factor analysis. Then the latent variables computed are used to compute a resilience index through the same technique.

Alinovi et al. (2010) perform a cluster analysis to classify the population into six sub-groups corresponding to six livelihood strategies, before running the computation of the resilience index. They are thus able to highlight the differences in livelihood groups corresponding to different resilience levels and resilience-building mechanisms.

From another perspective, Carter et al. (2006) and Keil et al. (2008) suggest using an observable variable as a proxy of resilience.[2] In fact, Keil et al. (2008) measured the resilience of Indonesian farmers to El Niño Southern Oscillation (ENSO)-related drought as "the observed degree of drought-induced expenditure reductions for basic necessities". In this framework, the absolute value of negative variations is supposed to be negatively correlated with resilience: a fully resilient household is expected to record null variations in basic consumption. They use Principal Component Analysis to aggregate the variables that describe consumption. In their analysis, the first principal component is extracted and used to compute the scores. Then they specify a model to identify the determinants of resilience. However, as we stated earlier, the fact that resilience is a complex phenomenon makes the proxy-based approach too simple to measure it.

[2] This is in fact the most-used approach to measure resilience

For that reason, and consistent with Ciani and Romano (2014), we adopt the approach of Alinovi et al. (2010). In doing so, we intend to fill the gap of empirical knowledge on how policy could efficiently help households cope with various shocks related to food insecurity in Niger.

3. Methodology

Our methodology builds on Alinovi et al. (2010). Using a cluster analysis, we first identify the livelihood strategy of households in Niger. The objective of the cluster analysis is to assign households to groups identified as coping strategy options against food insecurity. In our case, we adopt the hierarchical cluster analysis to group the households of our sample data.

After building the livelihood strategies, we built the resilience to food insecurity index based on a two-stage factor analysis: the multiple factor analysis.

At the first stage, we perform various factor analyses on the identified dimensions of the household resilience to food insecurity. These factor analyses allow us to compute some sub-indexes $(I_{Gi})_{(1 \leq i \leq K)}$ representing the K components (latent variables) of the resilience index.

At the second stage, we again use a factor analysis to compute the resilience index. This resilience index has 10 components:

- Access to basic services
- Durable goods
- House characteristics
- Adaptive capacity
- Physical connectivity
- Food security
- Agricultural assets
- Durable assets value
- Connectivity assets value
- Economics and demographics

The functional form of our resilience index, denoted RI, is:

$$RI = \frac{\sum_{k=1}^{K} \lambda_k I_{G_k}}{\sum_{k=1}^{K} \lambda_k} \quad (1)$$

In equation (1), λ_k is the weight of the component k and is drawn from the factor loadings and the eigenvalues resulting from the multiple factor analysis and I_{Gk} is the sub-index (latent variable) relative to the component k.

The normalized resilience index ($Norm_{RI}$) is obtained by the following:

$$Norm_{RI} = \frac{RI - (\min RI_l)_{l=1,\ldots,N}}{(\max RI_l)_{l=1,\ldots,N} - (\min RI_l)_{l=1,\ldots,N}} \quad (2)$$

Where N is the number of households in our sample.

3.1 Data and sources

The data are drawn from the Niger National Survey on Living Conditions and Agriculture (ECVM/A) 2011. This integrated multi-topic household survey was conducted to evaluate poverty and living conditions in Niger. Surveys of this type are regularly undertaken in Niger. The two most recent surveys were the QUIBB (Questionnaire des Indicateurs de Base du Bien-être) in 2005 and the ENBC (Enquête Nationale sur le Budget et la Consommation des Ménages) in 2007/08. This survey was implemented by the National Institute of Statistics (Institut National de la Statistique - INS) with technical and financial assistance from the World Bank.

The survey covers a sample of 3,968 households: 1,538 in urban areas and 2,430 in rural areas. The sample was drawn using stratified two-stage sampling, covering urban areas (Niamey, other urban) in two strata and all rural agroecological zones (agricultural, agropastoral, pastoral) in three strata. In the first stage of the sampling, 270 enumeration areas (EA) were drawn from the nearly 10,000 EAs and at the second stage, 12 households from urban areas and 18 from rural areas were drawn from each EA. Data collection was organized into two visits: a post-planting visit from mid-July to mid-September 2011 and a post-harvest visit in November and December 2011. Three questionnaires were designed to collect a range of information on households, their farms and the communities in which they live. For the household questionnaire, the data collected concerned the household roster, health, education, employment, non-farm enterprises, housing, non-labour income, and food and non-food consumption. The community questionnaire is dedicated to information on access to services and market prices. As for the agriculture questionnaire, it is designed to collect data on access to land, inputs used (seeds, fertilizers, pesticides, etc.), labour (household and hired labour), equipment, production, marketing and farm income, and extensive data on livestock.

For the purpose of our analysis, we concentrate on the household heads and reduce the sample to 3,578 households.

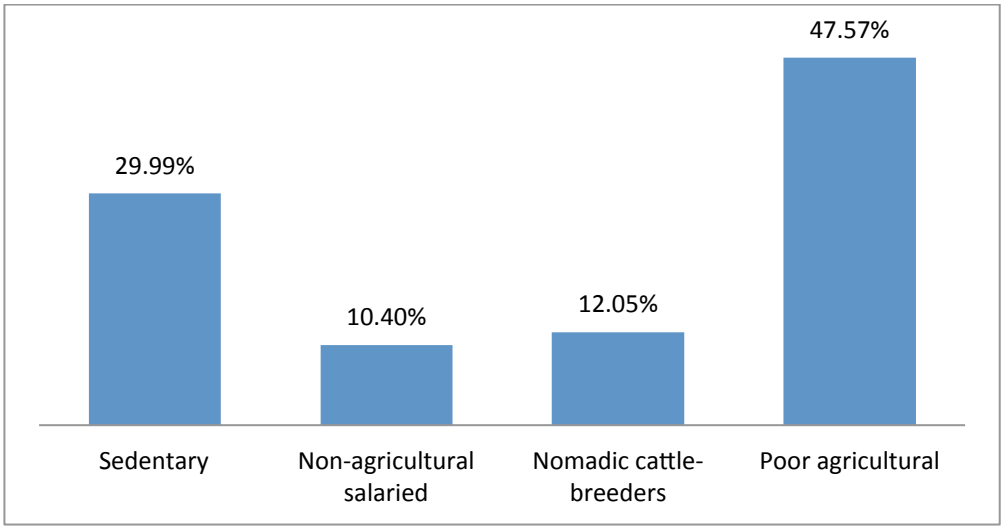
The variables used to identify the livelihood strategies are: household head demographic characteristics (age, gender, marital status, branch, socioeconomic group, industry, socio-professional category, etc.), region, food expenditure, household size, agricultural status, etc.

4. Results

4.1 Livelihood groups

Our analysis identifies four (4) livelihood strategy groups in Nigerien households:

Figure 2: Livelihood strategy groups in Niger



Source: Author's computation

Sedentary households (29.99 percent): We note that 98.82 percent of household heads in independent agriculture belong to this livelihood strategy. Over 90 percent of artisans and traders belong to this group and 63.05 percent of households living in Niamey are in this group. We also note that 98.89 percent of households in this livelihood strategy are sedentary, 91.91 percent of household heads in this group hold an individual enterprise and 87.89 percent of household heads are in permanent employment. Household heads in this group are on average 44 years of age and the average household size is five.

Non-agricultural salaried households (10.40 percent): In this livelihood strategy, 83.29 percent of households are in the fifth quintile of welfare. 81.88 percent of those who work in the health and education sectors are in this group. Household heads in this group are on average 43 years old and the average household size is five.

Nomadic cattle-breeder households (12.05 percent): 84 percent of nomad households and 85.13 percent of cattle-breeders belong to this livelihood group. 93.28 percent of households in this livelihood strategy are in rural areas. Household heads in this group are on average 45 years of age and the average household size is six.

Poor agricultural households (47.57 percent): 96 percent of agricultural households are in this livelihood strategy (most of them being small farmers). 94.42 percent of household heads who are temporary workers, over 80 percent of agropastoral and pastoral households and 86.85 percent of the poorest households are in this group. 85.77 percent of the household heads of this group completed primary education. 81.40 percent of rural households are in this group. Household heads in this group are on average 44 years old and the average household size is seven.

The distribution of livelihood strategy groups differs across regions of Niger (Table 1). For example, cattle-breeder households are mostly concentrated in the Agadez region (53.60 percent), while sedentary households are mostly concentrated in urban areas (46.13 percent). The distribution of poor agricultural households is quite uniform across regions. This reflects the importance of agricultural activities in Niger.

Table 2: ***Distribution of livelihood strategy groups across Niger regions (percentage)***

Livelihood strategy groups	Agadez	Diffa	Dosso	Maradi	Tahoua	Tillab´eri	Zinder	Urban region	Total
Sedentary	10.34	3.54	5.22	11.00	9.88	3.91	9.97	46.13	100
Non-agricultural salaried	8.06	1.34	5.11	4.57	5.91	3.49	6.72	64.78	100
Nomadic cattle-breeders	53.60	29.93	0.46	3.02	5.57	0.00	6.96	0.46	100
Poor agricultural	0.88	10.34	18.63	17.69	15.69	17.22	17.39	2.17	100
Total	10.82	9.73	11.01	12.55	11.71	9.73	12.80	21.66	100

Source: Author's computations

Table 3: ***Distribution of livelihood strategy groups within Niger regions (percentage)***

Livelihood strategy groups	Agadez	Diffa	Dosso	Maradi	Tahoua	Tillab´eri	Zinder	Urban region	Total
Sedentary	28.68	10.92	14.21	26.28	25.30	12.07	23.36	63.87	29.99
Non-agricultural salaried	7.75	1.44	4.82	3.79	5.25	3.74	5.46	31.10	10.40
Nomadic cattle-breeders	59.69	37.07	0.51	2.90	5.73	0.00	6.55	0.26	12.05
Poor agricultural	3.88	50.57	80.46	67.04	63.72	84.20	64.63	4.77	47.57
Total	100	100	100	100	100	100	100	100	100

Source: Author's computations

It appears that the largest share of cattle-breeders can be found in the Agadez region (59.69 percent), the largest share of poor farming households is found in the Tillabéri region (84.20 percent) and the largest share of sedentary and non-agricultural salaried is found in urban areas (63.87 percent and 31.10 percent respectively).

4.2 Resilience index

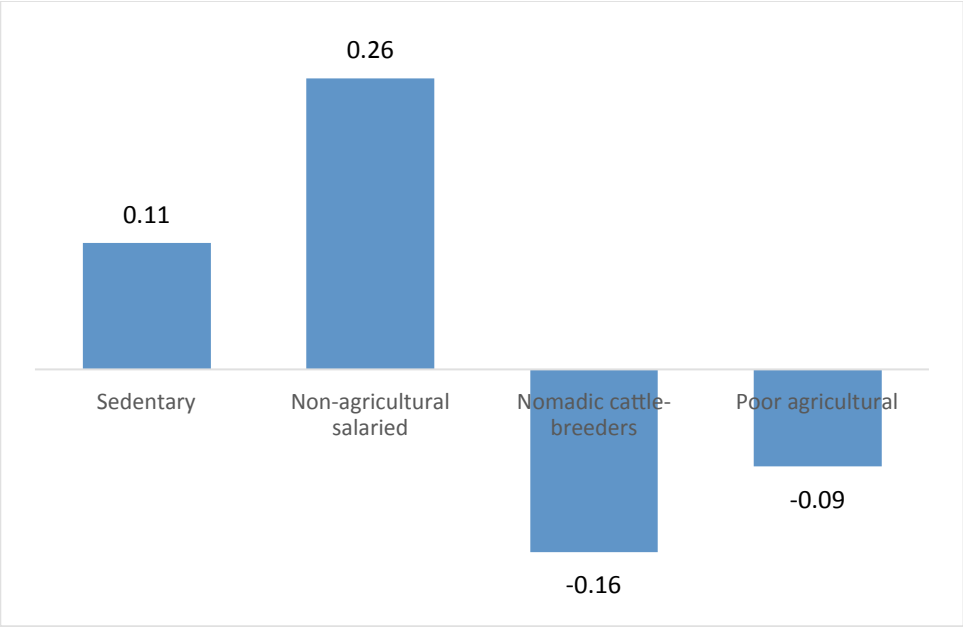
In this section we show the results for the resilience index. Details on the sub-indexes are reported in annex 2. Our resilience index is built on 10 components, each rep- resenting one dimension of household resilience to food insecurity. For the purpose of comparisons, we compute the difference between each livelihood group index and the overall resilience index for Niger (Figure 3). The results show that the richest non-agricultural salaried households are the most resilient (0.26), followed by the independent sedentary households (0.11). The least-resilient households are the poor agricultural households (-0.09) and the nomadic cattle-breeder households (-0.16).

Table 4: ***Resilience index by livelihood strategy group***

Livelihood strategy groups	Resilience index
Sedentary	0.11
Non-agricultural salaried	0.26
Nomadic cattle-breeders	-0.16
Poor agricultural	-0.09
Niger	0.2343

Source: Author's computations

Figure 3: Resilience by livelihood strategy group in Niger



Source: Author's computation

Table 4 shows the value of the sub-indexes of the resilience index by livelihood strategy group.

Table 4: *Sub-indexes by livelihood strategy group*

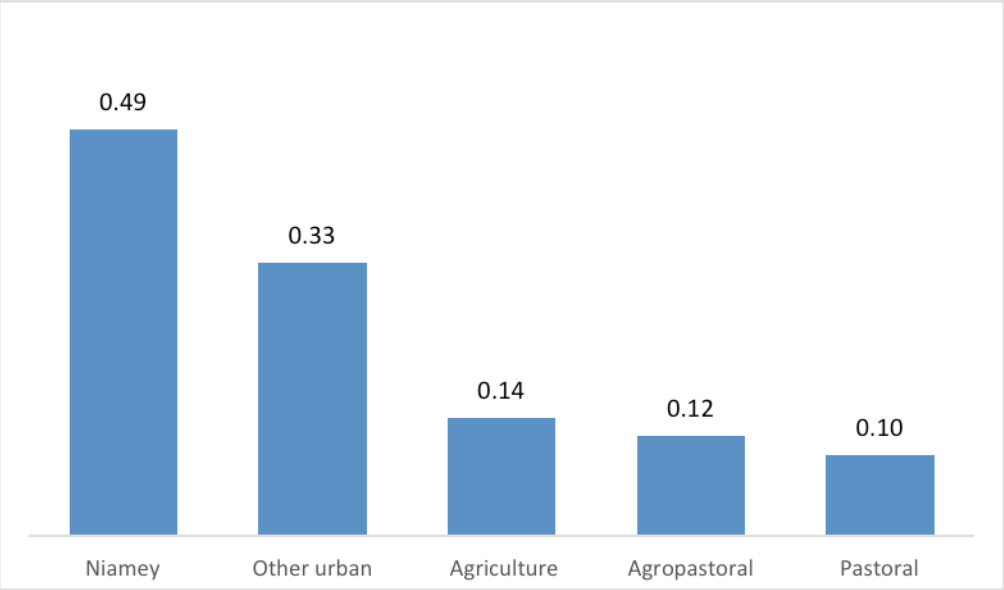
Sub-	Sedentary	Non-agricultural salaried	Nomadic cattle-	Poor agricultural
Access to basic services	0.45	0.57	0.15	0.15
Durable goods	0.51	0.76	0.08	0.18
House characteristics	0.76	0.69	0.53	0.84
Adaptive capacity	0.78	0.87	0.79	0.78
Physical connectivity	0.33	0.45	0.27	0.20
Food security	0.19	0.09	0.19	0.18
Agricultural assets	0.97	0.98	0.97	0.83
Durable assets value	0.001	0.003	0.000	0.000
Connectivity assets value	0.001	0.004	0.000	0.000
Economics and	0.79	0.83	0.82	0.79

Source: Author's computation

For instance it appears that access to water, electricity and other basic social services is a difficult issue for the two least-resilient livelihood strategy groups, namely the nomadic cattle-breeders and the poor agricultural households.

Figure 4 shows the distribution of the resilience index by agroecological zone. It is clear that Niamey households are the most resilient of all (0.49), while the least resilient of the group are pastoral households (0.10).

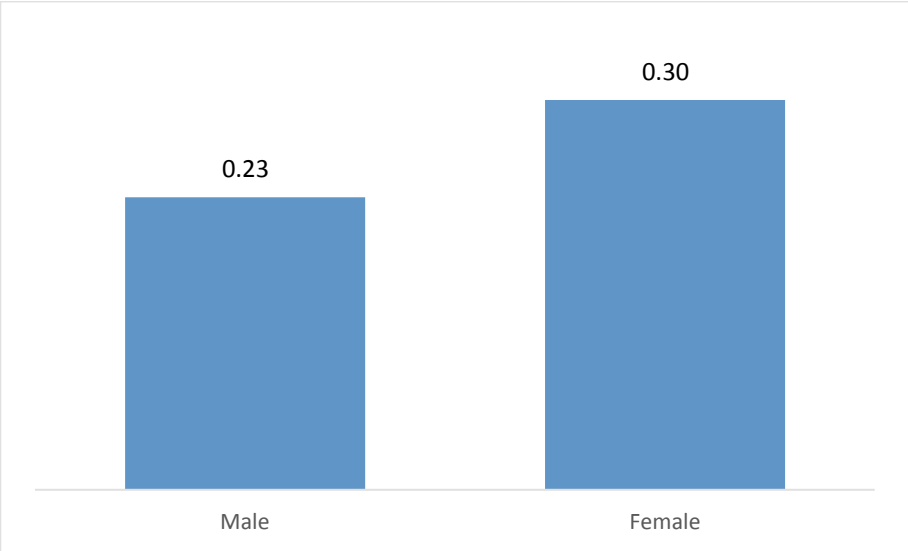
Figure 4: ***Resilience by agroecological zone in Niger***



Source: Author's computation

Regarding gender issues, Figure 5 shows the distribution of our resilience index by gender of the household head. It appears that households headed by a male (0.23) are less resilient than those headed by a female (0.30). This raises awareness of the importance of strengthening gender-based action in order to improve the resilience of female-headed households.

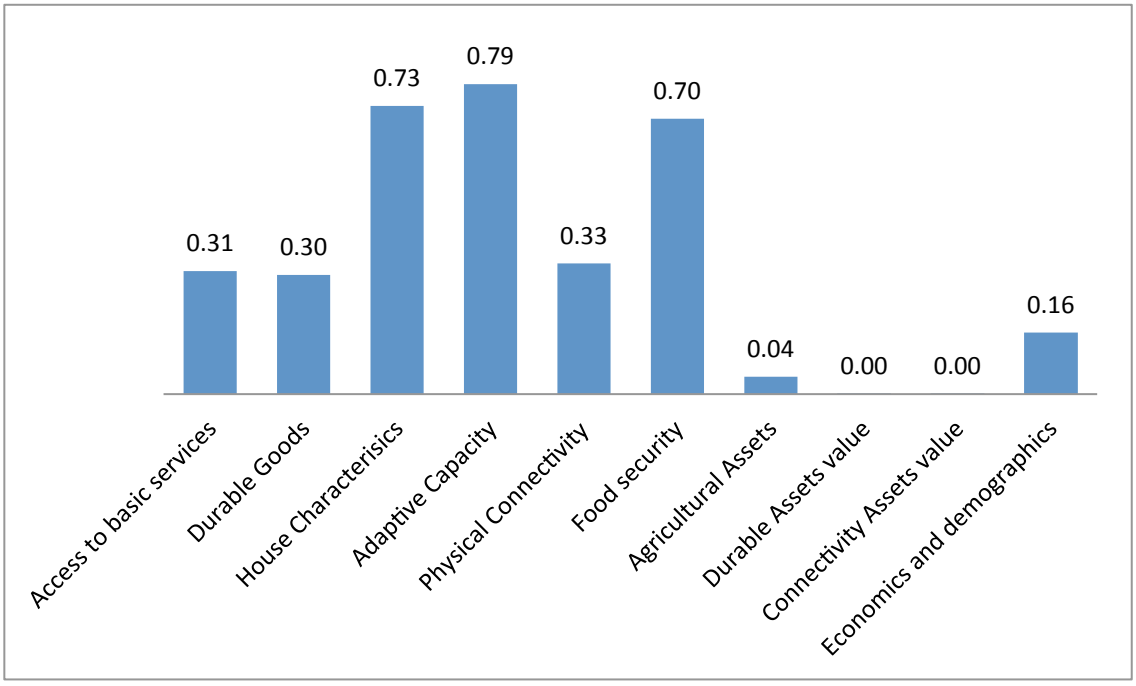
Figure 5: Resilience by gender of household head in Niger



Source: Author's computation

In fact, the disaggregation of the index into sub-indexes for households headed by women (Figure 6) shows that the main issue for these households is access to agricultural assets (mainly field and parcels ownership), access to non-agricultural durable assets (mainly housing materials), and access to physical connectivity assets (mainly radio, television, transports means).

Figure 6: Resilience sub-indexes for female-headed households in Niger



Source: Author's computation

Now we analyse the issue of inequalities in terms of resilience of livelihood strategy group in Niger. The percentile indexes for the Niger resilience index show high inequalities within households.

Table 5: Percentile ratios

p90/p10	p90/p50	p10/p50	
	p75/p25	506.115	14.241
	0.028	19.844	

Source: Author's computation

It appears that the most-resilient 10 percent of households are 506 times more resilient than the least-resilient 10 percent, which shows a very high level of inequality in the distribution of the resilience index in Niger. To confirm such a result, we compute the Gini index of the distribution of the resilience index. It appears that the Gini of the resilience index is high (Table 6) within the least-resilient households. The results also show fewer inequalities among the most-resilient households. Inequality is very high in all of the livelihood strategy groups.

Table 6: Gini of the resilience index by livelihood strategy group

Livelihood strategy groups	Gini
Sedentary	0.43
Non-agricultural salaried	0.26
Nomadic cattle-breeders	0.72
Poor agricultural	0.67
Niger	0.5879

Source: Author's computation

5. Conclusion and policy implications

This study focused on household resilience to food insecurity in Niger, employing a cluster analysis coupled with a multiple factor analysis. The cluster approach was used to identify livelihood strategy groups within Nigerien households. The resilience index estimates showed significant differences across regions and identified livelihood strategy groups. The main findings show that cattle-breeder households are the least resilient in Niger and that female-headed households are more resilient than those headed by men. As for policy implications, it is suggested that improvements be made to access to basic services for cattle-breeders and that the gender-based policy be strengthened in order to empower women and make them more resilient to food insecurity. More specifically, for female-headed households, policy action should focus on their access to agricultural assets, non-agricultural durable assets and physical connectivity assets.

Further investigation may show deeper gender disparities in household resilience to food insecurity and also provide a more in-depth focus on the determinants of such resilience in Niger.

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Annex 1: Results of the sub-indexes construction

Eigenvalues

Table 7: Access to basic services

Number	Eigen	Percent	Cumulative
1	0.550663	39.3331	39.3331
2	0.200665	14.3332	53.6663
3	0.200541	14.3244	67.9907
4	0.159389	11.3849	79.3756
5	0.115128	8.22343	87.5991
6	0.10373	7.40932	95.0084
7	0.0698825	4.99161	100

Source: Author's computation

Table 8: Durable goods

Number	Eigenvalue	Percent	Cumulative
1	0.500878	50.0878	50.0878
2	0.19458	19.458	69.5457
3	0.170835	17.0835	86.6293
4	0.133707	13.3707	100

Source: Author's computation

Table 9: Household characteristics

Number	Eigenvalue	Percent	Cumulative
1	0.75916	32.5354	32.5354
2	0.514334	22.0429	54.5783
3	0.398031	17.0585	71.6368
4	0.268715	11.5164	83.1531
5	0.153478	6.57761	89.7308
6	0.130935	5.61151	95.3423
7	0.108681	4.65774	100

Source: Author's computation

Table 10: Adaptive capacity

Number	Eigenvalue	Percent	Cumulative
1	0.531352	17.7117	17.7117
2	0.509005	16.9668	34.6786
3	0.5	16.6667	51.3452
4	0.5	16.6667	68.0119
5	0.490996	16.3665	84.3784
6	0.468648	15.6216	100

Source: Author's computation

Table 11: Physical connectivity

Number	Eigenvalue	Percent	Cumulative
1	0.461	46.1	46.1
2	0.323573	32.3573	78.4573
3	0.215427	21.5427	100

Source: Author's computation

Table 12: Food security

Number	Eigenvalue	Percent	Cumulative
1	0.461324	46.1325	46.1325
2	0.331237	33.1237	79.2561
3	0.207439	20.7439	100

Source: Author's computation

Table 13: Agricultural assets

Number	Eigenvalue	Percent	Cumulative
1	1.83203	91.6016	91.6016
2	0.167968	8.39838	100

Source: Author's computation

Table 14: Durable assets value

Number	Eigenvalue	Percent	Cumulative
1	3.23	80.7501	80.7501
2	0.527795	13.1949	93.945
3	0.242154	6.05385	99.9989
4	0.00004597	0.0011493	100

Source: Author's computation

Table 15: Connectivity assets value

Number	Eigenvalue	Percent	Cumulative
1	1.9782	65.94	65.94
2	1.0002	33.34	99.28
3	0.0216014	0.72004	100

Table 16: Economics and demographics

Number	Eigenvalue	Percent	Cumulative
1	1.30247	65.1235	65.1235
2	0.69753	34.8765	100

Source: Author's computation

Childhood disability and accumulation of human capital

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Abstract

While the majority of the world's population with disabilities lives in the developing countries, very little is known about the consequences of disability in those regions of the world. The present work uses data from the Demographic and Health Survey, Multiple Indicator Cluster Survey (EDS-MICS) 2011 in order to assess the effect of children's disability on their education in Cameroon. The scientific contribution of the present work resides in the fact that the estimates of the effects of disability are corrected both for endogeneity bias related to unobservable factors, through a family fixed-effects model, and for simultaneity bias through the use of disability present at birth. The effects are also assessed both with reference to school attendance and with reference to educational success, and depending on the severity of the disability. The outcome is that the difference in education related to the severity of the disability of the child is greater than that arising from gender, level of education of the parent and even, to a certain degree, standard of living. Moderate disability in the child reduces by 11 per cent his or her likelihood of attending school whereas severe disability results in a reduction of up to 45 per cent of this same likelihood. Moderate disability has no effect on educational success whereas severe disability reduces by an average of four years the number of years of schooling completed by the children afflicted, and retards educational progress by 0.598.

Keywords**:** disability, education, child, development, poverty, household fixed effects.

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1. Introduction

In the developed countries as in the developing countries, education is associated with a higher probability of access to employment, to a decent and better paid job (UNICEF, 2013) and to a better future state of health (see De Ridder *et al*. (2013)). Any hindrance of education thus creates a reduction in the future productivity of individuals and results in a future cost. It is for this reason that education for all and above all primary education for all take a leading place in all development strategies and that the elimination of inequalities in education constitutes a way of ensuring such an outcome (UN, 2014).

There are different types of inequality in education: by sex, ethnicity, level of urbanization, income, or disability status. Although the inequalities related to disability are less frequently covered in the relevant literature, they have proved to be of a greater scale than most other forms of inequality. Thus, Currie and Stabile (2007) demonstrate, for two developed countries, Canada and the USA, that the educational shortfall associated with disability is more significant than that related to income or to the education of the mother. Filmer (2008), working on thirteen developing countries, concludes that this shortfall is very often higher than that associated with gender, urbanization or economic status. The educational gap related to disability is thus as significant, if not more so, than that related to all other forms of inequality.

There are, however, numerous policies and laws having to do with the education of persons with disabilities. At the international level, since 1948, the Universal Declaration of Human Rights recognizes the right to education for all (UN, 1948), the Convention on the Rights of the Child of 1989 reinforces this right as it applies to children (UN, 1989), while the Convention on the Rights of Persons with Disabilities promotes the right of such people to education (UN, 2006).

In Cameroon, the general legal framework for education is set down by the 1998 Act on direction of schools which is intended to guarantee access to education without discrimination. In 2000, cost-free primary education was instituted in the country[1]. As for education specifically for persons with disabilities, this is governed by the 2010 Act providing for protection and promotion of persons with disabilities, article 29 of which states

[1] However, in practical terms, other expenses such as those for uniforms, transportation, exams and school books, as well as the dues to the Parent Teacher Association (APE), remain the responsibility of the parents.

that "the State shall contribute to the settlement of the expenses of teaching and of first vocational training of poor pupils and students with disabilities." (Cameroon, 2010).

However, the figures, both worldwide and national, persistently demonstrate the huge educational disadvantage suffered by persons having a disability. UNESCO estimates, for example, that in the developing countries, 98 per cent of children with disabilities do not attend school (ILO, 2009). These differences between children with a disability and those without a disability are made evident not only at the beginning of the period of education but also throughout it. Analyses covering 51 countries show that the rate of completion of primary education by persons aged between 18 and 49 is estimated at only 53 per cent for persons with a disability, as against 67 per cent for those without. Likewise, the mean number of years of schooling is 6.23 for persons with a disability as against 7.86 years for those persons without (WHO, 2011). The situation in Cameroon is hardly any better. Data from the General 2005 Census of Population and Housing (RGPH) reveal a net rate of attendance at primary level of 75.5 for children having no form of disability as against only 69.9 per cent for children with a disability (Mbouyap and Ahanda, 2010)[2]. A difference is also apparent in the levels of learning, whichever cycle of studies is considered. In fact, only 13.8 per cent of persons with a disability aged six and over show a level of the first cycle of secondary education, as against 18 per cent in the population as a whole. This leads to the assumption that disability is the major determinant of the shortfall in human capital facing children with a disability. However, things are far from being that simple. In fact, economic theory reveals much more complex relationships between the health of the child and his or her education. Some authors, based on a re-reading of life-cycle models, conclude that there may be a possible influence of the disability on the education (Case *et al.*, 2005; Cutler and Lleras-Muney, 2012; Fletcher and Lehrer, 2009; Currie and Stabile, 2006; Jackson, 2009; and Filmer, 2008).

On the other hand, based on Grossman's theory of nonmarket outcomes of education (2005), other studies assert that it is education that determines the health status of an individual and not the contrary. Still others emphasize the existence of observable and unobservable third factors that might influence both the disability status and the level of education. Thus, empirical studies show, after accounting for some of those factors, that

[2] Unless otherwise specified, all the figures in this paragraph come from the same source.

disability has no effect on children's education (Oreopoulos *et al.*, 2008; De Ridder *et al.*, 2013; and Filmer, 2008).

In the light of these divergences, both theoretical and empirical, and given the virtual lack of robust specific data in the developing countries, the present study takes as its objective to assess the effect of a child's disability on the accumulation of his or her human capital in Cameroon, using data from the Demographic and Health Survey, Multiple Indicator Cluster Survey (EDS-MICS) of 2011. Measuring the effect of a child's disability on his or her educational level would appear to be of considerable importance in the context of making economic policy recommendations. That would make it possible to not only to determine how to steer the efforts seeking to improve the education of this social group, but also and above all to avoid, for the individual and society, the future cost connected with exclusion from the labour market as a result of a shortage of human capital.

The scientific contribution of this work lies at four levels. Firstly, a relatively recent database is used so as to provide an up-to-date measure of the effect of disability on children's education. Secondly, the virtual dearth of information on the topic in the developing countries is overcome by using estimates bias-corrected both for endogeneity related to unobservable factors, by means of a household fixed-effects model, and for simultaneity by using disability present at birth. The foregoing makes it possible to obtain a more robust effect despite the cross-sectional structure of the database. Thirdly, the effect of the disability both on school attendance and on educational success is assessed, enabling a complete picture; as stated by the 2014 report on the MDGs: "The achievement of universal primary education requires both enrolment in, and completion of, the full cycle of primary school education" (UN, 2014, p. 18). Finally, the estimates are performed in line with the severity of the disability, which gives more power and precision to the economic policies proposed subsequently.

The rest of this chapter is organized in three sections. Section 1 presents a detailed review of the literature, both theoretical and empirical, on the relation between disability and education. Section 2 presents the methodology adopted by the present study. Finally, Section 3 proposes an analysis of the statistical and econometric results obtained. This is followed by a brief conclusion.

2. Literature review

2.1.1 *Theoretical link between childhood disability and education*

In economic theory, there exist three possible links between health and education (Cutler and Lleras-Muney, 2008). Firstly, a poor state of health may be behind lower educational attainment. Next, it is possible that education has an influence on an individual's state of health. Lastly, other third factors may influence both an individual's health and his or her education.

2.1.2 *Childhood disability, a determinant of the stock of education*

A poor state of health, particularly in an individual's first years of life, has the potential to retard the accumulation of his or her human capital. This conclusion ensues from certain life-cycle models (Case *et al.*, 2005). Indeed, while these models do illuminate the effect of health during childhood on the state of health at adult age, they make it clearly evident that this effect comes to pass, among other factors, through the impact of health on the level of education. Two primary channels make it possible to understand why such an effect is possible in the case of disability.

Firstly, health may have an influence on education by way of the morbidity that it causes and/or the expectations on lifespan that it alters (Cutler and Lleras-Muney, 2012). A child's disability may impair his or her physical and/or cognitive capacities. The child may then also have other, ancillary, sicknesses and will therefore be less assiduous in attending school and less able to follow the teaching when he or she does so, resulting in poor educational results and ultimately an inferior stock of education capital.

Secondly, beyond the morbidity effect from the child's disability on his or her educational results, which might be described as "direct," an "indirect" effect may also be detected, in the sense that disability may modify the "subjective" and "objective" expectations of return from education. The "subjective" expectation of return refers to the internal and external return from education modeled by the beliefs of the parents as to what a child with a disability is capable of accomplishing at school and on the labour market. The "objective" expectation of return arises out of an objective reasoning by the parents on whether it is worthwhile to educate their child given the situation on the labour market. Thus if the labour market is

marked by a strong discrimination against persons with disabilities (Baldwin and Choe, 2014) and if the type and/or severity of the child's disability is such that he or she is not very likely to find employment, this "objective" expectation of return will be poor[3]. Then, if as Becker (1962) states, the expected return on the investment in human capital is the principal determinant of the amount of this investment, it should be expected that the parents of children with disabilities will reduce the investment set aside for their education, particularly in households with low resources. One way or another, the child's disability will result in a lowering of the level of education achieved.

2.1.3 *Children's education, a possible determinant of their disability status?*

A massive quantity of literature has given itself the task of explaining why an individual's health status could be the result of his or her capital of knowledge and education (Cutlerand Lleras-Muney, 2008; Grossman, 2005). This literature is fully in keeping with Grossman's developments (2005) of the nonmarket results of education. The theoretical model developed by Grossman shows above all how an individual's education is capable of having an influence on certain nonmarket results such as health at adult age. While that model illuminates the causal link between education and health at adult age, it is perfectly possible to extend it to the case of the health of the child. For example, certain programmes of vaccination at school or of school canteens, set up in some developing countries, may protect the children from certain forms of disability. Likewise, children attending school may thereby escape working in the streets. School would thus be sheltering them from certain risk-laden environments, possible sources of accidents or generators of disabilities. A lack of education may also be an factor aggravating certain cognitive problems (Jackson, 2009). This theoretical link between accumulation of education capital and disability therefore needs to be included in the analysis.

2.1.4 *Third factors affecting both the child's education and his or her disability*

A number of third factors or family history factors may also effect both a child's disability status and his or her educational results. These elements may be either observable or unobservable. Among the observable factors, one may list the household income, the level

[3] It is important to note that the "subjective" and "objective" expectations of return may be related depending on the extent that the situation on the labour market may modify the beliefs on the capacities of the children with disabilities.

of education of the parents and also their social status. For example, a rich parent is able to invest more both in the education and in the health of his or her child (Cutler and Lleras-Muney, 2008, Case *et al.*, 2005). A poor parent will therefore have a greater likelihood of having children with disabilities, because he or she invests less in his or her offspring's health, and less educated children, since he or she invests less in their education. Among the unobservable factors that may affect both the health and the stock of knowledge of a child, a leading place is taken by his or her genetic traits and endowments (Cutler and Lleras-Muney, 2008). It is therefore possible that a child's genetic inheritance may be responsible for certain mental illnesses and also a source of poor educational results. Furthermore, unobservable factors of the family environment may impact both education and disability status. For example, a family environment that is noisy, eventful and lacking electricity may be the source of certain forms of disability, but may also be relatively unfavourable to the accumulation of education capital.

2.2 Empirical literature linking childhood disability and educational capital

2.2.1 *Elements demonstrating a correlation between childhood health and education in the empirical literature*

Based on the work of pioneers such as Barker (1995), who shows that birthweight is one of the determinants of certain chronic illnesses, a certain number of authors use that indicator and relate it to individuals' educational results. Even if what is involved is not strictly a disability, low weight, like the other indicators of health at birth, is associated with a high rate of disability and may thus be considered as a marker of conditions (Stabile and Allin, 2012).

Thus, authors such as Currie and Hyson (1999) and Case *et al.* (2005) in the United Kingdom and Hack *et al.* (2002) in the United States reach the conclusion that low birthweight is correlated with poor educational results. They also analyze other chronic health problems, including physical and mental disability, and show that the occurrence of a chronic illness is associated with a drop of 0.3 of the number of pupils who pass their Ordinary Level (O-Level) exams at the age of 16.

2.2.2 *Demonstration of a causal effect in the empirical literature*

Black *et al.* (2007) use a twins fixed-effects model that allows them to compare twins within one family and thus to allow for the unobservable heterogeneity that exists between households. They find that, in Norway, a 10 per cent increase in birthweight increases the probability of concluding secondary education by a little less than 1 per cent. However, their estimating technique obliges them to restrict their work to twins, which raises the problem of the external validity of their results. In fact, the population of twins differs in many aspects from populations of other children. This raises very clearly the problem of generalizing the results to the population as a whole.

Oreopoulos *et al.* (2008) will therefore, in Canada, use a sibling fixed-effects model and a twins fixed-effects model to assess the effect of certain indicators of health at birth such as the child's weight, the Apgar scores and the length of gestation[4]. They observe that, whereas most of these indicators have no effect on the scores obtained in language skills tests at grade 12, they do have a significant negative effect on the probability of reaching grade 12 by the age of 17.

Fletcher and Lehrer (2009) combine the sibling fixed-effects model and the "genetic lottery," the idea being that the health of the child, until attainment of adult age, is influenced by the behaviours (the choices) of the parents. It should therefore be dealt with on an endogenous basis. These authors therefore use the variations in the genetic markers between children, and their interactions, as an instrument of health, these markers resulting from the genetic lottery alone occurring at the child's conception. The authors observe that mental troubles have a negative effect on the number of years of education completed. However, even if this approach makes it possible to resolve the problem of endogeneity remaining after the use of the family fixed effects (owing to the fact that even for children from the same family there are different characteristics), the authors recognize that it is difficult thus to isolate the effect of a specific health problem, because of the existence of comorbidity. In fact, it is very rare, if not unknown, for genetic markers to be able to explain a specific health problem. As a consequence of this limitation and the lack of information on the genetic lottery in most databases, this method is difficult to generalize.

[4] The Apgar scores are a combination of five vital signs taken by health personnel at birth. They comprise heart rate, respiratory effort, muscle tone, response to stimulation and skin colouration. They run from 0 for bad to 10 for excellent.

Smith (2009) works on severe chronic illnesses (such as cancer, heart and lung problems and stroke) or moderate ones (hypertension, arthritis, diabetes). While simple regression shows a significant negative effect of chronic illness, bringing in the unobservable factors by fixed family effects makes this result disappear.

De Ridder *et al.* (2013) analyze the risk of poor school performance in the higher education of adolescents having certain health problems. These authors use a logistic sibling fixed-effects model, or a conditional logistic model, in order to take account of the heterogeneities that are unobservable at the family level. They thus note a high risk of school dropout among children having high psychological distress and problems in concentrating. However, when account is taken of the sibling fixed effects, the effect is not significant for the psychological distress. That being said, their study could suffer from selection bias, because only children in school were taken into account in the base sample, thus potentially excluding the adolescents who had already dropped out. Jackson (2009) uses the same model as well as a lagged health measure so as to avoid a simultaneity bias between health and education

Alongside these studies on general health problems, some have examined the childhood impairment, with a heavy preponderance of studies on mental disabilities and behavioural troubles (Currie and Stabile, 2007, 2006; Fletcher and Wolfe, 2008).

Currie and Stabile (2006) study the effects of attention deficit with and without hyperactivity (ADHD) on the human capital level of children in Canada and the USA and show that the effects of this behavioural problem are more marked than those of physical conditions. Currie and Stabile (2007) determine a fairly similar result when considering, in addition to ADHD, anxiety/depression, conduct disorders and other behavioural problems.

Fletcher and Wolfe (2008) extend the study of Currie and Stabile (2006) to older children in order to see the effect on long-term educational results of these troubles in the USA. They find that, once account is taken of the unobservable factors at family level, ADHD has no effect on long-term educational indicators such as the number of years of schooling and the likelihood of pursuing higher education. In order to explain this result, which is, in fact, counter-intuitive, the author shows that the fact of living with a child who has behavioural problems has a negative impact on the other children, which then results in a reduction in the differences observed between children.

2.2.3 *Empirical literature in the developing countries*

In the developing countries, while studies assessing the effect of problems of nutrition and above all of tropical diseases are frequent (Bobonis *et al.*, 2006; Field *et al.*, 2009; Clarke *et al.*, 2008), there are virtually none analyzing the effect of disabilities. While Mitra *et al.* (2011) and Mitra *et al.* (2013) had as their study population adults in fifteen developing countries, seven of them in sub-Saharan Africa, they show that disability is associated with a low number of years of education in such countries with the exception of Burkina Faso, Kenya and the Dominican Republic and also with a low probability of completing primary education in all of these countries except for Burkina Faso. However, owing to the format of the survey, designed to question only one individual per household, the authors were unable to establish a causal link and this result may only be interpreted as a correlation.

Filmer (2008) analyzes the interactions between childhood physical and/or mental disability, education and poverty in twelve developing countries and one emerging country. He finds that, although in most of these countries children with disabilities do not always live in poor households, their education is impacted by their disability. By applying a household fixed-effects model, the author observes that disability has a negative effect on the likelihood of attending school or of having done so in the past, except in Chad.

However, this study has several limitations. Firstly, the author uses certain specific measures of education such as current enrolment and past enrolment, which do not provide information on the performance of these children once they are at school. Next, the author establishes household fixed effects: however, although that approach allows him to take account of all of the unobservable characteristics that have an influence on the children's disability status and educational status (such as the preferences of the parents in investing in the education and health of the children, or the family environment), it does not permit controlling for the unobservable factors of a genetic type. Further, by applying a family fixed-effects model rather than a sibling fixed-effects model, the author leaves out of consideration that many families in the developing countries are comprised of children who do not have a direct filiation connection. Thirdly, the data used for the study are relatively old and do not include figures for Cameroon. Fourthly, the study does not control for the severity of the disability, nor the type. Finally, the author does not correct his estimates for potential bias of endogeneity linked to simultaneity.

3. Study data and samples

DHS-MICS data were used for the statistical and econometric analysis. The surveys were conducted between January and August 2011 by the National Institute of Statistics with the assistance of the United Nations Population Fund (UNFPA), UNICEF, the World Bank and the United States Agency for International Development (USAID). They are representative of the whole of the Cameroonian population and collected information on demographic and health indicators through three questionnaires: a women's questionnaire, a men's questionnaire and a household questionnaire.

In the household questionnaire, different modules were administered to some or all of the households surveyed. The disability module was administered to half of the households, selected at random. This subsample was used in all of the analyses performed in this study. In addition to demographic information such as age, sex and relationship to the head of household (HH), DHS-MICS collected information on current and past school attendance and on the educational attainment of children and young people aged 3–24 years for the current school year and the year preceding the survey.

However, as in the study by Filmer (2008), for most of the analyses in this study the upper age limit for the children was set at 17 years. This choice was justified by the objective of the study, which was to assess the effect of disability on children's education. Since the survey is cross-sectional and does not specify the exact date of onset of each disability, this effect can only be measured by using the population defined as children.[5] The lower age limit was set at 7 (Mani *et al.*, 2013; Khanam and Ross, 2011). Although information on schooling is collected for children as young as 3 years of age, most children under the age of 6 are in pre-primary school (nursery school), and their school attendance rate is therefore relatively low. Indeed, it is only at the primary level that education becomes compulsory in Cameroon. Children aged 6 were also excluded from the study for reasons related to the construction of the variables, as will be explained in greater detail below.

The overall sample for this study therefore consisted of children aged 7–17 for whom no

[5] The 1989 Convention on the Rights of the Child defines a child as "every human being below the age of eighteen years unless under the law applicable to the child, majority is attained earlier" (United Nations, 1989, p. 2056).

information on education was missing.[6] Since DHS-MICS collected information on all the children in each household, it was possible to carry out analyses at the household level. To perform these analyses using a household fixed-effects approach, only the subset of individuals living in households with at least two children with different disability status (i.e. with at least one child with a disability and one without) (Filmer, 2008) was used. This was the household sample. The analyses were also refined at the sibling level to include biological children of the head of household, at least one of whom had at least one disability and the other had none. This was the sibling sample.[7]

Although DHS-MICS does not provide specific information on the onset of disability, one of its advantages is that it indicates whether the disability was congenital or not. For some of the household-level analyses in this study, only children with a disability present at birth (38 per cent of the children with disabilities) and children with no disability were included in the sample. This was the sample of households with a congenital disability. In this case, the age range was extended to 24 years, as it was thus possible to be certain that the disability had occurred during childhood (because it was present at birth). This had the advantage of enlarging the sample. The sampling approach is described in Figure 1.

DHS-MICS identifies impairments such as lack of a body part or extremity, limb deformity, serious vision problems, serious hearing problems, serious speech problems and behavioural disorders, as described in Table 7.[8] The severity of the disability is then ascertained through a question that asks whether the impairment is partial or not. It was thus possible to have a categorical variable of disability with a value of 1 if the child did not have a disability, 2 if the child had a non-severe disability and 3 if the child had a severe disability.

Table 1 presents the distribution of disability by study sample. It shows that in almost all

[6] Information on school attendance and on number of years of schooling is missing for 0.37 per cent and 0.31 per cent of children, respectively.

[7] The decision to group children according to whether they were offspring of the head of the household rather than of the father or mother was guided by the desire to include as many children as possible in the sample. Overall, 45.06 per cent and 37 per cent, respectively, of the children included did not live in the same household as their father or mother and therefore could not be grouped together as siblings on that basis. However, in all households, there was a head of household (who might be a woman or a man) and that person was generally one of the children's parents.

[8] Even if the questions used are not those of the Washington Group on Disability Statistics, they generally yield results on disability prevalence that are quite close to those obtained in 2013 in Senegal using the Washington Group questionnaire.

samples there was a sufficient number of children with no disability, with non-severe disabilities and with severe disabilities to perform the analyses. The only difficulty was in the sample comprising children aged 7–17 who had been born with a disability, in which there were only 16 children with severe disabilities; this is why the analysis of congenital disabilities also included individuals aged 18–24.

Several measures of education are used in the literature (Mani *et al.*, 2013). Some evaluate access to school, while others reflect educational attainment. In order to ascertain access to school, this study used the variable school attendance. This is a short-term measure of education. This variable had a value of 1 if the child in question was currently enrolled in school and 0 if not. Educational attainment is a long-term measure of education because it is intended to reflect the child's progression from school entry to the time of the survey. To measure it, the number of years of schooling completed at the time of the survey was used.

However, this variable is better suited to adult populations (Patrinos and Psacharopoulos, 1997). Since the sample selected for this study is composed of individuals of school age, who therefore would not have completed their schooling, this variable is censored (Mani *et al.*, 2013). Another variable of educational attainment was therefore needed.

Some authors have used the relative number of years of schooling or academic progress (Mani *et al.*, 2013). This is the ratio between the number of years of schooling completed and the number of potential years of schooling. The latter refers to the number of years of schooling that an individual would have completed if he or she had begun attending school at the normal age and had gone on to complete an additional year of schooling each year. Academic progress or relative number of years of schooling thus supplies information about both whether a child has entered school late and whether his or her academic progress has been delayed by failure.

This variable is expressed as follows:

$$\boldsymbol{Academic\ progress} = \frac{\boldsymbol{Years\ of\ schooling}}{\boldsymbol{Age - E}} \qquad (1)$$

where *years of schooling* is the number of years actually completed and *E* is the usual age of school entry for the country in question. In Cameroon, *E* is 6 years of age (IBE-UNESCO, 2010). Equation 1 can be problematic when very young children are involved, in particular 6-year-olds, since for children of that age the *academic progress* variable is infinite, the denominator being zero. This is why 6-year-olds were not included in the study.

Table 2 provides details on the study samples. Column 1 describes the overall sample of children for whom no human capital variables were missing. Columns 2, 3 and 4 describe the samples in which there were at least two children with differing disability status. These samples were used for the fixed-effects models. Overall, approximately 3.2 per cent of children aged 7–17 in Cameroon have disabilities (2.7 per cent have non-severe disabilities and 0.05 per cent have severe disabilities). This prevalence is equal to that obtained by Filmer (2008) in Mongolia, but somewhat above that found in some African countries, such as Burundi, Zambia and South Africa (about 1.3 per cent), between 1995 and 2003. This difference probably reflects the fact that the 2011 DHS-MICS took better account of certain forms of disability. The disability prevalence figures obtained for the other three samples are much higher, which is perfectly understandable because these samples included only children living in a household with a child having a disability. Table 1 shows that, overall, the samples used for the fixed-effects analyses are quite close to the overall sample and could therefore be used without any risk of selection bias. There are, however, small differences with respect to the sample of households with a congenital disability, but this is explained by the difference in the age ranges taken into account.[9]

Since this study uses congenital disability to control for the simultaneity bias, it is important, for the external validity of the results obtained, to verify that this population is fairly similar to the population of persons with non-congenital disabilities. In order to do this, a difference in means test between children with and without a congenital disability was performed, the results of which are shown in Table 8. The first column shows the results of the test for the group aged 7–17 years and the second column for the group aged 7–24 years.

[9] A comparison, not shown here, between the subsample of households with children born with a disability and the overall sample of individuals aged 7–24 reveals that these samples are quite similar.

Table 1 – Disability status in study samples

	Total *N*	House-hold	Sibling *N*	Congenital disab. 7–24 yrs	Congenital disab. 7–17 yrs
No disabilitv	9588	573	323	466	226
Non-severe	268	224	145	129	86
Severe disab.	52	41	24	29	16
Total	9908	838	492	624	328

Source : Author based on data from DHS-MICS 2011. *N* is the number of individuals.

In the group aged 7–17, the two populations do not differ, except in terms of living environment. Among those aged 7–24, on the other hand, the human capital variable *years of schooling completed* differs significantly at the 5 per cent level of 0.71 years between those with non-congenital disabilities and those with congenital disabilities. However, as explained above, this variable is strongly censored, and if the age of the children with congenital disabilities is lower, as the test shows, it is normal that their years of schooling completed would also be lower. When this variable is adjusted for academic progress and academic lag, the difference between the two groups is no longer significant. Hence, overall, the two populations of persons with disabilities are quite similar, which shows that the results obtained from the sample of persons with a congenital disability can be generalized to the rest of the population with disabilities.

Table 3 shows the means of human capital variables by disability status of children. The data reveal that, irrespective of the education variable considered, there is a considerable human capital differential between children without a disability and those with a disability, and the gap is even wider if the disability is severe. For example, the school attendance rate is 84 per cent for children without a disability, 77 per cent for children with a non-severe disability and 31 per cent for children with a severe disability. Similarly, 92 per cent of children with severe disabilities are behind in terms of their academic progress, whereas only 73 per cent of children with non-severe disabilities and 67 per cent of children without disabilities fall behind. These descriptive findings suggest that there is a causal relationship between disability and low educational capital. However, this hypothesis requires further econometric research.

Table 2 – Means and standard deviations (SD) of variables

	Overall sample		Household sample		Sibling sample		Household w/	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Attends school	0.833	0.373	0.813	0.390	0.818	0.386	0.762	0.426
Years of schooling	3.738	2.892	3.438	2.796	3.278	2.682	4.755	3.656
Academic	0.720	0.524	0.651	0.500	0.636	0.488	0.689	0.495
Childhood disability								
No disability	0.968	0.177	0.684	0.465	0.657	0.475	0.747	0.435
Non-severe	0.027	0.162	0.267	0.443	0.295	0.456	0.207	0.405
Severe disability	0.005	0.072	0.049	0.216	0.049	0.216	0.046	0.211
Childhood illness								
No illness	0.943	0.231	0.930	0.256	0.923	0.267	0.929	0.256
Mild illness	0.019	0.138	0.017	0.128	0.018	0.134	0.019	0.137
Moderate illness	0.023	0.149	0.027	0.163	0.026	0.161	0.029	0.168
Severe illness	0.014	0.119	0.026	0.160	0.033	0.178	0.022	0.148
Age	11.445	3.125	11.549	3.099	11.386	3.030	13.849	5.023
Age2	140.756	74.280	142.969	73.799	138.805	71.850	216.997	150.034
Male	0.504	0.500	0.530	0.499	0.551	0.498	0.518	0.500
Biological child of	0.643	0.479	0.668	0.471			0.628	0.484
Education HH								
No education	0.276	0.447	0.234	0.424	0.240	0.427	0.143	0.350
Primary	0.387	0.487	0.437	0.496	0.457	0.499	0.503	0.500
Secondary or higher	0.336	0.473	0.329	0.470	0.303	0.460	0.354	0.479
HH age	48.882	14.009	49.677	12.394	48.699	10.602	51.556	13.447

HH disability	0.110	0.312	0.200	0.401	0.193	0.395	0.186	0.389
Place of residence								
Provincial capital	0.192	0.394	0.175	0.381	0.189	0.392	0.276	0.447
Other city	0.240	0.427	0.218	0.413	0.191	0.394	0.240	0.428
Rural area	0.568	0.495	0.606	0.489	0.620	0.486	0.484	0.500
Household size	8.214	4.615	9.245	3.963	9.089	3.763	9.899	5.260
Economic status								
Poorest	0.201	0.401	0.202	0.401	0.248	0.432	0.131	0.338
Poor	0.231	0.422	0.274	0.447	0.264	0.441	0.215	0.411
Middle	0.216	0.412	0.220	0.414	0.199	0.400	0.236	0.425
Rich	0.187	0.390	0.166	0.372	0.183	0.387	0.205	0.404
Richest	0.164	0.371	0.138	0.346	0.106	0.308	0.213	0.410
Number of		9908		838		492		624

Source: Author based on data from DHS-MICS 2011. + The total numbers of children attending school are 9,902, 838, 494 and 622, respectivel

Table 3 –Human capital level by disability status

	No disability	Non-severe	Severe	Total
Attends school	0.838 (0.369)	0.768 (0.423)	0.308 (0.466)	0.833 (0.373)
Years of school	3.755 (2.889)	3.500 (2.904)	1.788 (2.585)	3.738 (2.892)
Academic progress	0.726 (0.525)	0.617 (0.460)	0.277 (0.388)	0.720 (0.524)
Academic lag	0.667 (0.471)	0.735 (0.442)	0.923 (0.269)	0.671 (0.470)
No. of observations			9908	

Source: Author based on data from DHS-MICS 2011. Standard deviation shown in parentheses.

4. Method

The following equation was used initially to assess the effect of childhood disability on academic performance:

$$Y_i = \alpha + \beta H_i + \lambda X_i + \varepsilon_i \qquad (2)$$

where *Yi* represents the human capital of individual *i*. *H* represents disability status and *Xi* represents the set of individual and family control variables of individual *i*. β and λ represent the parameters to be estimated.

As in many studies (Currie and Stabile, 2006; Fletcher and Wolfe, 2008; Oreopoulos *et al.*, 2008; Black *et al.*, 2007; Filmer, 2008), equation 2 is estimated by means of a linear model for both the continuous variables (ordinary least squares (OLS) model) and the binary variables (linear probability model). This makes it possible to calculate robust variances at the cluster level and to interpret the results directly.

However, as previously noted, a child's disability status and academic performance may be influenced by other factors, such as the family environment, parental preferences regarding investment in human capital or genetic traits. Given these unobservable factors, the coefficient β obtained in equation 2 will suffer from an endogeneity bias.

To correct for this bias, children having the same parents can be compared. Many authors have used a sibling fixed-effects model for that purpose (Fletcher and Wolfe, 2008; Currie and Stabile, 2006; De Ridder *et al.*, 2013), while others have used a household fixed-effects approach (Filmer, 2008). By comparing children from the same family rather than all children in the household regardless of their parentage, the sibling fixed-effects model makes it possible to control for all observable and, especially, unobservable factors common to all members of a sibling group. The equation is thus:

$$Y_{if} = \alpha + \beta H_{if} + \lambda Z_{if} + \mu_f + E_{if} \qquad (3)$$

where Z is identical to X, except that it excludes the control variables common to members of the same sibling group. The subscript f indexes siblings. In other words, Y_{if} represents the academic performance of individual i of sibling group f, and μ_f represents the sibling fixed effects; it refers to the unobservable factors specific to the family, while E_{if} is the error term.

Nevertheless, there may still be a simultaneity bias. As noted in section 1 above, health and education may influence each other. It is possible to examine only the effect of disability on education and to eliminate any inverse effect by using a lagged variable of childhood disability (Jackson, 2009) — i.e. by taking into account only disabilities that occur before school age. Since the data used in this study indicated whether the child's disability had been present since birth, in some of the estimates the population of children with disabilities consisted solely of children with congenital disabilities.

5. Results

5.1 Elements demonstrating the existence of a correlation between disability and education

Table 4 presents the OLS estimate for the regression of disability on education for all children (in other words children living alone in a family, those living in families with several children having identical disability status and those living in families with children having differing disability status). It suggests that children with disabilities have a lower school attendance than the other children. Relative to a child without a disability, a child with a moderate disability has an 8-percentage-points lower likelihood of attending school. The

difference is even more marked for children with severe disabilities, and may go as high as 55 percentage points. Similarly, moderate disability reduces by approximately half a year the number of years of schooling completed and reduces the child's academic progress by 0.104. As for severe disability, it is associated with a reduction of 2.24 years of schooling and a reduction in progress through the school system of 0.445.

In order to have a clearer idea of the scale of these gaps, it would be interesting to compare them to those created by other customary sources of differences in human capital. Although the difference in educational results between children with non-severe disabilities and children without disabilities is less than that between children belonging to two very close welfare quintiles, such as the poorest and the poor, the difference between children without disabilities and those with severe disabilities is of a much greater scale than that between the poorest and the richest, in terms of school attendance (55 per cent as against 26 per cent). With regard to the number of years of schooling, by comparison with a child belonging to the poorest quintile, a child from the richest quintile has 2.6 more years of schooling completed, almost the same figure as for a child without a disability as compared with one suffering a severe disability. By contrast, the difference related to economic status is 0.11 higher than that related to the severity of the disability, in terms of academic progress. This shows that the gap created by the severity of the disability is much greater than that created by economic status in terms of school attendance and the reverse in terms of academic progress.

The fact of being a boy is associated with a greater likelihood of attending school and a higher number of years of education. This is in line with most of the studies, which show that the rivalry in the area of investment in human capital between children within households in Africa favours boys (Morduch, 2000). However, the difference related to gender is less than that observed even between children without a disability and those with moderate disabilities. Relative to a child living in a household the head of which is not educated, children in households the head of which has completed secondary or higher education have a 22 per cent higher likelihood of attending school, complete on average 1.37 more years of schooling and experience a rise in their academic progress of 0.28. Which is still less that the difference related to severe disability. Thus, just as in Filmer (2008) and Currie and et Stabile (2007), that shows that the gaps created by disability are much more significant than those created by gender or the level of education of the parent, which have been covered

more extensively in the literature. However, owing to the risks of endogeneity, the foregoing results may only be interpreted as correlations. It thus becomes necessary to carry out more robust estimates to determine a causal effect.

5.2 Correction for biases and demonstration of a causal effect of disability on education

Table 5 shows the results of the estimates by OLS (on the samples selected for the household fixed effects) and the household fixed-effects model. Overall, the OLS estimates are fairly close to those obtained in Table 4 with the large sample. Thus the results remain robust even if the sample size is reduced.

In terms of school attendance, the coefficients of disability obtained by using the household fixed-effects model remain fairly close to those obtained by the OLS and are still as significant. That suggests that the difference in school attendance obtained earlier was not the outcome of unobservable factors common to the households, but rather an effect of the disability. Non-severe and severe disabilities thus reduce children's school attendance by 10 per cent and 60 per cent respectively.

Table 4 – Relationship between disability and education: OLS for all children

	Attends school		Years of schooling		Academic progress	
	Coef.	SD	Coef.	SD	Coef.	SD
Childhood disability (none)						
Non-severe disability	-0.081***	(0.023)	-	(0.119)	-	(0.025)
Severe disability	-0.548***	(0.063)	-	(0.341)	-	(0.059)
Childhood illness (no illness)						
Mild illness	0.029	(0.023)	0.144	(0.123)	0.024	(0.030)
Moderate illness	0.027	(0.020)	0.222*	(0.111)	0.052	(0.027)
Severe illness	-0.040	(0.031)	-0.054	(0.146)	-0.016	(0.044)
Age	0.121***	(0.010)	0.783***	(0.048)	-	(0.016)
Age2	-0.006***	(0.000)	-	(0.002)	0.003***	(0.001)
Male	0.064***	(0.007)	0.097**	(0.037)	0.018	(0.009)
Biological child HH	0.018*	(0.009)	0.038	(0.046)	-0.006	(0.011)
Education HH (no						
Primary education	0.174***	(0.015)	0.873***	(0.071)	0.172***	(0.017)
Secondary education and	0.219***	(0.015)	1.366***	(0.078)	0.277***	(0.019)
Age HH	0.002***	(0.000)	0.019***	(0.002)	0.004***	(0.000)
Disability HH	0.011	(0.015)	0.090	(0.076)	0.002	(0.019)
Resident'l location (rural						
Provincial capital	-0.045**	(0.014)	-0.146	(0.078)	-0.019	(0.020)
Other town	-0.014	(0.012)	-0.143*	(0.070)	-0.036*	(0.018)

Household size	-0.004***	(0.001)	-	(0.006)	-	(0.001)
Econ. welfare (poorest)						
Poor	0.153***	(0.018)	0.742***	(0.081)	0.188***	(0.019)
Medium	0.196***	(0.018)	1.325***	(0.089)	0.312***	(0.022)
Rich	0.236***	(0.019)	1.954***	(0.097)	0.457***	(0.024)
Richest	0.264***	(0.020)	2.564***	(0.107)	0.558***	(0.026)
Constant	-0.153*	(0.060)	-	(0.289)	0.844***	(0.099)
R2	0.192		0.638		0.255	
Observations	9902		9908		9908	
Clusters	4239		4244		4244	

Source: Author, based on data from the EDS-MICS 2011. Coef.: coefficient, SD: robust standard deviation of clusters of households. * 5% significativity threshold, ** 1% significativity threshold, *** 0.1% significativity threshold. The variables in parentheses represent reference categories.

The effect of non-severe disability on the level of education and on academic progress diminishes when the unobservable factors are taken into account, but it remains very significant. By contrast, the effect of severe disability increases slightly. That means that the unobservable factors specific to households have a tendency to underestimate the effect of severe disability while it overestimates that of non-severe disability. The household fixed-effects models thus show that a child with a moderate disability and a child with a severe disability have a level of schooling lower by 0.44 and 2.41 years respectively than that of a child without a disability. The fact for a child of having a non-severe disability thus reduces his or her academic progress by 0.09, while the fact of having a severe disability reduces it by 0.52 relative to a child without a disability.

A more or less similar result is obtained from estimates using the sibling fixed effects shown in Table 9. The family fixed-effects model corrects the estimates of unobservable factors common to the children of a single household regardless of their kinship link with the head of the household. However, there may exist genetic unobservable factors impacting both the education and the disability status of the children. An attempt at controlling for these unobservable factors is made by considering only the biological children of the head of household. Allowing for these unobservable factors produces results fairly close to those obtained with the household fixed-effects model in terms of school attendance and number of years of education. However, that allowance suggests that non-severe disability does not have a significant effect on academic progress. It should be noted, however, that the OLS analysis of academic progress produce results that are quite different from those obtained in the overall sample. Thus the siblings sample might be less comparable.

As has been seen earlier, another possible source of endogeneity bias is the inverse

relationship that may exist between disability and education. In order to reduce this bias, the estimates presented in Table 6 include in the sample only the children without disabilities and with a disability from birth living in a household containing at least two children with differing disability status. The estimates are presented firstly with control for the inverse causality and without correction of the bias related to the unobservable factors (OLS), and then with correction both of the bias related to the unobservable factors and the inverse causality (household fixed effects).

Overall, these effects estimated on the basis of these OLS are fairly close to those obtained earlier. However, when the inverse causality and the unobservable factors at the household level are controlled for, non-severe disability no longer has a significant effect on academic progress. It becomes evident from the household fixed-effects model that disability reduces by 11 per cent the likelihood of school attendance of children with non-severe disabilities and by 45 per cent that of children with severe disabilities. The mean effect of the child's disability (28 per cent disregarding the severity of the disability) is considerably above that observed by Filmer (2008) in African countries such as Mozambique, South Africa and Zambia, but it is fairly close to that obtained in other developing countries such as Mongolia. Non-severe disability has no effect on the academic progress of the children afflicted. Severe disability on the other hand reduces the number of years of schooling completed by almost 4 and academic progress by 0.598.

Table 5 – OLS and household fixed-effects model

	Attends school progress				Years of schooling				Academic			
	OLS		FE		OLS		FE		OLS		FE	
	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD
Childhood disability (none)												
Non-severe disability	-	(0.027)	-0.108***	(0.02	-	(0.131)	-	(0.12	-0.106**	(0.033)	-0.093**	(0.03
Severe disability	-	(0.072)	-0.598***	(0.07	-	(0.383)	-	(0.43	-0.446***	(0.074)	-	(0.11
Childhood illness (none)												
Mild illness	-0.038	(0.122)	0.126	(0.07	0.390	(0.443)	0.220	(0.60	0.003	(0.100)	0.127	(0.07
Moderate illness	0.109	(0.062)	0.035	(0.06	1.011**	(0.357)	0.522	(0.38	0.130	(0.067)	0.033	(0.07
Sevre illness	0.067	(0.056)	0.006	(0.07	-0.008	(0.380)	-0.264	(0.28	0.083	(0.177)	-0.011	(0.10
Age	0.069*	(0.031)	0.101**	(0.03	0.605**	(0.171)	0.723***	(0.16	-0.102	(0.053)	-0.075	(0.05
Age2	-	(0.001)	-0.005***	(0.00	-0.002	(0.007)	-0.007	(0.00	0.003	(0.002)	0.002	(0.00
Male	0.111**	(0.023)	0.088***	(0.02	0.255	(0.130)	0.267*	(0.13	0.099*	(0.031)	0.077*	(0.03
Biological child HH	0.032	(0.030)	0.092*	(0.03	0.106	(0.173)	0.445	(0.25	0.017	(0.038)	0.067	(0.04
Education HH (no												
Primary education	0.121*	(0.053)			0.779**	(0.240)			0.126*	(0.052)		
Secondary education or	0.214**	(0.050)			1.449**	(0.247)			0.298***	(0.063)		
Age HH	0.000	(0.001)			0.011	(0.007)			0.005*	(0.002)		
Disability HH	0.042	(0.040)			0.427	(0.217)			0.013	(0.047)		
Resident'l location (rural												
Provincial capital	-0.064	(0.061)			-0.289	(0.249)			-0.014	(0.062)		
Other town	-0.048	(0.045)			-0.311	(0.271)			-0.042	(0.057)		
Household size	-0.003	(0.004)			-0.020	(0.025)			-0.006	(0.006)		
Econ. welfare (poorest)												
Poor	0.183**	(0.057)			0.924**	(0.203)			0.236***	(0.048)		
Middle	0.191**	(0.062)			1.391**	(0.289)			0.299***	(0.063)		
Rich	0.216**	(0.066)			2.010**	(0.285)			0.398***	(0.067)		
Richest	0.249**	(0.073)			2.842**	(0.344)			0.554***	(0.083)		
Constant	0.221	(0.196)	0.286	(0.17	-	(1.088)	-	(0.92	0.712*	(0.327)	1.177***	(0.31

Table 5 continued:

R2	0.233	0.232	0.631	0.593	0.298	0.146
Observations	838	838	838	838	838	838
Clusters		249		249		249

Source: Author based on data from the EDS-MICS 2011. Coef.: coefficient, SD: robust standard deviation of clusters of households. * 5% significativity threshold, ** 1% significativity threshold, *** 0.1% significativity threshold. The variables in parentheses represent reference categories.

Table 6 – OLS and household fixed-effects models with disability present from birth, age 7-24

	Attends school progress				Years of schooling				Academic			
	OLS		FE		OLS		FE		OLS		FE	
	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD
Non-severe disability	-	(0.037)	-0.110**	(0.03	-1.115***	(0.258)	-	(0.23	-0.113*	(0.045)	-0.074	(0.04
Severe disability	-	(0.092)	-	(0.10	-3.717***	(0.673)	-	(0.69	-0.519***	(0.076)	-	(0.13
Childhood illness (none)												
Mild illness	-0.069	(0.094)	0.080	(0.14	-0.192	(0.618)	0.537	(1.04	0.036	(0.125)	0.206	(0.13
Moderate illness	0.052	(0.073)	0.075	(0.06	-0.157	(0.713)	0.388	(0.83	-0.050	(0.087)	0.026	(0.09
Severe illness	0.040	(0.076)	-0.007	(0.10	-0.317	(0.557)	-0.452	(0.55	-0.018	(0.133)	0.062	(0.15
Age	0.050*	(0.020)	0.034	(0.01	1.282***	(0.130)	1.277***	(0.14	-0.036	(0.030)	-0.044	(0.03
Age2	-	(0.001)	-0.002**	(0.00	-0.029***	(0.005)	-	(0.00	0.000	(0.001)	0.001	(0.00
Male	0.096**	(0.029)	0.073*	(0.03	0.345	(0.204)	0.329	(0.19	0.085*	(0.035)	0.072*	(0.03
Biological child HH	0.138**	(0.033)	0.169***	(0.04	0.548*	(0.257)	0.933*	(0.38	0.025	(0.041)	0.052	(0.05
Education HH (no												
Primary education	0.011	(0.069)			0.154	(0.495)			0.030	(0.064)		
Secondary education or	0.065	(0.073)			0.906	(0.559)			0.134	(0.082)		
Age HH	0.002	(0.001)			0.030**	(0.010)			0.006**	(0.002)		
Disability HH	0.035	(0.042)			0.373	(0.282)			0.006	(0.056)		
Resident'l location (rural												
Provincial capital	0.013	(0.041)			0.101	(0.334)			-0.011	(0.057)		
Other town	-0.051	(0.041)			-0.381	(0.363)			-0.053	(0.061)		
Household size	0.002	(0.003)			-0.016	(0.022)			-0.000	(0.004)		
Econ. welfare (poorest)												
Poor	0.249**	(0.086)			1.507**	(0.495)			0.309***	(0.071)		
Medium	0.307**	(0.090)			1.799**	(0.537)			0.335***	(0.077)		
Rich	0.319**	(0.090)			2.983***	(0.622)			0.470***	(0.085)		
Richest	0.331**	(0.094)			3.450***	(0.631)			0.595***	(0.096)		
Constant	0.197	(0.172)	0.651***	(0.13	-10.651***	(1.136)	-	(0.99	0.415	(0.236)	1.155***	(0.23

Table 6 continued:

R2	0.326	0.278	0.594	0.548	0.312	0.222
Observations	622	622	624	624	624	624
Clusters		154		154		154

Source: Author based on data from the EDS-MICS 2011. Coef.: coefficient, SD: robust standard deviation of clusters of households. * 5% significativity threshold, ** 1% significativity threshold, *** 0.1% significativity threshold. The variables in parentheses represent reference categories.

6. Conclusion

The objective of this study was to assess the effect of childhood disability on the accumulation of educational capital in Cameroon. This effect was measured taking into account the possibility that there may exist unobservable factors specific to families, with a potential for impacting both education and disability status, such as heredity, the family environment and also the preferences of the parents with regard to human capital, but also taking account of an inverse causality between education and disability, in the sense that education and certain educational support programmes (vaccination, canteens) may impact disability status. In order to do this, a household fixed-effects model was used, as well as a disability present at birth.

It becomes evident from this work that the difference in educational results related to the severity of the child's disability is greater than that resulting from gender, parent's level of education and even, to some degree, standard of living. A child's moderate disability reduces by 11 per cent his or her likelihood of attending school whereas severe disability results in a reduction of up to 45 per cent in that likelihood. This finding is in line with the few results obtained in developing countries. It is also observed that moderate disability has no effect on educational success. The difficulty for children with non-severe disabilities would thus appear to lie primarily at the level of access to school. However, severe disability reduces by an average of 4 years the number of years of schooling completed by the children thus afflicted and retards their academic progress by 0.598.

This result leads to the assumption that disability creates a significant future indirect cost, in the sense that it impedes children's accumulation of human capital, with the children thus having a degree of difficulty in entering the labour market and/or being less well paid in their adult years.

The present paper contributes to the existing literature in three main aspects. Firstly, it corrects the shortage of information concerning the effect of disability on education in the developing countries. In doing so, unlike the few studies covering the developing countries, it corrects the estimates for endogeneity bias related both to the unobservable factors and to simultaneity. The effect obtained can thus be strictly interpreted as a causal effect of disability on education even though the data used are cross-sectional.

Secondly, the effect of disability is assessed both on access to education and on educational success, which makes it possible to bring in certain explanatory elements on these two important sections of an individual's educational process. Thirdly, this effect is expressed by the level of severity, which is a way of providing more accuracy to the analyses and thus of ensuring greater effectiveness in the policies that might result.

These results can give rise to a number of economic policy recommendations. Firstly, these results show that the educational gap between children without disabilities and those with disabilities arises neither from third elements nor from an effect of education on disability, as economic theory might suggest, but rather is in fact a consequence of the disability. Establishing policies aimed at reducing childhood disability is thus also a means to eliminate an impediment to universal education.

Next, efforts should be made both on the education supply side, by guaranteeing access to the educational establishments, including specialized establishments, and on the demand side, by provision of better information to parents on the opportunities offered by educating children with disabilities, in order to increase their rate of school attendance. Because as UNICEF says, the fact the that parents think that children with disabilities are incapable of studying in school may be the main cause of their under-education (UNICEF Armenia, 2012).

Finally, the public authorities should improve the quality and above all ensure the suitability of the education on offer, so that children with severe disabilities can obtain better educational results.

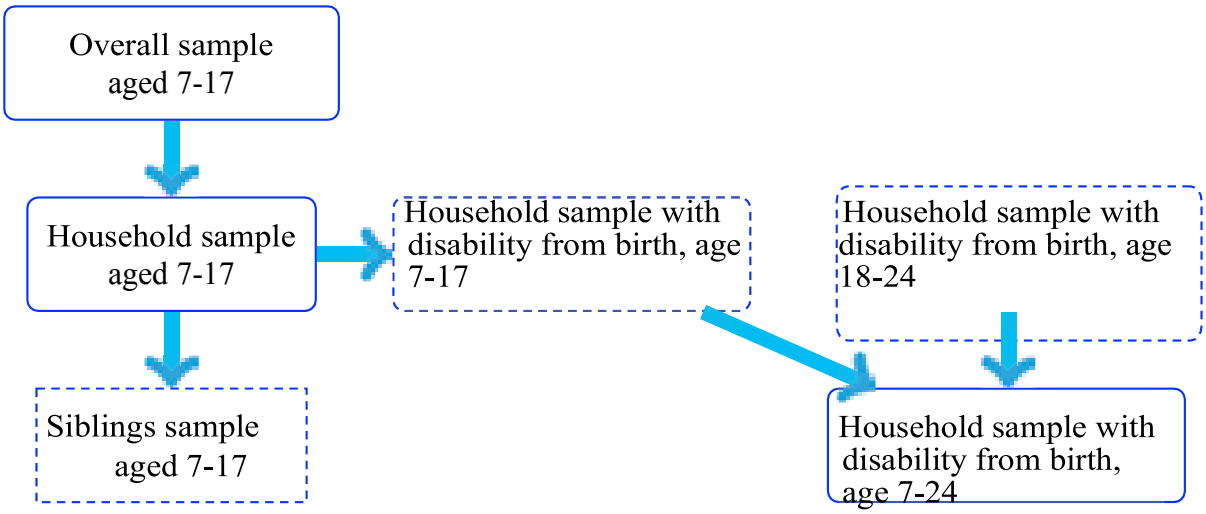
The present study, however, suffers from certain limits. Firstly, despite the fact that it attempted to isolate the causal effect of childhood disability, by monitoring the unobservable factors common to children of the same family, it is possible that there remain unobservable factors specific to each child, which impact both his or her disability status and his or her educational results.

Secondly, disability existing from birth has been used to control for simultaneity bias. Although it has been determined that the populations of children with disabilities from birth and those of the others with disabilities were fairly similar, the effect of the disability obtained could be larger than that arising from disabilities occurring later in the child's life.

Indeed, as Case *et al*. (2005) state, the effect of a chronic illness may be cumulative. This calls for the collection of longitudinal data on disability in the developing countries in order to ensure a better analysis of the effects of a child's disability on his or her educational progress.

Annexes

Figure 1 – Main steps of the sample of the study



Source: Author

Table 7 – Types of disability

	Definition	Frequency
Missing limb or extremity	Does your household include someone who is missing part of his or her body, for example, a hand, an arm, a foot or a leg? Does your household include someone who is missing some extremities, such as fingertips, tips of toes, nose or ear? Does a person have certain extremities that are insensitive ?	0.081
Deformation	Does your household include someone who is from a deformation of the upper or lower limbs and who cannot, or finds it difficult to, walk and/or use his or her arms or hands?	0.253
Visual defect	Does your household include someone who can see or who is blind?	0.169
Auditory defect	Does your household include someone who can barely hear or who is deaf?	0.331
Speech defect	Does your household include someone who has serious difficulties in talking or is dumb?	0.197
Mental defect	Does your household include someone who has behavioural troubles?	0.128
Observations		320

Note: Questionnaire prepared by the author on the basis of data from the EDS-MICS 2011.

Table 8 – Test for difference in means between children with disabilities from birth and other children with disabilities

	Age 7 to 17		Age 7 to 24	
	Δ Mean	SD	Δ Mean	SD
Attends school	-0.063	0.052	-0.035	0.047
Years of school	0.149	0.333	0.719*	0.345
Academic lag	0.068	0.050	0.065	0.036
Academic progress	-0.071	0.055	-0.033	0.042
Sickness	0.061	0.035	0.099***	0.028
Age	0.629	0.347	1.090*	0.475
Male	-0.030	0.057	-0.053	0.047
Biological child HH	0.004	0.055	-0.050	0.046
Second. education +	-0.087	0.056	-0.041	0.046
Age HH	-0.050	1.544	-1.791	1.310
Disability HH	0.036	0.046	0.053	0.038
Rural environment	0.129*	0.057	0.085	0.047
Household size	0.043	0.424	-0.123	0.389
Rich	-0.078	0.057	-0.064	0.046
No. of observations		320		492

Source: Author based on data from the EDS-MICS 2011. Δ Mean represents the difference mean difference or proportion difference between the other children with disabilities and the children with a disability from birth, ET: standard deviation of the difference. * 5% significativity threshold, ** 1% significativity threshold, *** 0.1% significativity threshold.

Table 9 – OLS and sibling fixed-effects model

	Attends school progress				Years of schooling				Academic			
	OLS		FE		OLS		FE		OLS		FE	
	Coef.	ET	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD
Childhood disability (none)												
Non-severe disability	-0.132***	(0.034)	-0.140***	(0.033	-0.349*	(0.158)	-0.343*	(0.155	-0.077	(0.043)	-0.075	(0.042
Severe disability	-0.491***	(0.098)	-0.497***	(0.112	-2.014***	(0.489)	-2.161***	(0.610	-0.433***	(0.093)	-0.449***	(0.120
Childhood illness (none)												
Mild illness	-0.131	(0.163)	0.107*	(0.052	0.686	(0.616)	1.404*	(0.670	-0.075	(0.108)	0.148	(0.103
Moderate illness	0.159***	(0.043)	0.168**	(0.062	0.894*	(0.432)	0.839	(0.466	0.136	(0.085)	0.104	(0.102
Severe illness	0.027	(0.073)	-0.054	(0.086	-0.010	(0.446)	-0.118	(0.390	0.155	(0.218)	0.018	(0.144
Age	0.082*	(0.041)	0.100*	(0.040	0.719**	(0.224)	0.710**	(0.221	-0.076	(0.066)	-0.065	(0.066
Age2	-0.004*	(0.002)	-0.004**	(0.002	-0.008	(0.010)	-0.007	(0.010	0.002	(0.003)	0.002	(0.003
Male	0.119***	(0.032)	0.102**	(0.035	0.299	(0.165)	0.254	(0.155	0.077	(0.040)	0.044	(0.043
Biological child HH												
Education HH (no	0.053	(0.071)			0.445	(0.302)			0.052	(0.067)		
Primary education	0.187**	(0.065)			1.289***	(0.331)			0.266***	(0.079)		
Secondary education or	0.001	(0.002)			0.003	(0.010)			0.005*	(0.002)		
Age HH	-0.010	(0.056)			0.320	(0.262)			-0.020	(0.053)		
Disability HH												
Resident'l location (rural	-0.134	(0.079)			-0.473	(0.299)			-0.067	(0.073)		
Provincial capital	-0.094	(0.060)			-0.348	(0.338)			-0.070	(0.068)		
Other town	-0.012	(0.007)			0.008	(0.032)			-0.001	(0.007)		
Household size												
Econ. welfare (poorest)	0.205**	(0.066)			1.190***	(0.238)			0.300***	(0.059)		
Poor	0.203*	(0.080)			1.493***	(0.364)			0.350***	(0.079)		
Medium	0.238**	(0.078)			1.950***	(0.306)			0.416***	(0.072)		
Rich	0.263**	(0.089)			3.462***	(0.432)			0.688***	(0.085)		
Richest	0.249	(0.260)	0.300	(0.232	-5.837***	(1.360)	-3.829**	(1.210	0.572	(0.409)	1.140**	(0.397
Constant	0.241		0.218		0.637		0.608		0.329		0.110	
Observations	494		494		492		492		492		492	
Clusters	160				160				160			

Source: Author based on data from the EDS-MICS 2011. Coef.: coefficient, SD: robust standard deviation of clusters of households. * 5% significativity threshold, ** 1% significativity threshold, *** 0.1% significativity threshold. The variables in parentheses represent reference categories.

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Climatic Shocks and Food Security: The Role of Foreign Aid

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Abstract

Little is known about the role that foreign aid can play in dampening the effects of climate change. This paper investigates the role of aid in mitigating the adverse effect of climatic shocks on food security in developing countries. Because foreign aid is an important source of revenue for developing countries, it can enable them to face climatic shocks by mobilizing or stabilizing resources for the financing of agriculture production or food imports. Our results show that foreign aid dampens the effect of climatic shocks on food security. Moreover, the dampening effect is higher for countries that are vulnerable to food price shocks.

Keywords: food prices vulnerability, foreign aid, food security, climatic shocks
JEL classification: F35, Q17, Q18, Q54

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1. Introduction

According to several reports, greenhouse gas emissions are related to planet warming and changes in precipitation (Christensen et al., 2007), which could negatively affect developing and developed countries. There is indeed increasing evidence that greenhouse gases have already begun to warm the planet (Christensen et al., 2007). This in turn will likely cause changes in precipitation patterns as warming trends continue (Christensen et al., 2007), which could have significant negative impacts in both developed and developing countries. For instance, Mitchell and Tanner (2006) conclude that, in 2050, southern Africa will probably be 10-20 percent drier than the previous five decades. Moreover, climate change will negatively affect agricultural production and food security.

Several authors have analysed the relationship between climate change and food security. Christensen et al. (2007) conclude that food production is highly vulnerable to weather conditions, while Haile (2005), Dilley et al. (2005) and Ringler et al. (2010) confirm that food crises and malnutrition in Africa are related to climate events. In addition, Lee et al. (2012) show that climate variability (such as high temperature and precipitation) raises agricultural production in Asian countries, while a high drop in temperature is detrimental. Badolo and Kinda (2014) show that the impact of climatic variability on food security in developing countries is worse in those countries where civil conflicts are present or those that are vulnerable to food price shocks.

Despite these previous studies, little is known about the role that foreign aid flow can play in dampening the effects of climate change. There are several reasons behind the interest in the effect of foreign aid, one of the main motivations being that foreign aid flows are a major source of revenue for developing countries (particularly least developed countries (LDCs)). These flows can constitute an important mechanism for mitigating the effect of climatic shocks on food security because they allow recipient countries to mobilize or stabilize resources used to finance agriculture production or food imports. In the economic literature, several papers have analysed the importance of aid flows as shock absorbers in developing countries, mostly focusing on the effects of foreign aid on macroeconomic stabilizations and coping with various types of shocks. Collier and Dehn (2001) show that aid flow mitigates the negative effect of commodity prices, while Chauvet and Guillaumont (2009) and Guillaumont and Chauvet (2001) find that aid is efficient for countries that face economic vulnerability resulting from external shocks (trade, food prices shocks) and natural disasters. However, a limitation of these studies is that they do not analyse the potential role of foreign aid in mitigating the adverse effects of climatic shocks on food security.

This paper explores the role of aid in the mitigation of the effects of climatic variability in the recipient economies. Using panel data for 71 developing countries over the period 1970–2008, the results indicate that foreign aid significantly dampens the effect of climatic shocks on food security. More interestingly, it appears that the marginal effect of aid is high for countries that are more vulnerable to food price shocks.

The paper is structured as follows: section 2 contains a discussion of the literature review on the relationship between climatic shocks, foreign aid and food security. Section 3 discusses the econometric method, and section 4 presents empirical results. The last section is devoted to concluding remarks and implications.

2. Literature review

2.1 Determinants of food security

2.1.1. Traditional factors

According to the economic literature, many factors may affect food security in developing countries. Badolo and Kinda (2014) group the main factors of food security into three approaches: production-based approach, market-based approach and institutional failures.

The production-based approach assumes that food security in developing countries can be explained by a decline in food availability. In the economic literature, food availability decline is the result of population growth and the scarcity of natural resources and food security (Malthus (1798), Ehrlich and Ehrlich (1991), Ophuls and Boyan (1992)).

Contrary to the production-based approach, the market-based approach considers that famine is explained by food access, rather than food supply or availability. As a precursor of this approach, Sen (1983) puts forward the concept of entitlements. He suggests that people have an entitlement to food that depends on personal endowments and exchange conditions. The endowments can be defined as the combination of all resources owned by people (for instance land, equipment, animals, knowledge, skills and employment revenues). Sen (1983) shows that a shift in exchange conditions and employment can reduce people's ability to acquire food and can be a source of insecurity in developing countries. In addition, several authors analyse the link between economic performance and food insecurity. Wiesmann (2006) and Smith and Haddad (2000) show that national incomes contribute to food security because they: (a) strengthen countries' health environments and services and women's education by raising government budgets, (b)

raise the ability of countries to buy food in international markets. In addition, through poverty reduction, Smith and Haddad (2000) suggest that economic growth increases food access and security for households.

Finally, institutional failures such as the implementation of inappropriate policies, the failure of governments, and civil conflicts can affect food delivery (Keen, 1994; Sen, 2000). According to Sen (2000), democracy can help prevent famines, as leaders of democratic societies are incited to implement policies to tackle food insecurity. Indeed, by making information available, free press can favour the implementation of warning systems and policies for food security. Meanwhile, Drėze and Sen (1991) and Smith and Haddad (2000) show that democratic institutions are an important determinant of food security. By encouraging human rights (including the right to food) and community participation, Haddad and Oshaug (998) and Haddad and Oshaug (1998) conclude that democracy reduces child malnutrition.

2.2 The importance of climatic shocks

In addition to traditional factors, climatic variability can impact food security in developing countries through several channels (Badolo and Kinda, 2014): agricultural production, households incomes, food prices, economic resources and civil conflicts.

First, climatic variability can impact food security through agricultural production. In the short term, rainfall variability and extreme events (such as droughts and floods) reduce farm yields and decrease agricultural income, alongside household and national food availability. In the longer term, such events favour underinvestment, agricultural stagnation and rural poverty in countries that depend on rain-fed agriculture (Kydd et al., 2004).

Second, rainfall variability can affect food security via household incomes. By decreasing agricultural production, it negatively impacts household income from the agricultural sector. According to some authors, including the International Labour Organization (2007), 36 percent of the world's working population livelihoods (and 66 percent of those in sub-Saharan Africa) depend on agricultural production. Climatic variability can also impact rural labour markets by reducing incomes and decreasing the demand for goods and services in affected areas. Climatic shocks therefore increase the vulnerability of households to food insecurity. For instance, climatic variability in Africa increases food insecurity through adverse effects on farm revenues (Nhemachena et al., 2010). Furthermore, climatic shocks can increase food insecurity through their negative effect on economic growth. For instance, Dell et al. (2008) show that climatic shocks severely impact

economic growth in developing countries by reducing total productivity, agricultural yields and investments. This reduces the ability of countries to buy food on international markets, to increase investments in infrastructures, services and technology that support food production and to finance public goods such as health and education services.

Third, climatic variability affects food security through food prices. By reducing food availability in markets, climatic shocks can increase food prices and reduce food accessibility. Using theoretical models, Ringler et al. (2010) conclude that climatic variability favours higher food prices and childhood malnutrition in sub-Saharan Africa.

Fourth, climatic variability can be a factor in food insecurity by increasing the risk of civil conflicts. Indeed, Buhaug et al. (2008) assume that in the long term, climate shocks will probably lead to substantial scarcity and variability of renewable resources. This will increase the risk of civil conflicts (Miguel et al., 2004), in turn favouring food insecurity.

2.3 Foreign aid as a resilience factor to climatic shocks

This subsection is devoted to analysing ways to address climatic shocks by investigating the role of foreign aid as a risk coping mechanism.

2.3.1 *The stabilizing effect of aid*

Several arguments may justify the stabilizing effect of aid. First, we may consider that foreign aid has a stabilizing effect on economic growth and resources in countries affected by climatic vulnerability. As many developing countries have a disproportionate part of their GDP in climate-sensitive sectors such as agriculture, climatic shocks have large and negative effects on their economic growth by reducing their agricultural production and exports (Jones and Olken, 2010; Dell et al., 2008; Mendelsohn et al., 2006). On the other hand, foreign aid can be countercyclical and, in the presence of climatic shocks (followed by revenue shocks), can reduce public spending volatility.

Second, the economic literature (Chauvet and Guillaumont, 2009; Guillaumont and Chauvet, 2001) on aid and economic growth has shown that foreign aid is more efficient in vulnerable countries by allowing economic growth to become more stable. By stabilizing the economic resources (potentially affected by climatic shocks), foreign aid contributes to reducing the instability of public investment necessary to finance public services (health, education, infrastructures) that support food and agricultural production.

Third, foreign aid can mitigate the effect of climatic shocks on food availability in the recipient countries through the vulnerability of countries to food price shocks. Indeed,

Combes et al. (2012) show that foreign aid has a dampening effect on the impact of food price shocks on both level and volatility of household consumption. Moreover, climatic variability favours food insecurity through food price shocks vulnerability (Badolo and Kinda, 2014). Therefore, the dampening effect of aid may be high for countries that are more vulnerable to food price shocks. Moreover, aid may favour the implementation of economic reforms (Collier, 1997; Morrissey, 2004) that reduce the high level and volatility of food prices in developing countries. Indeed, better economic and trade reforms reduce the dispersion of food prices in non-integrated markets (Aker, 2010; Araujo et al., 2005).

2.3.2 *Aid and capacity-building*

Beyond the importance of more financial resources (foreign aid), developing countries require technical resources to strengthen their institutions. Indeed, one problem facing developing countries is the lack of capacity-building to withstand climate change. According to the United Nations Development Programme (UNDP, 2009), capacity is 'the ability of individuals, institutions, and societies to perform functions, solve problems, and set and achieve objectives in a sustainable manner'.

By providing education (skills), experience and knowledge, external technical experts allow many developing countries to implement mitigation and adaptation policies against climate change. According to Nelson and Phelps (1966), education increases people's ability to understand information and adopt new behaviours. For example, it can enable people (agricultural households, for example) to adopt new technologies such as drought- and heat-tolerant crop varieties. Thus, by financing education, foreign aid can make individuals more adaptable and less dependent on climate-sensitive sectors such as agriculture. Foreign aid may therefore facilitate the implementation of climate change adaptation policies in agricultural science and technology, water conservation, risk management, and capacity-building (Huang, 2013). Moreover, foreign aid may finance investments that make the economy more flexible.

In other words, the capacity-building efforts of foreign aid may potentially contribute towards reducing the negative effects of climate change by improving the quality of human resources (through education) and the transfer of new technologies and good practices from other countries (through international cooperation, networking, and information sharing), and by increasing income.

3 Empirical analysis

3.1 Empirical model

The aim of the paper is to analyse the role of aid in the mitigation of the effects of climatic shocks on food security. For this purpose, we follow the following steps:

First, we test the effect of climatic shocks on food security. Similarly to Badolo and Kinda (2014), this baseline equation is:

$$Y_{i,t} = \alpha_i + \beta_1 CS_{i,t} + \omega X_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (1)$$

With $CS_{i,t}$ the variable of climatic variability (log) in a country i at the period t; $\varepsilon_{i,t}$ is the error term, γ_t represents time fixed effect, and α_i country fixed effects. $X_{i,t}$ is the matrix of control variables, which are population growth, income per capita (log), democratic institutions, arable land (log), cereal production land (log) and real effective exchange rate (log). $Y_{i,t}$ is the food supply. Because food security is a multidimensional concept, we use the proportion of undernourished people for robustness checks.

Second, we analyse the mitigating effect of aid. To test this hypothesis, we adopt the following specification (equation (2)):

$$Y_{i,t} = \alpha_i + \beta_1 CS_{i,t} + \beta_2 CS_{i,t} * Aid_{i,t} + \beta_3 Aid_{i,t} + \omega X_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (2)$$

With $Aid_{i,t}$ the amount of official development assistance (ODA) per capita. If this hypothesis is proven to be true, the coefficient associated to the interactive term (β_2) will be positive. The hypotheses tested are : β_1 <0 β_2 >0 and β_3 >=0

Estimation strategy

In order to estimate our models (equations (1), (2)), we may apply ordinary least squares (OLS), fixed effects (FE) or random effects (RE). However, as OLS do not take into account unobserved heterogeneity of countries, it is adequate to apply FE or RE. In order to choose the adequate specific effect, we will use the Hausman test.

3.2 Data sources and description of variables

Data cover the period from 1960 to 2008 for 71 developing countries and are compiled into five-year averages (1960-1964, 1965-1969, etc.). The data on foreign aid, population growth, income per capita, and proportion of undernourished people are from World Bank

Statistics (World Bank Group, 2011). Those on democratic institutions, rainfall and food supply are from Polity IV (Center for Systemic Peace, 2011), Centre for Research and Studies on International Development (CERDI, see (Guillaumont, Guillaumont Jeanneney, et Wagner 2015; Guillaumont et Simonet 2011)) and the Food and Agriculture Organization (2011) respectively.

3.2.1 *Food security*

According to the United Nations Development Programme (UNDP, 1994), food security can be defined as "a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". Several indicators have been used in the literature because food security is a multidimensional and flexible concept. Similarly to Badolo and Kinda (2014), we use two complementary indicators:[2] proportion of undernourished people and food supply per capita. Food supply per capita is a simple average of food supplies of main cereals (maize, rice, sorghum, millet, wheat, soybeans and sugar) consumed in developing countries.

3.2.2 *Rainfall variability*

Climatic variability is measured by the standard deviation of the growth rate of rainfall, which is frequently used in economic literature. It is computed as the five-year rolling standard deviation of the growth rate of rainfall series.

4 Results

4.1 Baseline results

Columns 1 and 2 of Table 1 show the results of the fixed effects (FE) and random effects (RE) of rainfall variability on food insecurity. We use FE, since the Hausman test shows this model to be more appropriate than the RE model. Our finding that rainfall variability reduces food supply in developing countries is similar to that of Badolo and Kinda (2014). According to them, the results can be explained by several reasons. Climatic variability is a factor of uncertainty, raises fluctuation in agricultural production and negatively impacts household incomes. This effect may be higher for countries that depend on rainfall for agriculture production (rain-fed agriculture). In addition, through reducing agriculture production, climatic variability can reduce agricultural incomes and economic growth (Dell

[2] The Global Hunger Index is currently considered to be the best indicator of food security. However, long-term data are not available.

et al., 2008) in developing countries. Therefore their ability to import food (from international markets) will be limited.

In the next step, we include control variables to check the robustness of results (column 3 to 5 of Table 1). These are cereal production land, arable land and real effective exchange rate (REER). The results conclude that rainfall variability has a negative impact on food supply, whereas land use improves food supply and production. The REER has no impact on food supply per capita.

Table 1: Impact of rainfall variability on food supply per capita

Dependent variable	Food supply				
	(1)	(2)	(3)	(4)	(5)
	FE	RE	FE	FE	FE
Rainfall variability	-0.0179***	-0.0194***	-0.0167***	-0.0140**	-0.0196**
	(-2.802)	(-2.986)	(-2.899)	(-2.308)	(-1.976)
Rainfall	0.148**	0.0209**	0.122**	0.118*	0.110
	(2.036)	(2.403)	(2.443)	(1.702)	(0.909)
Income per capita	0.0557**	0.107***	0.0688***	0.0785***	0.0233
	(2.079)	(4.533)	(2.827)	(3.060)	(0.579)
Population growth	-0.0300***	-0.0257**	-0.0165*	-0.0237**	-0.0547**
	(-2.816)	(-2.414)	(-1.694)	(-2.339)	(-2.241)
Democratic institutions	-0.000663	0.000476	-0.00200	-0.000159	0.000497
	(-0.185)	(0.136)	(-0.617)	(-0.0467)	(0.0940)
Cereal production land			0.259***		
			(9.772)		
Arable land				0.269***	
				(6.983)	
Exchange rate (REER)					-0.0242
					(-1.449)
Intercept	4.238***	4.780***	0.796	3.754***	4.826***
	(7.994)	(13.81)	(1.335)	(7.391)	(5.606)
Observations	517	517	517	517	517
Countries	71	71	71	71	71
R-squared	0.289		0.417	0.361	0.299

Note: t-statistics are presented in parentheses under the estimated coefficients. ***, ** and * indicate significance of the estimated coefficient at 1, 5 and 10 percent respectively. The study period is 1960–2008. Source: Author's estimate.

4.2 The role of aid

This section focuses on the importance of foreign aid. We assume that foreign aid can improve food security in developing countries. Moreover, we consider that the presence of foreign aid could reduce the negative effect of climatic shocks on food security.

Table 2 presents the results of the non-linear impact of climatic shocks on food supply, depending upon the aid. Unsurprisingly, climatic shocks always seem to be associated with food insecurity in developing countries. The results (column 2 of Table 2) indicate that the coefficients associated with climatic shocks and to the interactive term (climatic shocks *aid) are negative and positive respectively. This result reveals that the negative impact of climatic variability on food supply decreases with aid. In other words, climatic shocks are a factor in food insecurity in developing countries, although its effect is mitigated in the presence of aid. These results confirm the idea that foreign aid acts as a climatic shock absorber in the recipient countries. First, foreign aid can be countercyclical and, in the presence of climatic shocks (and then revenue shocks), smooths public spending. Second, by stabilizing economic resources (potentially affected by climatic shocks), foreign aid contributes to reducing the instability of public investment necessary to finance public services (health, education, infrastructure) that support food and agricultural production.

Previous authors (Guillaumont and Chauvet, 2001; Chauvet and Guillaumont, 2009) have concluded that foreign aid is more effective in vulnerable countries by allowing economic growth to become more stable. Moreover, Badolo and Kinda (2014) conclude that the negative impact of climatic shocks are high for vulnerable countries that are less able to maintain food availability. We assume that the role of aid as a climatic shock absorber will be high in the most vulnerable countries. In order to test this hypothesis empirically, equation (3) is estimated with the most vulnerable countries from the sample (above the 75th percentile of the distribution of the vulnerability index). Column 3 of Table 2 shows that the negative effect of climatic shocks on food security increases when the sample is restricted to the countries above the 75th percentile of the vulnerability index. For this restricted sample, aid has a powerful dampening effect on the negative impact of climatic shocks on food security in developing countries (column 4 of Table 2).

Table 2: Rainfall variability, foreign aid and food supply per capita

Dependent variable	Food supply per capita			
	Full sample		Vul>75th per.	
	(1)	(2)	(3)	(4)
Rainfall variability	-0.0179***	-0.0718***	-0.0511**	-0.114***
	(-2.802)	(-2.859)	(-2.573)	(-2.741)
Rainfall variability* Aid per capita		0.0430*		0.0602*
		(1.941)		(1.662)
Aid per capita		0.000296		0.000976
		(0.797)		(1.309)
Rainfall	0.148**	0.208	0.526**	0.561**
	(2.036)	(1.567)	(2.510)	(2.592)
Income per capita	0.0557**	0.205***	0.358***	0.352***
	(2.079)	(4.577)	(5.056)	(4.205)
Population growth	-0.0300***	-0.00438	-0.000735	0.000843
	(-2.816)	(-0.288)	(-0.0401)	(0.0385)
Democratic institutions	-0.000663	-0.00175	-0.00837	-0.00970
	(-0.185)	(-0.316)	(-0.974)	(-1.102)
Intercept	4.238***	2.844***	-4.90e-05	-0.530
	(7.994)	(2.902)	(-3.30e-05)	(-0.336)
Observations	517	370	215	194
R-squared	0.289	0.117	0.186	0.254
Countries	71	67	43	38

Note: t-statistics are presented in parentheses under the estimated coefficients. ***, ** and * indicate significance of the estimated coefficient at 1, 5 and 10 percent respectively. The study period is 1960–2008.

Source: Author's estimate.

4.3 Robustness checks

4.3.1 *Inertia of food supply and addressing endogeneity of aid*

Is food supply characterized by inertia phenomena? In other words, it is important to know whether the lagged level of food supply is a potential determinant of the current level of food supply. We include the lagged level of food supply in our baseline equation. The dynamic nature of our specified model requires the implementation of the Generalized Method of Moments (GMM) estimation from Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998).

Because aid aims to improve food security (to reduce poverty) in the recipient country, we may assume that countries with greater needs (food insecurity, macro-vulnerability, etc.)

will receive more aid. The econometric estimation of the model facing reverse causality between aid and food security requires us to deal correctly with endogeneity. We use lagged variables (aid per capita) to control for endogeneity. The results in Table 3 show that the lagged level of food supply has no effect on its current level (column 2). There is no inertia for food supply in developing countries. In addition, using lagged variables to control for endogeneity of aid does not alter the previous results.

4.3.2 *Complementary indicator of food security*

We consider the proportion of undernourished people as another indicator of food security. In column 1 of Table 4, we find that rainfall variability has an effect on the proportion of undernourished people. Column 2 reveals that the impact of climatic variability on malnutrition decreases with aid. Column 3 shows that aid has a powerful dampening effect for countries that are highly vulnerable to food price shocks (above the 75th percentile of the vulnerability index).

Table 3: Impact of climatic variability on food security: inertia of food supply and endogeneity of aid

Dependent variable	Food supply	
	Fixed effects	GMM-system Two step
Lagged food supply		0.0150
		(0.540)
Rainfall variability	-0.0718***	-0.106*
	(-2.859)	(-1.743)
Rainfall variability* Aid per capita	0.0430*	0.00212**
	(1.941)	(2.344)
Aid per capita	0.000296	0.0334**
	(0.797)	(2.489)
Rainfall	0.208	-0.106
	(1.567)	(-1.245)
Income per capita	0.205***	0.0723
	(4.577)	(1.447)
Population growth	-0.00438	-0.119**
	(-0.288)	(-2.191)
Democratic institutions	-0.00175	0.00324
	(-0.316)	(0.645)
Intercept	2.844***	1.513***
	(2.902)	(2.825)
Observations	370	358
R-squared	0.117	

Countries	67	67
AR(1)		0.06
AR(2)		0.95
Hansen test		0.75
Instruments		24

Note: t-statistics are presented in parentheses under the estimated coefficients. ***, ** and * indicate significance of the estimated coefficient at 1, 5 and 10 percent respectively.

Table 4: Rainfall variability, foreign aid and proportion of undernourished people

Dependent variable	Prevalence of undernourishment			
	Full sample		Vul>50th per.	
	(1)	(2)	(3)	(4)
Rainfall variability	0.0721***	0.0704***	0.102***	0.107***
	(5.110)	(3.892)	(4.203)	(3.812)
Rainfall variability* Aid per capita		-0.00681***		-0.0122***
		(-3.194)		(-4.012)
Aid per capita		-0.0441***		-0.0564***
		(-3.405)		(-3.654)
Rainfall	-0.000536	-0.000384	-0.000110	-0.000192
	(-1.050)	(-0.472)	(-1.148)	(-1.367)
Income per capita	-0.0711***	-0.0917***	-0.0704***	-0.0872***
	(-4.873)	(-4.102)	(-3.744)	(-3.546)
Population growth	0.632*	0.682	0.725*	0.916*
	(1.702)	(1.453)	(1.703)	(1.894)
Democratic institutions	-0.171	-0.193	-0.206	-0.239
	(-1.103)	(-0.904)	(-1.006)	(-0.974)
Intercept	-61.94***	-71.65***	-46.54**	-49.72**
	(-3.676)	(-3.041)	(-2.292)	(-2.044)
Observations	314	216	232	173
R-squared	0.134	0.194	0.199	0.346
Countries	79	61	62	50

Notes: t-statistics in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Author's estimate.

5 Conclusion

This paper investigates the role of aid in mitigating the adverse effects of climatic shocks on food security in developing countries. Using panel data for 71 developing countries over the period 1970–2008, our results show that foreign aid significantly dampens the effects of climatic shocks on food security. More interestingly, it appears that the marginal effect of aid is higher for countries that are more vulnerable to food price shocks. In other words, when countries exhibit a high level of vulnerability to food price shocks, aid has a strong dampening effect on the impact of climatic shocks on food security.

Our results are important in terms of recommendations for economic policies. While the debate about the role of foreign aid (especially food aid) on food security is ongoing, this paper shows that foreign aid dampens the impact of climatic variability on food security. However, foreign aid has no direct effect on food supply in developing countries. This result suggests that foreign aid should be increased in developing countries. However, such a policy must be implemented in countries that are vulnerable to food price shocks and affected by climatic variability.

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Appendices

Appendix 1: Variables definition and sources

Variables	Definition	Source
Food supply	Food supply refers to the total amount of the commodity available as human food during the reference period. Food supply is the total of food production + food import - food exports + food stocks variation.	FAO (2011)
Rainfall variability and level	The absolute deviation of the yearly average rainfall from its own trend (long-term mean rainfall 1950–2008).	Calculated by the Authors using data from Centre for Studies and Research on International Development (see (Guillaumont & Simonet 2011)
Food price vulnerability (FPV)	The FPV index[3] is a weighted average of the following variables: ratio of total food imports to total household consumption, ratio of total food imports to total imports of goods and services, and the inverse of the level of GDP per capita.	Authors from World Development Indicators —WDI (2011)
Income per capita	Gross domestic product per capita	WDI (2011)
Population growth	Annual population growth rate	WDI (2011)
Democratic institutions	The Polity Score captures the regime authority spectrum on a 21-point scale ranging from -10 (hereditary monarchy) to +10 (consolidated democracy).	Polity IV (2010)
Arable land	Arable area as a percentage of total land area	WDI (2011)
Cereal production land	Cereal[4] production area refers to harvested area or land under cereal production	WDI (2011)

3 To calculate this index, we use the principal component analysis (PCA) applied to three variables.

4 Cereals include wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat and mixed grains.

Aid	Net aggregate official development assistance transfers (in 2011 US$ million) per capita	WDI (2012)
Real effective exchange rate (REER)	REER is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs.	IFS (2011)

Source: Compilation created by author.

Appendix 2: Descriptive statistics of variables

Variable	Mean	Std. dev.	Min	Max
Food supply	389.04	153.74	18.63	1318.99
Rainfall variability	10.37	10.35	0.001	118.69
Rainfall	1200.57	812.04	16.81	3882.82
Food price vulnerability	46.15	64.45	0.84	381.48
Aid per capita	192.37	663.26	-113.21	11258.35
Income per capita	6396.13	10374.16	84.28	95885.27
Population growth	1.88	1.54	-4.64	16.24
Democratic institutions	-0.52	5.64	-10	10
Cereal production land	$2.22\ 10^{7}$	$7.10\ 10^{7}$	0	$6.95\ 10^{8}$
Arable land	13.30	12.94	0	71.65
Real effective exchange rate	460.20	4391.8	40.85	97285.19

Source: Author's calculations.

Appendix 3: List of countries

Albania	Guatemala	Nicaragua
Algeria	Honduras	Nepal
Argentina	Haiti	Pakistan
Azerbaijan	Indonesia	Panama
Burundi	India	Peru
Burkina Faso	Iran	Philippines
Bangladesh	Jamaica	Paraguay

Bulgaria	Kenya	Rwanda
Bolivia	Kuwait	Sudan
Brazil	Liberia	Senegal
Botswana	Libya	El Salvador
Cameroon	Sri Lanka	Syria
Chile	Lithuania	Togo
China	Morocco	Thailand
Côte d'Ivoire	Moldova	Trinidad and Tobago
Colombia	Madagascar	Tanzania
Costa Rica	Mexico	Uganda
Croatia	Mali	Ukraine
Ecuador	Mongolia	Uruguay
Egypt	Mozambique	Venezuela
Ethiopia	Mauritania	South Africa
Fiji	Malaysia	Zambia
Gabon	Niger	Zimbabwe
Ghana	Nigeria	

Source: WDI (2011)

Gender-based financial discrimination and economic growth in developing countries

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Abstract

This paper investigates the effect of gender discrimination in access to finance on economic performance. It also analyzes the mediating effect of this correlation through more financial development using a sample of developing countries. We argue that better finance may create more wage employment which may be beneficial for a number of women (in particular self-employed women by necessity) who face entry barriers in the labor market and who may not perform better with more access to finance due to their lack of sufficient educational and managerial skills. As such financial development can reduce the hampering effect of gender discrimination in access to finance on the growth rate. Using the recent and unique indicator of the OECD gender discrimination in access to finance, we find that gender discrimination in access to formal financial services reduces significantly the GDP growth rate of the countries in our sample. However, this negative effect declines with more financial development. Our results are robust to different specifications, to the use of different financial development indicators and to the correction of omitted variables and simultaneity bias.

Keywords: Gender; Finance; Economic Growth
JEL Classification: G00, O57

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1. Introduction

A number of scholars have investigated the effects of different forms of gender inequality on economic performance. Related pieces of evidences have supported a negative association between gender inequality in access to education and in the labor market, and the growth rate of GDP (see for instance Lagerröf (2003), Klasen (2002) and Klasen and Lamanna (2009)).[1] In many developing countries, gender inequality in access to finance coexists with these different forms of gender inequality (Hallward-Driemeier (2013)), and may also have similar negative repercussions on the economic growth of countries. While finance may boost the growth rate, thereby promoting investment and innovative activities, in contrast, discrimination in access to finance may depress the growth rate by creating inefficiency in the allocation of capital, increasing income inequality.[2] As far as we know, despite anecdotal evidence on negative effect of gender gap in access to finance on the economic performance, there are few empirical studies that analyze this correlation in a cross-country setting.

This paper takes one step further and provides an empirical framework that enables us first to test whether gender-based financial exclusion depresses the growth rate in a cross country analysis using a sample of developing countries across different regions; second, it allows us to test whether the negative correlation between gender-based financial exclusion and the economic growth rate can be mediated through more financial development. Different plausible mechanisms may explain the connection between gender discrimination in access to finance and economic growth, and the possible role that better financial development may play in mediating this relationship.

On the one hand, gender discrimination in access to finance reduces women's economic opportunities inside and outside the home, and as such reduces their bargaining power (Amartya (1990)). This may negatively affect education, health, fertility, and hence economic performance. In addition, we argue that, in the presence of gender-based financial discrimination, men with lower entrepreneurial and innovative ability have higher chances to get access to credits and loans than women with better entrepreneurial and innovative ability that can generate higher productivity, and sustain long-lasting businesses. It is well established that exclusion from access to financial services may engender inefficiency in the allocation of available capital (Beck and Demirgüç-Kunt (2007)). Such an inefficiency

[1] Earlier evidence on the role of gender inequality on economic growth can be found, for instance, in Barro and Lee (1994) and Barro and Sala-i-Martin (1995).

[2] See Schumpeter and Opie (1934); Gurley and Shaw (1955) for evidence on finance, innovation and investments. See Anderson (1990) and Khan and Reinhart (1990), Romer (1990); Aghion and Howitt (1992) for evidence linking investments, innovation and economic growth

results in an increase in income equality (Aghion and Bolton (1997); Beck and Demirgüç-Kunt (2007)), and consequently a decline in the economic growth rate (Barro (2000); Banerjee and Duflo (2003)). Our first goal in this paper is to assess the direct effect of gender-based financial exclusion on economic growth, focusing on developing countries.

One the other hand, in many developing countries entrepreneurs by opportunity[3] coexist with entrepreneurs by necessity (e.g., Vivarelli (2013); Quatraro and Vivarelli (2014)). This is particularly accentuated in the group of women entrepreneurs who are more likely to operate by necessity, due to the high discrimination in access to wage employment (Naudé and Minniti (2010)). These entrepreneurs would not necessarily gain much from more access to finance due to their lack of sufficient managerial skills and entrepreneurial ability, and thus may not contribute to economic growth (Vivarelli (2013)) in their home country. We believe that some of these women may prefer to switch from self-employed by necessity to being employed if they have easy access to decent wage employment. At the same time, recent investigations have shown that finance generates more and better wage employment (Aterido et al. (2011); Pagano and Pica (2012)), which we believe is highly beneficial for many women who face different barriers in the labor market, including those entrepreneurs by necessity. Our second goal in this paper is to explore the extent to which more financial development may reduce the negative effect of gender- based financial discrimination on economic growth, bearing in mind that financial development may create more wage employment, which may be beneficial for many women entrepreneurs by necessity who face entry barriers in the labor market, and who may not be successful in their business, with more access to finance.

For our analysis, we use a cross-section of data that includes more than hundreds of developing countries, covering the period 1980-2010. We employ the unique indicator of gender-based financial discrimination recently launched by the OECD. This variable informs us whether men and women in a society have equal access to financial services. It captures formal and informal laws and practices that constrain women's access to financial services in formal institutions, including opening a bank account and obtaining loans or credit. We find that the higher the level of gender-based financial discrimination, the lower the economic growth rate. Our term of interaction between gender discrimination in access to finance and financial development has a positive and significant sign. This provides evidence that financial development tends to reduce significantly the negative effect of higher gender discrimination in access to finance on economic growth. Results are robust to

[3] See Schumpeter and Opie (1934) and Baumol (1990) for a clear definition of these two types of entrepreneurs.

different specifications, and to different sample size. Our results are also robust to the correction of endogeneity issues. In fact, endogeneity bias may occur because of omitted variables and also because of reverse causality. For the former we add control variables to our model, and for the latter we provide some instruments for the indicators of financial development. However, we have not used instruments for the measure of gender discrimination in access to finance, leaving the door open for deeper research on this issue.

The total effect of gender discrimination in access to finance on economic growth takes a value of zero if the ratio of domestic credit to GDP is higher than 131%. This value goes down to 72% if we consider the indicator of liquid liability and to 100% for the indicator of broad money. The latter values decrease to 58% and 61% if we consider the short-run growth analysis using the 5-years panel data.

The rest of the paper is structured as follows. The next section presents a brief review of the literature. Section 3 describes the data and presents some descriptive statistics, while Section 4 sets up the empirical methodology. Section 5 discusses the main findings in this paper. Some concluding remarks follow in Section 6.

2. Review of the Literature

This paper can be related to two different strands of the literature. First, it is closely related to the influential literature that has addressed the relationship between various forms of gender inequality and economic growth. The gender gap in access to education has been associated with a negative impact on the economic growth rate in different works (e.g, Barro and Lee (1994) and Barro and Sala-i-Martin (1995), Galor and Weil (1996), Lagerӧf (2003), Klasen (2002), among others). While some of these studies have proposed a theoretical model to analyze the negative effect of the gender gap in education on the economic growth rate (Galor and Weil (1996), Lagerӧf (2003)), others have proposed empirical evidence based on cross-country regressions. In their seminal work, Barro and Lee (1994), Barro and Sala-i-Martin (1995) and Klasen (2002) have, for instance, provided evidence of a negative effect of gender inequality in access to education on economic growth.

Various arguments have been put forward to explain this negative effect. In their seminal work Klasen (2002) have discussed some of the mechanisms by which the gender gap in access to education may result in a lower growth rate. One is that in an environment where ability to school is equally distributed among men and women, a gender gap in education

means that a man with a lower ability than a woman will be more likely to have access to education than a woman. As a consequence, this reduces the potential average stock of human capital if we believe that ability is a key determinant of the level of human capital supplied. Another sustained argument is on the existing imperfect substitution between men and women in terms of human capital (Tzannatos (1999), World Bank (2001)) and the diminishing marginal return to education.

Besides the focus on education, other scholars have analyzed the effect of existing gender discrimination in the labor market on economic growth, and the results are quite mixed. While some have provided evidence that gender discrimination in the employment sector boosts the growth rate (Horton (1999) and Tzannatos (1999) among others), others, in contrasts support the evidence of a negative effect of gender discrimination in the labor market on economic growth (e.g, Klasen and Lamanna (2009), Seguino (2000a), Seguino (2000b)). The former works have argued that an increase in women's level of education, by lowering the gender gap in access to education, may enable employers to hire more women with low wages. This will in turn generate more investment and higher economic growth (Horton (1999) and Tzannatos (1999) among others). In contrast, the latter strand of the literature has argued that a decrease in discrimination in the labor market (including in wages and participation) presents several desirable development features that lead to more growth. For instance, a decline in gender discrimination in the labor market may increase the bargaining power of women (Amartya (1990)), and lower the fertility rate (de Cavalcanti and Tavares (2001)).

Beyond these different studies on the gender gap in education and on the labor market, it is worth noting the importance of gender discrimination in social institutions that negatively affects different development goals that are important for growth. Different forms of gender discrimination exist in the family code, physical integrity, civil liberties and in access to and control of resources. These types of discrimination have been linked to less food security (OECD (2012)), high fertility (Branisa et al. (2013)) and lower education (Asian Development Bank (2013)).

The gender gap in access to financial services coexists with these different types of gender discrimination. Access to finance is crucial for firm growth, especially for small and newly established firms that generally lack capital in order to fully realize their potential (Beck and Demirgüç-Kunt (2005); Klapper et al. (2006)). In contrast, exclusion from access to financial services (loans, credits, savings etc.) may engender inefficiency in the allocation of available capital, which may in turn result in an increase in income inequality

(Aghion and Bolton (1997); Beck and Demirgüç-Kunt (2007)), and thus a decline in the economic growth rate (Barro (2000); Banerjee and Duflo (2003)).

Recent studies have pointed-out the significance of existing gender discrimination in access and use of financial services in many developing countries (Aseidu et al. (2013), Hallward-Driemeier (2013)). However, despite the anecdotal evidence that has emphasized the negative effect of gendered financial exclusion on economic growth, little empirical evidence has tested this correlation in a cross-country setting. Our paper tries to fill this gap, and tests whether discrimination in access to finance is linked with a lower economic growth rate in the long and short terms using a sample of developing countries for the period 1980-2010.

Our paper is also closely linked to the literature on the impacts of finance on different aspects of the economy. Dating back to Schumpeter (1911), the prominent role of finance in development has been well documented. In a similar spirit, recent studies have addressed the correlation between finance and economic growth, and found that finance is a good driver of economic growth (Beck et al. (2000); Levine et al.(2000); King and Levine (2000), Beck et al. (2014)). Different explanations may account for the positive effect of financial development on economic growth. Finance may increase growth by boosting productive investments and innovation (Schumpeter and Opie (1934), Gurley and Shaw (1955)), and by providing more and better employment (Aterido et al. (2011)).

However, this literature dealing with the effect of financial development on economic growth has raised a controversy. Some recent studies have not found significant or robust results that financial development increases the level of growth. For example, the recent study by Menyah et al. (2014) has supported a limited impact of financial development on economic growth in a sample of African countries. Also Henderson et al. (2013), using a non-parametric framework to account for non-linearity, find that the growth rates of developing countries do not benefit much from financial development. These findings are in line with the view of Rostow (1960), who has posited that in the initial stages of development, finance may not be a key driver of a country's growth rate, but at the later stage it may play a crucial role. In parallel, other studies have shown that the effect of financial development on economic growth is a U-shaped relationship where more advanced countries benefit less from more financial development than do less advanced countries (e.g, Arcand et al. (2015), Samargandi et al. (2015); Law and Singh (2014)).

Another group of scholars have tried to interact indicators of financial development with other key determinants of economic growth in order to see if there are some interacting or mediating effects of financial development. One can note, for instance, the work of Aghion et al. (2005), who have emphasized that financial constraints make convergence less likely for poor countries, thereby preventing them from taking full advantage of technology transfer. This conclusion is the interpretation of the negative sign on their term of interaction between the indicator of financial development and initial income in the growth regression. Other significant studies are the paper by Alfaro et al. (2010) on financial development, FDI and economic growth, and the paper by Ahlin and Pang (2008) linking financial development, corruption and economic growth. The former have shown that the contribution of FDI to growth increases with the level of financial development. The latter study has asked whether financial development and corruption are complements or substitutes in the growth process. Their results support the view that, while less corruption and more financial development enhance growth, their term of interaction shows that these two variables are substitutes in the growth process.

In this paper we complete this literature by adding two new features. We first address empirically the effect of financial exclusion on economic growth, focusing specifically on the existing gender-based financial exclusion that remains an important issue for many developing countries. Second, we employ a term of interaction strategy in order to analyze to what extent an increase in financial development may help to mediate the negative effect of gender-based financial exclusion and economic growth.

3. Data and Descriptive Statistics

Our data refer to a number of different developing countries with different characteristics, and cover the period 1980-2010. Our dependent variable is the growth rate of GDP per capita between 1980 and 2010, taken from the Penn world table version 8.0. Let us note that for robustness checking we will also employ 5-year panel data in order to increase our sample size. It is worth noting that the panel data allow us to study the growth rate in the short run instead of the long run, and also our measure of gendered financial exclusion does not vary over time. To assess the effect of gender-based financial exclusion on economic growth, we use the unique and newly available indicator of gender discrimination in access to finance from the Gender, Institutions and Development Database released by the OECD in 2014. This indicator captures formal and informal laws and practices that constrain women's access to financial services in formal institutions, including opening a bank account and obtaining loans or credit. This variable informs us whether men and

women in a society have equal access to financial services. It takes three different values: 0; 0.5 or 1, where 0 is for non-discrimination and 1 for full discrimination.

The value 0 is allocated to countries where the law indeed guarantees equal gender access to formal financial services such as credit, bank account and bank loans. The value of 0.5 is recorded when the law guarantees equal rights between men and women as described above, but there are some customary, traditional or religious norms and practices that discriminate against women. Such existing discrimination caused by norms and practices may hinder women's ability and access to legally recognized financial services. Finally, the value 1 is given when the law does not guarantee equal rights between men and women in terms of access to financial services, or when women do not have legal rights to access to finance. In our sample, two countries, explicitly Nigeria and Democratic Republic of Congo, are assigned a score of 1, while the rest of the countries are equally distributed between 0 and 0.5, with an important number of Sub- Saharan African countries recording a score of 0.5.

To capture the level of financial development in a country, we refer to the commonly used indicators of financial development taken from the World Development Indicators data and also from the Financial Development and Structure Dataset. These different indicators are domestic credit normalized by GDP, as well as liquid liabilities and broad money, both relative to GDP. For each country we take the average over the period 1980-2010. We also consider a number of additional control variables taken from the Penn World table, including GDP per capita at the initial period in order to test for the convergence hypothesis between the countries. In addition, we control for standard explanatory variables such as the growth rate of the population augmented by a depreciation and technological change term commonly fixed at 0.05; the investment in physical capital and government expenditures. These variables are all averaged over the period 1980-2010. We also include an indicator of the distance to the latitude in absolute value taken from La Porta et al. (1999).

In some of our specifications we include a measure of the initial level of human capital and the average level of political and economic institutions. However, the inclusion of these variables reduces significantly the number of observations in our analysis, which is why we do not include them in all our specifications. We employ the index of human capital per person from the Penn World table. This measure is compiled combining years of schooling from Barro and Lee (2013) and returns to education from Psacharopoulos (1994). For the institutional indicators, we follow some recent influential works (e.g. Flachaire et

al. (2014)), distinguishing political from economic institutions. We measure political institutions using the index of democracy from the polity IV compilation. This index ranges between 0 and 10, where a value of 0 denotes an autocratic government and a value of 10 a full democracy. This measure takes into account the competitiveness and openness of executive recruitment, the constraints on the executive, and the competitiveness of political participation. The indicator of economic freedom comes from the Fraser Institute and measures the extent to which property rights are protected and the freedom that individuals have to engage in voluntary transactions.

Table 1 presents some descriptive statistics of the data used in this paper as well as the data source of the different variables. The average value for the indicator of gender discrimination in access to finance is about 0.3, with a standard deviation also close to 0.3. Due to some missing values on the different variables included, our sample is reduced to a maximum of 91 countries. Tables 8, 9 and 10 report the list of countries and their associated values for the indicator of gender discrimination in access to finance, and the level of financial development using our three proxies for financial development.

4. Empirical Strategy

We regress our dependent variable, the economic growth rate (growth), on a set of explanatory variables including gender discrimination in access to finance (AcessFin), financial development (FinDev) and the term of interaction between financial development and gender discrimination in access to finance (AcessFin $*$ FinDev). Our specification takes the following form:

$$\text{growth}_i = \beta_0 + \beta_1 \text{AcessFin}_i + \beta_2 \text{FinDev}_i + \beta_3 \text{AcessFin}_i * \text{FinDev}_i + \beta_4 X_i + \varepsilon_i, \varepsilon_1 \sim N(0, \sigma^2) \quad (1)$$

Our parameters of interest are β_1 and β_3. The estimated coefficient on β_1 informs us about the effect of gender discrimination in access to finance on economic growth, while the estimated coefficient on β_3 indicates whether the effect of gender discrimination in access to finance on growth depends on the level of financial development. We expect to find a negative sign on the former coefficient and a positive sign on the latter. First, we argue that higher gender discrimination in access to finance may deprive women of economic empowerment, reducing their much-needed bargaining power inside and outside the home. Also, the presence of such gender-based financial discrimination inhibits the performance of good and talented women entrepreneurs who may significantly gain

from better access to credit and loans. This is particularly true for the small and new start-up businesses that account for a significant portion of women entrepreneurs. These negative repercussions may create additional inequality and inefficiency in the allocation of available resources in the economy, and then depress the growth rate.

Second, we hypothesize that more financial development may impede the negative effect of the gender discrimination in access to finance on economic growth. There may be different plausible explanations for this mediating effect through more financial development. One can claim that financial development creates more and better wage jobs, which may generate greater income for those women who face different entry barriers in the labor market. Also, this may be income for those women who face different entry barriers in the labor market. Also, this may be beneficial for women entrepreneurs by necessity for whom wage employment is more profitable than being self-employed. This can be partly explained by the fact that generally this type of entrepreneurs lacks sufficient managerial and entrepreneurial skills to sustain their business.

We do not expect any particular sign and significance for the parameter on financial development β_2. In fact, there is an influential literature that has empirically investigated the effect of financial development on economic growth (Beck et al. (2000); Levine et al. (2000); Menyah et al. (2014)), but results are mixed and the question of whether financial development increases the growth rate of an economy remains open and may depend on different characteristics, including the stage of development of a country (Henderson et al. (2013); Arcand et al. (2015)).

To compute the total effect of the gender gap in access to finance on economic growth we use the following formula:

$$\frac{\partial Growth}{\partial Access\ Finance} = \underline{\beta_1 + \beta_3 * FinanDev}$$

5. Empirical findings

(a) Cross-Sectional Data

This section presents our results, testing our two hypotheses. We first regress growth on the gender discrimination in access to finance, financial development and on the interaction term between these two variables. Results are reported in Table 3. We start with the first column, where we control only for the gender discrimination in access to finance. We find a negative and significant coefficient, meaning that an increase in gender discrimination in access to finance reduces the growth rate of the countries. This result is in line with the previous literature that has highlighted that gender gaps in education and in the labor market hinder the growth rate of GDP (Klasen (2002) for the former and Klasen and Lamanna (2009) for the latter). Our findings thus complement this previous literature by looking at the effect of the gender discrimination in access to finance, something that has not been empirically tested. We next include the different indicators of financial development across the columns (2)-(4). The coefficients on the different indicators of financial development are positive, indicating that financial development boosts growth, as suggested in some previous studies (Beck et al. (2000); Levine et al. (2000); King and Levine (2000)). However, the coefficients are hardly significant, casting doubt on the importance of finance for growth as previously argued in the literature (Menyah et al. (2014)).

In the last three columns we include the term of interaction between the gender discrimination in access to finance and financial development. The coefficients are all positive and significant at the 1% level. This tells us that financial development reduces the negative effect of the gender discrimination in access to finance on economic growth. This result confirms our hypothesis that the gender discrimination in access to finance hinders the growth rate, but this negative effect is less severe with greater financial development.

(b) Omitted variables bias and endogeneity bias

We replicate our results in Table 4, where we now control for additional explanatory variables. In the first three columns we do not include human capital and institutions for the sake of limiting the loss of a significant number of countries for which data on these variables are not available. Results are in line with our previous findings, where the gender gap in access to finance depresses growth, but this vanishes with more financial development. The coefficients on physical investment and government expenditures are positive, while the coefficient on the initial income is negative, confirming the

convergence hypothesis in our sample of developing countries.

In addition to the bias that may come from omitted variables, our results may also suffer from endogeneity bias on some variables. We are mainly concerned about the possible endogeneity of gender discrimination in access to finance and also possible endogeneity of our measures of financial development. For the former, endogeneity may occur because of omitted variables that may affect both the growth rate of the GDP and our variable of interest, gender discrimination in access to finance. In this case we have previously controlled for additional variables such as the level of development using initial levels of income and of human capital as well as the level of democracy of the countries, bearing in mind that more development and more democracy may affect both the economic performance but also any possible discrimination that may exist in a society, including gender discrimination in access to finance.

The latter source of endogeneity comes from the fact that financial development and economic growth are measured simultaneously. To control for this simultaneity bias we follow the approach proposed by Beck et al. (2000), using legal origin as an instrumental variable in order to extract the exogenous component of financial intermediary development. The indicator of legal origin is taken from La Porta et al. (1999). Results are reported in Table 5 and show that the coefficients on access to finance remain negative and significant. The coefficients on the term of interaction between the gender gap in access to finance and financial development are positive and significant except when we use liquid liability as our indicator of financial development, where we lose some significance on our main variables of interest. The Sargan and Baumann tests (see Sargan (1958) and Basmann (1960)) on the validity of the instruments reported at the bottom of Table 5 are not rejected.

(c) Panel Data:

Next, in Table 6 we employ 5-year panel data covering the same time period, 1980-2010 in order to increase substantially our number of observations. Indeed, given that our indicator of gender discrimination in access to finance is fixed and does not change over time, we cannot include country fixed-effects to control for unobserved characteristics. However, we have considered the inclusion of time fixed-effects for robustness checking. We run a number of pooled estimations using different specifications. Our results are in line with our previous conclusion that gender- based financial exclusion reduces significantly the growth rate of the countries and this result is robust across the different specifications, and

to the inclusion of time fixed-effects. Turning to the coefficients on the terms of interaction between gender discrimination in access to finance and the different indicators of financial development, we find that the estimates have all the expected positive signs, however, we lose some significance in column (6) where we include time fixed effects when using the indicator of domestic credit relative to GDP.

(d) Total effect of gender-based financial discrimination

The overall effect of the gender discrimination in access to finance on growth is neutral if and only if the following condition is satisfied:

$$\frac{\partial Growth}{\partial AccessFinance} = \beta_1 + \beta_3 * FinanDev = 0 \quad (2)$$

Table 7 reports the values of financial development for which the total effect of gender discrimination in access to finance on the long-term and the short-term economic growth is equal to zero. These levels of financial development are computed using the estimates reported in Tables 3, 4 and 6. We observe that the levels of the indicators of financial development for which the condition in equation 2 is satisfied are higher when we use results in Table 4, where we have controlled for omitted variables bias, than when we use estimates of Table 3 without additional controls. Using the estimates reported in columns (1), (2) and (3) of Table 4, we observe that the total effect of the gender gap in access to finance is neutral if our preferred indicator of financial development, domestic credit, is equal to 131% of GDP. This value goes down to 72 % if we consider liquid liability as our indicator of financial development and 100% for the measure of broad money. In our data, Lebanon, Liberia, South Africa and Zimbabwe record values for domestic credit relative to GDP higher than 131%, while we have a longer list of countries that record indicators of liquid liability higher than 72%; these include Antigua and Barbuda, China, Egypt, Jordan, Kuwait, Lebanon, Macao, Malaysia, St.Kitts and Nevis, and Thailand. Finally, countries that record quantities of broad money higher that 100% of GDP are Jordan, Lebanon, Macao, Malaysia and Zimbabwe.

When we use the estimates in Table 6 based on the 5-year panel data, we find that the required value for the indicator of domestic credit to GDP remains similar to the previous estimated value. This tells us that the level of financial development needed to offset the negative effect of the gender discrimination in access to finance on economic

performance is similar whether we consider long-run or short-run economic performance. However, this is not true for the other indicators of financial development, for which we find smaller values in the case of short-run economic performance. As shown in Table 7, the required value for liquid liability relative to GDP is 58, while the required value for broad money relative to GDP is 61.

6. Concluding Remarks

Gender equality and women's economic empowerment have been a central goal in achieving successful and sustainable development. However, the majority of women in many developing countries are still disproportionally disadvantaged in terms of economic opportunities and access to resources. Different forms of gender inequality, such as inequality in access to education and inequality in the labor market, have been associated with a decrease in the growth rate of economies. Gender discrimination in access to finance coexists with these different types of gender inequality, and yet has the strength to reduce economic performance to the same extent as the other forms of gender discrimination. However, despite anecdotal evidence that finds a direct and negative effect of gender-based financial discrimination on the growth rate of countries, to our limited knowledge there are no studies that have tested this relationship in a cross-country comparison study.

This paper takes one step further and provides an empirical framework that enables us to test whether gendered financial discrimination depresses the growth rate in a cross-country comparison analysis of developing countries. We also assess whether the negative correlation between gender-based financial discrimination and economic growth rate can be mediated by increased financial development. Our motivation is based on the idea that financial exclusion, including gender-based financial exclusion, may engender inefficiency in the allocation of available capital. This may consequently increase income inequality and reduce the economic growth rate. We also argue that financial development may create more wage employment, which can be seen as an an opportunity for many women entrepreneurs by necessity who face entry barriers to the labor market, and who may not be successful in their business through more access to finance due to their limited educational and managerial ability.

Our analysis is based on cross-sectional and panel data that include many developing countries over the period 1980-2010. Using the unique indicator of gender discrimination in access to finance recently launched by the OECD, we find that the higher the level of gender-based financial exclusion, the lower the level of the growth rate. Our term of

interaction between gen- der discrimination in access to finance and financial development has a positive and significant sign. This provides evidence that financial development tends to reduce significantly the negative effect of gender discrimination in access to finance in both long-run and short-run economic growth. The total effect of gender discrimination in access to finance on economic growth takes a value of zero if the level of our preferred indicator of financial development, domestic credit relative to GDP, is equal to 131. For the other indicators of financial development, namely, liquid liability and broad money relative to GDP, the values that offset the negative effect of gender-based financial exclusion are lower and also vary depending on whether we consider the cross-sectional or the panel data.

Our results have made a contribution to the international debate that has emphasized that discrimination towards women in respect of access to formal finance in a society may have negative repercussions for the entire society. As such, policies that are intended to promote better access to formal financial services for women have the potential to raise the growth rate of the economy. The question of how to make women's access to finance efficient remains important because, in many developing countries, in particular in sub-Saharan Africa, there is a significant number of women entrepreneurs by necessity due to existing gender discrimination in the labor market. These women may not improve their performance by means of greater access to higher loans and credit due to their lack of educational, managerial and entrepreneurial skills. Therefore policies that are intended to promote financial development may help to create more jobs for those women who can switch from being self-employed by necessity to being employed.

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Table 1: Descriptive Statistics and Data Source

Variable	Obs	Mean	Std Dev	Min	Max	Description	Data Source
Growth	109	1.6856	2.1451	-3.4086	10.8501	Average growth rate	Pen World
ln(GDP)	109	7.8097	1.0134	5.9901	11.1647	Log of initial GDP per capita	Pen World
ln(pop+0.05)	110	1.9449	0.1346	1.4909	2.2193	Log of population growth	Pen World
ln(Invest)	124	2.8666	0.4204	1.6862	4.0239	Log of average investment	Pen World
ln(GOV)	124	3.0081	0.4255	1.8069	4.2773	Log of average government consumption	Pen World
Human Capital	86	1.7426	0.4095	1.0862	2.6303	Log of initial human capital	Pen World
Access Finance	105	0.2714	0.2688	0	1	Gender inequality in access to finance	OECD
ln(Credit/GDP)	121	3.7437	3.0376	1.9847	36.0328	Log of average domestic credit to GDP	World Bank
ln(Broad/GDP)	123	3.7428	2.6939	2.3830	32.76077	Log of average broad money to GDP	World Bank
ln(Liquid/GDP)	122	3.4785	0.6241	1.8356	5.3802	Log of average liquid liabilities to GDP	World Bank
Democracy	111	3.6823	3.0342	0	10	Average index of democracy	Polity IV
Economic Freedom	104	6.2185	0.7306	4.1533	7.4733	Average index of economic freedom	Fraser Institute

This table shows the descriptive statistics of the variables used in the cross-section analysis. The variable **Growth** defines the growth rate of income per capita between 1980 and 2010. The variable **GDP** per capita and **Human Capital** are measured at the initial period, in 1980. The remaining variables are averaged over the period 1980-2010.

Table 2: Table of Correlation

	Growth	ln(GDP)	ln(POP)	In(Invest)	ln(Gov)	Human Cap	Access Fin	ln(Credit)	ln(Broad)	ln(Liquid)	Dem	Eco
Growth	1											
ln(GDP)	-0.021	1										
ln(POP+0.05)	-0.396	-0.246	1									
ln(Invest)	0.192	0.376	-0.136	1								
ln(Gov)	0.173	-0.139	-0.197	-0.127	1							
Human Cap	0.290	0.613	-0.648	0.345	0.099	1						
Access Fin	-0.451	-0.226	0.405	-0.058	-0.065	-0.476	1					
ln(Credit)	0.251	0.055	-0.098	-0.042	0.119	0.047	-0.144	1				
ln(Broad)	0.252	0.050	-0.077	-0.014	0.118	0.041	-0.148	0.994	1			
ln(Liquid)	0.435	0.433	-0.237	0.391	0.037	0.339	-0.204	0.144	0.149	1		
Dem	0.133	0.259	-0.498	0.083	-0.114	0.525	-0.462	-0.054	-0.083	0.071	1	
Eco	0.1384	0.431	-0.161	0.267	0.005	0.443	-0.143	-0.273	-0.257	0.396	0.331	1

This table presents the correlation between the variables used in this study.

Table 3: The Effect of Gender-based Financial Exclusion on Economic Growth, Cross-Section Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AccessFinance	-2.594***	-2.572***	-2.406***	-2.445***	-8.651***	-11.19***	-10.62***
	(0.783)	(0.775)	(0.779)	(0.787)	(2.413)	(3.950)	(3.100)
ln(Credit)		0.0697			0.0496		
		(0.0595)			(0.0580)		
ln(Liquid)			0.651*			-0.314	
			(0.349)			(0.546)	
ln(Broad)				0.0932			0.0727
				(0.0680)			(0.0661)
AccessFinance*ln(Credit)					1.858***		
					(0.701)		
AccessFinance*ln(Liability)						2.637**	
						(1.164)	
AccessFinance*ln(Money)							2.476***
							(0.911)
Constant	2.299***	1.991***	0.0154	1.903***	2.016***	3.302*	1.920***
	(0.309)	(0.397)	(1.261)	(0.422)	(0.384)	(1.903)	(0.408)
Observations	91	89	91	91	89	91	91
R-squared	0.109	0.138	0.144	0.128	0.204	0.191	0.197

This table reports the estimations of our baseline specification, controlling for only gender-based discrimination in access to finance, the level of financial development and the term of interaction between gender discrimination in access to finance and financial development.

Standard errors are in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 4: The Effect of Gender-based Financial Exclusion on Economic Growth, Cross-Section

Data

	(1)	(2)	(3)	(4)	(5)	(6)
AccessFinance	-7.724***	-10.31***	-8.500***	-9.111***	-7.981**	-9.457***
	(2.376)	(3.641)	(3.169)	(2.192)	(3.389)	(3.333)
ln(Credit)	0.0588			0.0840*		
	(0.0517)			(0.0423)		
ln(Liquid)		-0.259			0.308	
		(0.561)			(0.518)	
ln(Broad)			0.0707			0.0972*
			(0.0597)			(0.0523)
AccessFinance*ln(Credit)	1.584**			1.926***		
	(0.668)			(0.599)		
AccessFinance*ln(Liability)		2.414**			1.766*	
		(1.091)			(0.983)	
AccessFinance*ln(Broad)			1.842**			2.159**
			(0.915)			(0.954)
ln(pop+0.05)	0.716	-1.323	-0.390	-1.263	-2.131	-1.924
	(1.767)	(1.839)	(1.790)	(1.871)	(2.124)	(2.071)
ln(GDP)	-0.536***	-0.618***	-0.605***	-0.696***	-0.729***	-0.712***
	(0.202)	(0.219)	(0.212)	(0.209)	(0.235)	(0.235)
ln(Invest)	1.538***	1.570***	1.458***	0.581	0.759	0.723
	(0.486)	(0.494)	(0.498)	(0.477)	(0.544)	(0.525)
ln(Gov)	1.110**	1.208**	1.126**	-0.496	0.114	-0.174
	(0.478)	(0.488)	(0.495)	(0.484)	(0.514)	(0.536)
Latitude	2.755	1.568	2.116	2.972**	2.495	2.887*
	(1.672)	(1.778)	(1.752)	(1.403)	(1.608)	(1.598)
HC				0.712	0.285	0.229
				(0.690)	(0.751)	(0.756)
Dem				-0.120*	-0.0172	-0.0295
				(0.0713)	(0.0772)	(0.0763)
Eco				0.287	0.0809	0.277
				(0.273)	(0.290)	(0.308)
Constant	-3.453	2.127	-0.495	6.305	6.878	6.837
	(4.439)	(5.101)	(4.582)	(4.468)	(5.425)	(5.163)
Observations	89	91	91	75	76	76
R-squared	0.412	0.404	0.388	0.554	0.486	0.481

This table reports the estimations results of our model, including additional control variables across the different columns. Standard errors are in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5: The Effect of Gender-based Financial Exclusion on Economic Growth, Instrumental variables

	(1)	(2)	(3)	(4)	(5)	(6)
AccessFinance	-9.035***	-3.841	-9.254**	-9.710***	-6.699	-9.704**
	(3.059)	(17.25)	(3.620)	(2.578)	(12.86)	(3.833)
ln(Credit)	-0.181			0.0198		
	(0.277)			(0.145)		
AccessFinance*ln(Credit)	1.874**			2.062***		
	(0.821)			(0.677)		
ln(Liquid)		1.098			0.577	
		(3.580)			(2.650)	
AccessFinance*ln(Liquid)		0.431			1.396	
		(5.281)			(3.710)	
ln(Broad)			-0.0704			0.0753
			(0.295)			(0.175)
AccessFinance*ln(Broad)			2.013**			2.219**
			(1.008)			(1.058)
ln(Pop+0.05)	0.512	-0.282	-0.460	-1.228	-1.887	-1.921
	(2.005)	(3.312)	(1.855)	(1.906)	(3.172)	(2.074)
ln(GDP)	-0.479**	-0.765*	-0.586**	-0.653***	-0.747**	-0.702***
	(0.237)	(0.443)	(0.223)	(0.232)	(0.289)	(0.248)
ln(Invest)	1.356**	1.429**	1.394**	0.553	0.680	0.719
	(0.585)	(0.630)	(0.531)	(0.489)	(0.941)	(0.527)
ln(Govexp)	1.241**	1.363**	1.209**	-0.450	0.145	-0.160
	(0.559)	(0.646)	(0.539)	(0.503)	(0.595)	(0.547)
Latitute	2.856	1.121	2.231	3.059**	2.499	2.908*
	(1.887)	(2.177)	(1.826)	(1.440)	(1.612)	(1.609)
HC				0.755	0.294	0.239
				(0.709)	(0.757)	(0.761)
DEM				-0.127*	-0.009	-0.032
				(0.074)	(0.111)	(0.078)
ECO				0.146	0.056	0.235
				(0.413)	(0.378)	(0.445)
Constant	-2.348	-3.331	-0.0024	6.939	5.837	7.065
	(5.155)	(15.15)	(4.841)	(4.750)	(11.44)	(5.454)
Nb obs	89	91	91	75	76	76
R-squared	0.253	0.361	0.347	0.538	0.484	0.480
Sargan Statistics	0.367	0.506	0.536	0.511	0.451	0.780
Sargan P-value	0.545	0.477	0.464	0.475	0.502	0.377
Basmann Statistics	0.327	0.453	0.480	0.425	0.346	0.653
Basmann P-value	0.567	0.501	0.488	0.515	0.539	0.419

This table reports the IV-estimation results. We instrument financial development using legal origin data from la Porta. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 6: The Effect of Gender-based Financial Exclusion on Economic Growth, Panel Data

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AccessFinance	-2.157**	-7.452**	-12.95***	-11.65***	-6.867**	-11.97***	-11.30***
	(0.862)	(2.974)	(3.535)	(4.042)	(2.948)	(3.504)	(4.004)
ln(Credit)		-0.689*			-0.513		
		(0.397)			(0.400)		
AccessFinance*ln(Credit)		1.528*			1.284		
		(0.855)			(0.849)		
ln(Liquid)			0.218			0.158	
			(0.518)			(0.512)	
AccessFinance*ln(Liquid)			3.187***			2.846***	
			(1.047)			(1.039)	
ln(Broad)				-0.363			-0.506
				(0.569)			(0.565)
AccessFinance*ln(Broad)				2.830**			2.668**
				(1.171)			(1.161)
Ln(GDP)	-1.110***	-0.920***	-1.352***	-1.162***	-0.625**	-0.960***	-0.810**
	(0.293)	(0.308)	(0.298)	(0.303)	(0.315)	(0.314)	(0.316)
LN(Pop+0.05)	-0.478	-0.560	-1.191**	-0.577	-0.412	-0.995*	-0.455
	(0.621)	(0.610)	(0.564)	(0.611)	(0.613)	(0.568)	(0.615)
Ln(Invest)	1.008**	1.186***	0.881*	1.076**	0.840*	0.631	0.831*
	(0.449)	(0.452)	(0.463)	(0.459)	(0.454)	(0.466)	(0.462)
Ln(GovExp)	0.973**	0.576	0.181	0.664	1.104**	0.737	1.200**
	(0.459)	(0.477)	(0.453)	(0.472)	(0.496)	(0.478)	(0.494)
HC	2.319***	2.041***	1.995***	2.066***	0.950	0.956	1.060
	(0.647)	(0.657)	(0.604)	(0.643)	(0.723)	(0.670)	(0.706)
Time FE	No	No	No	No	YES	YES	YES
Constant	1.544	3.866	7.474**	4.566	1.428	4.123	2.307
	(2.894)	(3.267)	(3.211)	(3.364)	(3.505)	(3.457)	(3.569)
Nb obs	490	459	431	470	459	431	470
R-squared	0.079	0.079	0.128	0.089	0.117	0.162	0.121
Number of countries	82	81	82	82	81	82	82

This table reports the estimations using the panel data. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 7: Minimum values of Financial Development for No Gender Effect on Growth

	Table 3 (columns 5, 6 &7)	Table 4 (columns 1,2 &3)	Table 6 (Columns 2, 3&4)
Credit/GDP	105.22	131.14	131.23
Liquid/GDP	69.65	71.58	58.17
BroadMon/GDP	72.91	100.94	61.35

Table 8: List of Countries

Country	Access Finance	Ln(credit/GDP)	Ln(liquidLiability/GDP)	Ln(Broad Money
Albania	0	0.527475	4.10572	4.16293
Angola	0.5	0.09837	2.81268	3.15529
Antigua and Barbuda	.	0.707006	4.49816	4.28149
Argentina	0	0.335247	3.02505	3.07628
Bahamas	.	0.662661	4.02429	3.82628
Bahrain	0.5	0.27725	4.16863	4.19044
Bangladesh	0.5	0.337136	3.74402	3.42316
Barbados	.	0.644424	4.25774	4.15835
Belize	.	0.476202	3.89134	3.84566
Benin	0.5	0.162369	3.28792	3.16172
Bhutan	0	0.09044	2.86532	3.63292
Bolivia	0	0.431406	3.54666	3.53997
Botswana	0.5	-0.28491	3.34159	3.44559
Brazil	0.5	0.84894	3.45723	3.62643
Brunei	.	0.262668	4.23913	4.23586
Bulgaria	0	0.591221	3.9344	4.06601
Burkina Faso	0.5	0.120248	3.02099	2.85613
Burundi	0	0.21433	2.90716	2.8566
Cambodia	0	0.089872	2.87886	2.89427
Cameroon	0.5	0.193268	2.89079	2.90453
Cape Verde	.	0.518116	4.05785	4.03542
Central African Republic	0.5	0.15923	2.84015	2.86082
Chad	0.5	0.118235	2.58233	2.48674
Chile	0	0.793705	4.17871	3.87353
China	0	1.0096	4.71917	4.59248
Colombia	0	0.413282	3.16891	3.38142
Comoros	.	0.158722	3.13475	3.11819
Congo, Dem. Rep.	1	0.072769	1.83564	2.38303
Congo, Republic of	0	0.151876	2.79012	2.82725
Costa Rica	0	0.344507	3.39142	3.56389
Cote d'Ivoire	0.5	0.325017	3.28261	3.31909
Djibouti	.	0.385162	4.22438	4.2682
Dominica	.	0.555561	4.13999	4.1637
Dominican Republic	0	0.346766	3.09679	3.35207

Table 9: List of countries continuation…

Country	Access Finance	Ln(credit/GDP)	Ln(liquidLiability/GDP)	Ln(Broad Money/GDP)
Ecuador	0	0.195333	3.13821	2.85204
Egypt	0.5	0.910127	4.37215	4.32439
El Salvador	0.5	0.454525	1.84302	3.65764
Equatorial Guinea	0	0.158228	2.37186	2.65818
Ethiopia	0.5	0.37292	3.61706	3.43995
Fiji	0.5	0.605227	3.7407	3.81387
Gabon	0.5	0.182518	2.80567	2.85775
Gambia, The	0.5	0.226799	3.37818	3.20181
Ghana	0.5	0.245805	2.94684	3.10196
Grenada	.	0.6575	4.27575	4.30164
Guatemala	0	0.306245	3.26837	3.31591
Guinea	0.5	0.133714	3.05281	2.75479
Guinea-Bissau	0.5	0.143249	2.69594	3.11138
Honduras	0.5	0.389219	3.56001	3.56261
India	0.5	0.510297	3.88482	3.79418
Indonesia	0.5	0.392116	3.56746	3.48969
Iran	0.5	0.483664	3.76267	3.76875
Iraq	0.5	-0.05137	3.57837	3.2939
Jamaica	0	0.542516	3.84453	3.94676
Jordan	0.5	0.891353	4.65784	4.60852
Kenya	0.5	0.446334	3.72335	3.52883
Kuwait	0	0.773463	4.29107	4.2344
Laos	.	0.101696	2.79322	2.87832
Lebanon	0.5	1.37788	5.3802	5.21073
Lesotho	0	0.096935	3.63213	3.71267
Liberia	0	1.32822	3.1133	3.11421
Macao	.	0.424351	4.9144	4.91192
Madagascar	0	0.226265	3.06076	2.9806
Malawi	0.5	0.233159	3.00875	3.00237
Malaysia	0	1.20281	4.69249	4.62046
Maldives	.	0.467801	3.99842	3.61896
Mali	0	0.182858	3.11133	3.08075
Mauritania	0.5	0.405624	3.258	3.12001
Mauritius	0	0.700814	4.24276	4.24678
Mexico	0.5	0.404408	3.20267	3.32811

Table 10: List of countries continuation...

Morocco	0.5	0.634585	4.21277
	4.08924		
Mozambique	0	0.101486	3.1776
	3.33142		
Namibia	0.5	0.433364	3.73644
	3.65013		
Nepal	0.5	0.353459	3.66328
	3.58072		
Niger	0.5	0.130395	2.69348
	2.60459		
Nigeria	1	0.26115	3.19039
	3.11954		
Oman	0.5	0.254754	3.49721
	3.35126		
Pakistan	0	0.488218	3.7239
	3.75808		
Panama	0	0.739974	4.07992
	4.01218		
Paraguay	0	0.221952	3.22496
	3.22568		
Peru	0	0.206511	3.09386
	3.24021		
Philippines	0.5	0.451268	3.80483
	3.6883		
Poland	0	0.406112	3.67502
	3.72713		
Romania	0	0.455079	3.30685
	3.59898		
Rwanda	0.5	0.121458	2.67374
	2.72211		
Sao Tome and Principe	.	0.150417	3.41683
	3.4404		
Saudi Arabia	0.5	0.088022	3.77902
	3.61173		

Senegal	0	0.300986	3.23338
	3.19752		
Sierra Leone	0.5	0.353086	3.02964
	2.83397		
South Africa	0	1.35644	3.86752
	4.08448		
Sri Lanka	0	0.413016	3.6482
	3.46921		
St. Kitts & Nevis	.	0.916512	4.53613
	4.57069		
St. Lucia	.	0.72569	4.20346
	4.28315		
Sudan	0	0.183295	3.00385
	3.00352		
Suriname	.	0.553814	4.00312
	3.98941		
Swaziland	0.5	0.141042	3.21444
	3.28452		
Syria	0.5	0.53888	4.05427
	4.01035		
Tanzania	0.5	0.179383	2.84889
	3.14311		
Thailand	0.5	1.13949	4.40793
	4.32945		
Togo	0.5	0.235218	3.50143
	3.43506		
Trinidad & Tobago	0	0.423955	3.91148
	3.72321		
Tunisia	0.5	0.663185	3.9576
	3.84014		
Turkey	0	0.370165	3.30917
	3.43057		
Uganda	0.5	0.133991	2.46014
	2.77626		
Uruguay	0.5	0.491709	3.68922
	3.723		

Venezuela	0	0.318214	3.4166
	3.36526		
Vietnam	.	0.507352	4.08133
	4.0075		
Zambia	0.5	0.506069	2.92609
	3.22232		
Zimbabwe	0	4.50E+13	3.57104
	32.7607		

Building Resilience to Climate-Related Shocks: Farmers' Vulnerability to Climate Shocks in the Niger Basin of Benin[1]

Boris Odilon Kounagbè LOKONON

Abstract

This paper assesses the vulnerability of farm-based livelihood systems to climate shocks in the Niger Basin of Benin using a household survey data set relative to the 2012-2013 agricultural year. The indicator approach is used to calculate vulnerability to climate shocks as a function of exposure, sensitivity and adaptive capacity; and a Classification and Regression Tree model is used to assess its meaningfulness. Adaptive capacity is broken down into five sub-components: financial capital; physical, institutional capital and technology; natural capital; human capital; and social capital. The findings reveal that the highest levels of vulnerability to climate shocks do not necessarily coincide with the highest levels of exposure and sensitivity, or the lowest adaptive capacity. Social capital is very important in building the resilience of farm-based livelihood systems, particularly when other kinds of capital are lacking. The vulnerability of farm-based livelihoods also depends on the nature of the climate shocks, with heat waves, droughts and erratic rainfall having the greatest affect. Forecasts suggest that vulnerability to climate shocks will increase in the absence of adaptation. Building the resilience of farm-based livelihood systems to climate shocks is therefore vital and should run through each of the three components of vulnerability, taking into account the specific adaptation potentialities of the different agroecological zones.

Keywords: Climate shocks; integrated approach; Niger Basin of Benin; resilience; vulnerability

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1. Introduction

Climate change and variability constitute a serious global environmental issue (Hare et al., 2011; Vincent and Cull, 2014). Climate shocks and extreme climatic events such as floods, droughts, strong winds, heat waves, earthquakes and hurricanes are widespread. However, it is not easy to attribute an extreme weather event and climate shock to a change in the climate, as a wide range of extreme events and climate shocks are experienced in most regions of the world, even under unchanging climatic conditions (IPCC, 2013). The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC, 2014) states that climate shocks will likely have an overall negative effect on agricultural production in many African countries and regions, and this could lead to food insecurity and an increase in malnutrition. Unlike in developed countries, agriculture in most African countries is largely rain-fed and is therefore subject to climate conditions. For instance, Kurukulasuriya et al. (2006) found that agricultural net revenues would fall with more warming or drying in Africa. However, the extent to which climate shocks affect agricultural production differs across African regions. Roudier et al. (2011) showed that the impact on yield is larger in northern West Africa (Sudano-Sahelian countries) than in the southern part of West Africa (Guinean countries). These adverse impacts can increase the vulnerability of agriculture-dependent livelihoods, especially of small-scale farmers (Dixon et al., 2003; IPCC, 2014).

Vulnerability to climate shocks can be exacerbated by other shocks such as poverty, unequal access to resources, food insecurity, conflict, and incidence of diseases like malaria and Ebola fever (IPCC, 2014). Shocks can be classified in two categories, namely, idiosyncratic and covariate shocks. Idiosyncratic shocks are specific to each household (for example, death of the principal income earner, chronic illness, injury, etc.) and covariate shocks affect whole communities (for example, floods, droughts, strong winds, etc.). The combination of climate and non-climatic shocks could push farmers into the poverty trap. When caught in the poverty trap without any chance of aid (from government, non-governmental organizations or other institutions) households can no longer escape from poverty; they are on the other side of the Micawber frontier[2] (Carter and Barrett, 2006). Therefore, they will remain permanently poor and vulnerable to climate shocks.

Assessing the vulnerability of farm-based livelihood systems to climate shocks can help identify and characterize actions towards strengthening their resilience (Kelly and Adger, 2000; Islam et al., 2014). Numerous papers have been published on vulnerability to climate change and variability, including climate shocks on fisheries systems (for example, Islam et al., 2014), on agricultural livelihoods (for example, Brooks et al., 2005; Vincent, 2007; Shewmake, 2008; Deressa et al., 2008; Deressa et al., 2009; Etwire et al., 2013; Simane et al., 2016) and on other sectors of

[2] The Micawber frontier separates households expected to be persistently poor from those that need time to improve their well-being (Carter and Barrett, 2006).

the economy (for example, Dixon et al., 2003; Dunford et al., 2015). Three main types of methods are used by these studies: econometric methods, indicator methods and simulations. The literature identifies three major approaches to vulnerability analysis: socioeconomic, biophysical and integrated approaches (the integrated approach combines the socioeconomic and biophysical approaches) (Deressa et al., 2008). An integrated assessment can be done either through mapping vulnerability or computing indices, and may be theory driven or data driven. Vulnerability indicators can be developed at country level or smaller units of analysis (Vincent and Cull, 2014). However, there are some issues with the indicator approach, including weighting, sensitivity and uncertainty, as well as issues relating to validation and future vulnerability (Vincent, 2007; Alinovi et al., 2009; Vincent and Cull, 2014). This study departs from the previous studies on vulnerability to climate-related shocks by validating the indicator approach through a Classification and Regression Tree (CART) model, and by assessing future vulnerability through an econometric analysis.

The objective of this paper is to assess the vulnerability of farmers to climate shocks in the Niger Basin of Benin, to help build their resilience to these shocks. The Niger Basin of Benin has been chosen as the study area because (i) it is located in Africa, which is considered the most vulnerable continent to climate-related shocks (IPCC, 2014); (ii) Benin is moderately to highly vulnerable to climate shocks (Brooks et al., 2005); (iii) the agricultural sector employs 70 per cent of the active population and contributes 39 per cent of GDP (République du Benin, 2014); and (iv) the Niger Basin covers 37.74 per cent of Benin.

2. Vulnerability to Climate Shocks and its Relationship to Resilience

In the economic literature, vulnerability is defined as the risk of falling into poverty in the future, even if the people concerned are not necessarily poor now. It is often related to the effects of shocks such as a drought, a drop in farm prices or a financial crisis (Haughton and Khandker, 2009). Vulnerability of farm-based livelihoods to climate shocks can be defined as the degree to which a farm-based livelihood system is susceptible to, or unable to cope with, the adverse effects of climate shocks and extremes (adapted from IPCC, 2014, p. 1775). Vulnerability is a function of the character, magnitude and frequency of climate shocks to which a farm-based livelihood system is exposed, as well as the sensitivity and adaptive capacity of the livelihood system (adapted from IPCC, 2014, p. 1775).

Exposure, in the IPCC framework, has an external dimension, whereas both sensitivity and adaptive capacity have an internal dimension (Füssel, 2007). To assess the vulnerability of farm-based livelihood systems to climate shocks, it is necessary to understand each of these three components. Exposure, in the context of this study, is the nature and degree to which a farm-based livelihood system is exposed to significant climate shocks (adapted from, IPCC, 2014, p. 1765). Exposure indicators characterize the frequency of extreme events, the scale of land

erosion and sea level rise, and changes in temperature and rainfall (Islam et al., 2014). Sensitivity, in this study, is the degree to which a farm-based livelihood system is affected, either adversely or beneficially, by climate shocks (adapted from IPCC, 2014, p. 1772). Sensitivity does not always have a negative effect, because in some cases climate shocks may be beneficial to farm-based livelihood systems. Adaptive capacity is the ability of a farm-based livelihood system to adjust to climate shocks, to moderate potential damages, to take advantage of opportunities or to cope with the consequences (adapted from IPCC, 2014, p. 1758).

Vulnerability has a negative connotation. Thus, the analyses include an assessment of resilience – an increasingly influential component in development and vulnerability reduction (Béné et al., 2012). Resilience is the ability of a farm-based livelihood system to absorb disturbances, while retaining the same basic structure and ways of functioning, the capacity for self-organization and the capacity to adapt to climate shocks (adapted from IPCC, 2014, p. 1772). It can also be defined as the capacity of a farm-based livelihood system to absorb disturbances and reorganize, while undergoing change to essentially retain the same function, structure, identity and feedback (adapted from Resilience Alliance, 2010, p. 51).

There is a definite relationship between vulnerability and resilience (Schoon, 2005; Béné et al., 2012). Adaptive capacity, which is one of the three components of vulnerability, is influenced by resilience (Klein et al., 2003; Adger, 2006). A farm-based livelihood system lacks resilience because it is vulnerable, and is vulnerable due to a lack of resilience (Klein et al., 2003). The relationship between vulnerability and resilience is not only through adaptive capacity. An important feature of resilience is its consideration of the dynamic aspects of vulnerability, in the sense that resilience refers to the ability of a farm-based livelihood system to return to an earlier stable state, after a climate shock (Füssel, 2007).

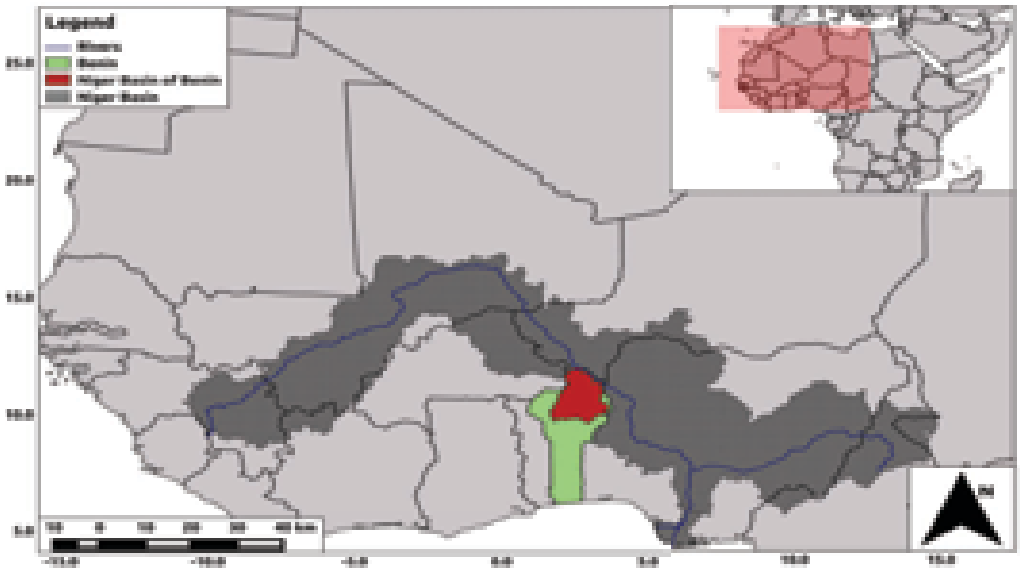
In his analysis of Resilience Alliance's definition of vulnerability, Füssel (2007) referred to vulnerability as the antonym of resilience. He also argued that the second aspect of Resilience Alliance's definition of vulnerability – which considers vulnerability as a function of three factors: exposure, sensitivity and resilience (owing to adaptive capacity) – seems to be incompatible with the first. In other words, considering resilience as a component of vulnerability is incompatible with referring to vulnerability as the antonym of resilience. Some scholars, including Adger (2000), also consider vulnerability as the opposite of resilience (Schoon, 2005). A farmer can be very poor and unwell, but very resilient – in which case resilience alone is not sufficient for analyzing the relationship between climate and development (Béné et al., 2012).

3. Methods

3.1 Study area

The Niger Basin of Benin is located in the extreme north of Benin, between latitudes 11° and 12°30′ north and longitudes 2° and 3°20′40 east. It covers over one-third of the country – 114,763 km^2 of the total 114,763 km^2 (Figure 1). It belongs to the Middle Niger watershed. The Niger River is the largest in West Africa (4,200 km long, with a watershed of 1,125,000 km^2). The Niger Basin of Benin covers (wholly and partially) five of the country's eight agroecological zones (AEZs). It belongs to the Sudanian Savanna zone.

Figure 1: Map of the Niger Basin



Source: Author

Agriculture is the main activity of households in the basin. They produce for home consumption and sell a part of their crops. Production takes place during May and November (during the single wet season). Cotton production is the main source of cash income. Tree and shrub plantations are rare. Young farmers focus on cash and food crops like cotton and maize due to their market advantage, whereas older farmers plant oil palms, teak and cashew trees because they believe that these will provide them with revenue in their old-age (Callo-Concha et al., 2013, citing Igué et al., 2000).

Farmers rely principally on traditional agricultural systems, which are characterized by their reliance on labour (mostly family labour) combined with the limited use of improved inputs, production methods and farm equipment. Animal traction is widespread in the eastern part of the basin due to cattle rearing. Cattle are also kept as insurance against unexpected demands, catastrophe or hardship. Small animal breeding (sheep, goats, and poultry) and fisheries are also developed in the basin. Although not all farm households own their own cattle and plough for animal traction, many borrow them from their neighbours to prepare their land.

Pesticides are used more frequently than fertilizers. Pesticides are used for cotton production, which requires a minimum amount of insecticides. In fact, 75 per cent of farmers in Northern Benin use mineral fertilizers, but not for all crops (Callo-Concha et al., 2013). They use fertilizers mainly for cotton and maize. In addition, farmers use manure to improve yield. The use of new varieties of seeds is not widespread. Irrigation is widespread only in a municipality located near the Niger River (Malanville), where it is used for rice production. Furthermore, it is hard for farmers to access credit outside of the cotton system. Land is another issue. All land is state-owned, and the customary ownership scheme is respected however a way to privatize the land that is minimally used by landlords is also present (Callo-Concha et al., 2013).

The mains types of soils found in the basin are tropical ferruginous soils and hydromorph soils, which can be found in the alluvial plains and swamps – the latter being less common. The majority of soils are relatively impoverished and are subject to leaching and flooding. The basin is covered by two synoptic climatic stations (Kandi and Natitingou). The most severe droughts during the past 60 years occurred in 1977 and 1983, adversely affecting the agricultural sector. However, floods occur almost every year in the basin and affect farmers, especially those located near the Niger River. Severe floods were recorded in 1962, 1968, 1988, 1997, 1998 and 2010. In terms of future climate conditions, temperature is projected to increase in the basin during the twenty-first century (Hulme et al., 2001). Rainfall is projected to increase between December and February, and to decrease between June and August, in some scenarios (Hulme et al., 2001). Therefore, the basin will likely face difficult climate conditions and farmers will be adversely affected, if they do not adapt.

3.2 Specification of the vulnerability approach

3.2.1 *The theoretical model*

The vulnerability (v) level at period t is a function of exposure variables E_v, sensitivity variables S_v, adaptive capacity variables AC_v, v levels of the periods $t-j$ (j helps to account for lagged vulnerability levels in explaining its current level) and unobservable characteristics including measurement errors and innate v, μ_t:

$$v_t = f\left(E_{v,t}, S_{v,t}, AC_{v,t}, v_{t-j}, \mu_t\right), j = 1, 2, \dots, T \qquad (1)$$

Adaptive capacity is composed of five kinds of capital: physical, institutional capital and technology (PC), human capital (HC), natural capital (NC), financial capital (FC) and social capital (SC) (Scoones 1998). Equation 1 then becomes:

$$v_t = f\left(E_{v,t}, S_{v,t}, PC_{v,t}, HC_{v,t}, NC_{v,t}, FC_{v,t}, SC_{v,t}, v_{t-j}, \mu_t\right), j = 1, 2, \dots, T \qquad (2)$$

The financial capital variables include income from cropping and from off-farm activities, which is obtained by maximizing household utility. It is assumed, for sake of simplicity, that

vulnerability level depends on current household incomes, though a portion of income serves as consumption in the following period.

Assuming that there are n members within the household, consumption and leisure of each member at period t is respectively $c_{i,t}$ and $l_{i,t}, where$ $i = 1, 2, \dots, n$. The Agricultural Household Model has two components (Benjamin, 1992). Firstly, a twice differentiable, quasi-concave utility function defined over consumption and leisure: $u_{h,t} = u\left(c_t = \sum_{i=1}^{n} c_{i,t}\,, l_t = \sum_{i=1}^{n} l_{i,t}\,; a_t\right)$. The utility function is parameterized by the vector a_t, which summarizes household characteristics at a given period t. Secondly, a twice differentiable simple, concave production function: $Q_t = F_t(L_t; A_t)$, where L_t is labour (the sum of family and hired labour, $L_t = L_t^F + L_t^H$; where $L_t^F = \sum_{i=1}^{n} \alpha_i \times L_{i,t}^F$ and $L_t^H = \sum_{k=1}^{m} \delta_k \times L_{k,t}^H$), and land A_t is assumed fixed and exogenous. $(\alpha_i, \delta_k) \in (0, 1] \times (0, 1]$ accounts for the heterogeneity of family and hired labour; it is assumed that the household can hire m categories of labour (for example, men, women, etc.). $F_t: R_+ \to R_+$, $F_t'(L_t; A_t) > 0$ and $F_t''(L_t; A_t) < 0$ for all $L_t > 0$, $\lim_{L_t \to 0} F_t'(L_t; A_t) = \infty$ and $\lim_{L_t \to \infty} F_t'(L_t; A_t) = 0$.

Each household member could work on the family farm and/or could look for off-farm activities. The price of hired labour L_t^H and off-farm labour L_t^O are assumed to be equal to w_t. The time endowment of the household is $T_t(a_t) = \sum_{i=1}^{n} \alpha_i \times T_{i,t}$ and its exogenous income is y_t. The exogenous income includes any kind of assistance from friends, relatives and remittances. All prices are normalized by the output price. The farm household allocates its time endowment between leisure, work on the farm and work off the farm. It is also possible for the farm household to hire labour to produce output that is sold in a competitive market. Thus, the farm household's problem is:

$$Max\ u\left(c_t = \sum_{i=1}^{n} c_{i,t}\,, l_t = \sum_{i=1}^{n} l_{i,t}\,; a_t\right) \tag{3}$$

with respect to $c_t, l_t, L_t^O, L_t^H, L_t^F$ subject to

$$c_t = F_t(L_t; A_t) - w_t \times L_t^H + w_t \times L_t^O + y_t, \tag{4}$$

$$l_t + L_t^F + L_t^O = T_t(a_t) \tag{5}$$

$$L_t^F + L_t^H = L_t \tag{6}$$

Collapsing the three constraints into a single constraint yields:

$$c_t + w_t \times l_t = y_t + \rho_t(w_t; A_t) + w_t \times T_t(a_t) \equiv Y_t. \tag{7}$$

Consumption of goods and leisure at period t equals full income Y_t, which is composed of exogenous income y_t, value of time endowment $w_t \times T_t(a_t)$, and non-maximized farm profits $\rho_t(w_t; A_t) = F_t(L_t; A_t) - w_t \times L_t^H - w_t \times L_t^F$.

In the case separation holds, the problem will be solved recursively. First, the household will maximize profit at each period, and then utility. Profit maximization yields the household labour demand:

$$L_t^* = L_t^*(w_t, A_t) \tag{8}$$

Thus, the optimal profit is:

$$\rho_t^* = \rho_t^*(w_t, A_t) \tag{9}$$

the maximization of utility yields:

$$l_t^* = l_t^*(w_t, Y_t; a_t) \tag{10}$$

Thus, the household labour supply (work on the farm and work off farm) is given by:

$$L_t^S(w_t, Y_t; a_t) = T_t(a_t) - l_t^* \tag{11}$$

Hence, equation 2 becomes:

$$v_t = f\left(E_{v,t}, S_{v,t}, PC_{v,t}, HC_{v,t}, NC_{v,t}, FC'_{v,t}, SC'_{v,t}, \rho_t^*, y_t, w_t \times l_t^*, w_t \times L_t^{F*}, w_t \times L_t^{O*}, v_{t-j}, \mu_t\right), j = 1, 2, \dots, T \tag{12}$$

where $FC'_{v,t}$ are financial capital variables, except incomes from farming and from off-farm activities, and $SC'_{v,t}$ are social capital variables, except any kind of assistance from friends and relatives.

If separation does not hold, the problem will not be solved recursively. Therefore, consumption and production decisions are linked and are made simultaneously. Thus, the wage rate depends on household characteristics (shadow wage):

$$w_t^* = w_t^*(a_t) \tag{13}$$

Hence, w_t^* becomes an argument of the solutions of the problem instead of w_t and v at period t is given by:

$$v_t = f\left(E_{v,t}, S_{v,t}, PC_{v,t}, HC_{v,t}, NC_{v,t}, FC'_{v,t}, SC'_{v,t}, \rho_t^*, y_t, w_t^* \times l_t^*, w_t^* \times L_t^{F*}, w_t^* \times L_t^{O*}, v_{t-j}, \mu_t\right), j = 1, 2, \dots, T \tag{14}$$

If separation does not hold in the Niger Basin of Benin due to, among others, the imperfection of the labour market, it is the latter equation that is employed. v_t is assumed to be increasing in the adaptive capacity variables and decreasing in the exposure and sensitivity variables. Therefore, a policymaker that aims to minimize the vulnerability level of households should implement either policies which will decrease exposure or sensitivity, or which will strengthen adaptive capacity.

3.2.2 *Empirical approach*

Equation 14 is used to assess vulnerability to climate shocks. The vulnerability index is calculated as the net effect of adaptive capacity, sensitivity and exposure:

$$v = adaptive\ capacity - (exposure + sensitivity). \qquad (15)$$

One of the features of the indicator approach is to assign a weight to each indicator. Thus, two alternatives may be used: either to give them equal weight or to assign different weights – to avoid the uncertainty of equal weighting given the diversity of indicators used (Deressa et al., 2008). This study adopts the differential weighting alternative by using dimension reduction methods: Principal Component Analysis (PCA) and Factor Analysis (FA). However, PCA and FA are not based on any particular economic theory. Moreover, FA is controversial, partly due to the lack of invariance under transformation and the consequent non-uniqueness of the factors' solutions (Larose, 2006). However, they do remain useful tools. Each continuous indicator of the components of vulnerability is normalized before running PCA and FA, by using Z-Score standardization:

$$X_i^* = \frac{X_i - M_i(X)}{SD_i(X)} \qquad (16)$$

where X_i^* is a normalized value of a continuous indicator of a farm household; X_i and $SD_i(X)$ are the actual value and the standard deviation of the same indicator, respectively. The indicators were normalized because they were measured on different scales. Regarding adaptive capacity, the variables 'distance from dwelling to drinking water source' and 'distance from dwelling to paved or tarred road' are considered as costs. Therefore, the negatives of their Z-scores are used.

As vulnerability is a multidimensional concept (Vincent and Cull, 2014), it is not appropriate to base the computation on only the first component extracted from PCA and FA. The multi-dimensionality of vulnerability is taken into account by using all the extracted components in building the sub-indices. Thus, each component from PCA and FA is weighted by its explained variance. Suppose p components are extracted for each indicator, equation (17) is employed, before building the sub-indices:

$$Y_i^* = \frac{Var_j}{\sum_{j=1}^{p} Var_j} \times Factor_{ji} \times X_i^*, for\ all\ component\ j \quad (17)$$

where Var_j is the explained variance of the component j and $Factor_{ji}$ is the jth factor score relative to the ith indicator.

Two of the key issues of the indicator method relate to its validation and future vulnerability assessment (Vincent, 2007; Alinovi et al., 2009; Vincent and Cull 2014). To assess the meaningfulness of the procedure used for computing the vulnerability index, a CART model can

be used (Alinovi et al., 2009). The CART model is used in this study to estimate the vulnerability decision tree and related splitting rules. CART models are non-parametric techniques for exploring non-linearities and interactions, and are useful in their own right, but are especially valuable for pre-processing data (Larose, 2005). They aid the researcher in choosing from many potentially relevant variables, and by suggesting refinements in functional form that are appropriate in subsequent parametric analysis. As the target variable is continuous (vulnerability index), CART will create a regression tree. If the target variable is categorical, CART will create a classification tree. The original indicators that are used for the computation of vulnerability index are employed in the CART analysis.

In addition, an econometric analysis is performed to find the main factors that can significantly lessen vulnerability to climate shocks and for forecasting purposes. This is due to the major limitation of multivariate models – they always produce normalized indicators, so it is difficult to compare the level of vulnerability over time (Alinovi et al., 2009). The choice of the relevant variables for the econometric analysis is based on the CART analysis. A sensitivity tests is performed through changes and omission of certain indicators. Furthermore, a Monte Carlo (MC) analysis is run to assess the uncertainty within the vulnerability index calculation model.

3.3 Description of the variables and data

3.3.1 *Description of the variables*

Indicators are selected for each sub-index of vulnerability. Exposure can be best represented by the frequency of climate shocks and extreme events, and changes in temperature and rainfall. In this study, four indicators characterize exposure (Table 1), under the assumption that farmers living in areas with higher changes in temperature and precipitation are most exposed to climate shocks.[3]

Sensitivity to climate shocks could be captured by the extent to which these shocks affect income or any proxy of livelihood (Deressa et al., 2008). This study relies on the commonly held assumption that areas experiencing climate shocks are subject to sensitivity due to loss in yield and thus in income, and includes an indicator capturing the direction of changes in yields during the last 20 years (Table 1). Adaptive capacity reflects the five types of capital: physical, financial, human, natural and social capital (Scoones, 1998). Thus, indicators are selected for each component of adaptive capacity (Tables 2 and 3). Farm households with more of these five types of capital are better able to cope with and adapt to the impacts of climate shocks.

[3] Farmers were asked to give their perception relative to a period of 20 years prior to the survey. However, those that do not have 20 years of experience were asked to state their perception based on the length of their experiences. For the purposes of this paper, therefore, the last 20 years refers to a period of up to 20 years (depending on experience).

This paper relies on the assumption that cross-sectional variability captures temporal variability. Normally, panel data should be used to capture the evolution of each indicator over time, due to the dynamic aspect of vulnerability. Moreover, only climate shocks are considered, even though climate shocks and other shocks such as illness are interrelated.

3.3.2 *Data*

The data comes from a household survey in the Benin Niger Basin, conducted between April and May 2013. A three-stage sampling technique was used to select farm households. First, municipalities were randomly chosen within each AEZ, based on the number of agricultural households. Second, villages were randomly selected within selected municipalities. Finally, random farm households were selected within selected villages. One AEZ was disregarded (AEZ V), because only one of its municipalities is located within the Niger Basin. A sample of 545 households was chosen for the whole basin. The survey questions were designed to address the three components of vulnerability. They relate to socioeconomic and environmental attributes; farmers' perceptions of climate change, and temperature and rainfall patterns over the past 20 years or so; and adaptation strategies. The respondents were typically household heads. However, when the household head was not available, another adult member of the household was interviewed.

Table 1. Exposure and sensitivity indicators and sub-indices across agroecological zones.

		AEZ I	AEZ II	AEZ III	AEZ IV	All households
Number of farm households		**80**	**175**	**235**	**55**	**545**
Over the last 20 years		**Indicators of exposure**				
Change in rainfall	Yes	0.87	0.97	0.88	0.82	0.9
	No	0	0	0	0.02	0
	Don't know	0.13	0.03	0.12	0.16	0.1
Increase in intensity of rainfall	Yes	0.68	0.49	0.62	0.69	0.6
	No	0.16	0.22	0.22	0.15	0.2
	Don't know	0.16	0.29	0.16	0.16	0.2
Increase in length of dry spells during the rainy season	Yes	0.4	0.39	0.47	0.38	0.42
	No	0.36	0.25	0.15	0.29	0.23
	Don't know	0.24	0.36	0.38	0.33	0.35
Change in temperature	Yes	0.69	0.63	0.72	0.38	0.65
	No	0.06	0.17	0.13	0.26	0.15
	Don't know	0.25	0.2	0.15	0.36	0.2
Sub-Index of exposure		**0.01**	**0.02**	**-0.08**	**0.26**	**0**
		Indicators of sensitivity				
Have experienced floods		0.8	0.38	0.46	0.53	0.49
Have experienced droughts		0.41	0.55	0.43	0.33	0.46

Have experienced strong winds		0.93	0.97	0.94	0.98	0.95
Have experienced heat waves		0.53	0.62	0.57	0.67	0.59
Have experienced erratic rainfall		0.71	0.86	0.92	0.84	0.86
Have experienced heavy rainfall		0.88	0.89	0.71	0.85	0.81
Change in planting dates throughout the year	Yes	0.61	0.8	0.82	1	0.8
	No	0.36	0.19	0.15	0	0.18
	Don't know	0.03	0.01	0.03	0	0.02
Change in yield	Increase	0.23	0.26	0.19	0.02	0.2
	Decrease	0.47	0.48	0.64	0.47	0.55
	Don't know	0.3	0.26	0.17	0.51	0.25
Sub-Index of sensitivity		**-0.60**	**0.18**	**-0.01**	**0.34**	**0**

Note: All values for indicators are proportions of farm households and means for the sub-indices

Table 2. Financial capital and physical, institutional capital and technology indicators and sub-indices across agroecological zones

Indicators	AEZ I	AEZ II	AEZ III	AEZ IV	All households
Indicators of financial capital					
Fertilizer use value (CFA)	99,602	177,012	61,487	17,532	99,741
Herbicide use value (CFA)	24,092	53,181	25,880	309	31,803
Insecticide use value (CFA)	390	54,600	15,783	1,702	24,566
Yearly income from agricultural off-farm activities (CFA)	39,850	20,023	43,085	2,782	31,138
Yearly income from non-agricultural off-farm activities (CFA)	358,375	207,162	232,637	720,469	292,145
Yearly income from cropping (CFA)	1,674,924	1,605,389	1,275,887	1,107,275	1,423,249
Yearly income from livestock (CFA)	96,714	115,217	42,368	13,173	70,791
Sub-Index of financial capital	**0**	**0.07**	**-0.03**	**-0.07**	**0**
Indicators of physical, institutional capital and technology					
Tractor use[a]	0.08	0.03	0.22	0	0.12
Plough use[a]	0.91	0.88	0.30	0	0.55
Livestock value (CFA)	1,009,15	1,809,803	957,733	72,921	1,149,589

	9				
Amount of credit obtained (CFA)	44,688	21,314	12,481	7,000	19,492
No. of times household accessed extension services	0.28	2.31	0.95	0.02	1.19
Distance from dwelling to food market (km)	2.12	1.52	2.25	4.15	2.19
Distance from dwelling to paved or tarred road (km)	19.43	8.24	10.92	8.44	11.06
Access to electricity[a]	0.35	0.17	0.22	0.25	0.22
Asset value (CFA)	287,533	340,198	322,477	188,378	309,505
Sub-Index of physical, institutional capital and technology	**0.07**	**0.09**	**-0.01**	**-0.18**	**0.02**

[a] These indicators refer to the proportion of farm households that use a tractor or a plough and that have access to electricity, respectively.

4. Results

The surveyed households reported to have experienced many climate shocks throughout the last 20 years. The main climate shocks that farmers experienced in all four AEZs were strong winds, followed by erratic rainfall, heavy rainfall, heat waves, floods, and finally droughts (Table 1). AEZ I farmers experienced floods more often than those in other AEZs. These floods were mostly due to overflows from the Niger River.

Table 3. Human, natural and social capital indicators and sub-indices across agroecological zones

Indicators	AEZ I	AEZ II	AEZ III	AEZ IV	All households
Indicators of human capital					
Household head age (years)	42	40.30	41	41.09	40.93
Household head No. of validated attained education years	1.59	1.31	1.86	2.35	1.69
Number of men	2.59	2.37	2.49	2.64	2.48
Number of women	2.34	2.35	2	2.69	2.23
Number of children	3.51	3.60	3.09	2.20	3.23
Sub-Index of human capital	**0**	**-0.01**	**0**	**0.03**	**0**
Indicators of natural capital					
Bush and valley bottom land use size (ha)	3.24	8.06	4.64	2.48	5.32
Compound land use size (ha)	0.90	1.04	0.69	0.92	0.86
Supplementary irrigated land use size (ha)	1.22	0.04	0.01	0	0.19
Irrigated land use size (ha)	0.06	0.04	0.02	0	0.03

Sub-Index of natural capital	**0.09**	**0**	**-0.02**	**-0.03**	**0**
Sub-Index of social capital[a]	**0.02**	**-0.41**	**0.14**	**0.68**	**0**

[a] Sub-index of social capital is calculated based on 13 quantitative and categorical variables: membership in labour sharing group (yes = 1, no = 0); membership in farmers' organization (yes = 1, no = 0); amount of financial assistance received (in CFA); value of in-kind assistance received (in CFA), have received moral assistance (yes = 1, no = 0); number of relatives the household has in the village; labour mobilized from relatives or friends within the community (in man-days); number of close friends; number of people the household could turn to who would be willing to lend money (no one = 1, one or two people = 2, three or four people = 3, five or more people = 4), whether the household can rely on its neighbours to take care of children when they are travelling (definitely = 1, probably = 2, probably not = 3, definitely not = 4), working for the benefit of the community during the last 12 months (yes = 1, no = 0), believing that people that do not participate in community activities will be criticized (very likely = 1, somewhat likely = 2, neither likely nor unlikely = 3, somewhat unlikely = 4, very unlikely = 5), proportion of people in the community that contribute time or money towards common development goals (everyone = 1, more than half = 2, about half = 3, less than half = 4, no one = 5).

4.1 Vulnerability

Lower values of the index show more vulnerability and higher values depict less vulnerability (and therefore more resilience). The results show that 57.43 per cent of the farm households are vulnerable to climate shocks. Among these households, 31.74 per cent are in a critical situation (very vulnerable to climate shocks). The most vulnerable household is in AEZ II, whereas the least vulnerable household is in AEZ I, where farmers mostly use irrigation. The differences among the AEZs' vulnerability levels are all significant ($p < 0.05$), except between AEZs II and IV, and between AEZs III and IV. On average, farmers in AEZ I are the least vulnerable, followed by those in AEZs III, IV and II (Tables 4). The findings reveal that the highest levels of vulnerability to climate shocks do not necessarily coincide with the highest levels of exposure and sensitivity, and the lowest adaptive capacity. For example, farm households in AEZ II, which are the most vulnerable and have the lowest adaptive capacity, are not the most sensitive or the most exposed to climate shocks.

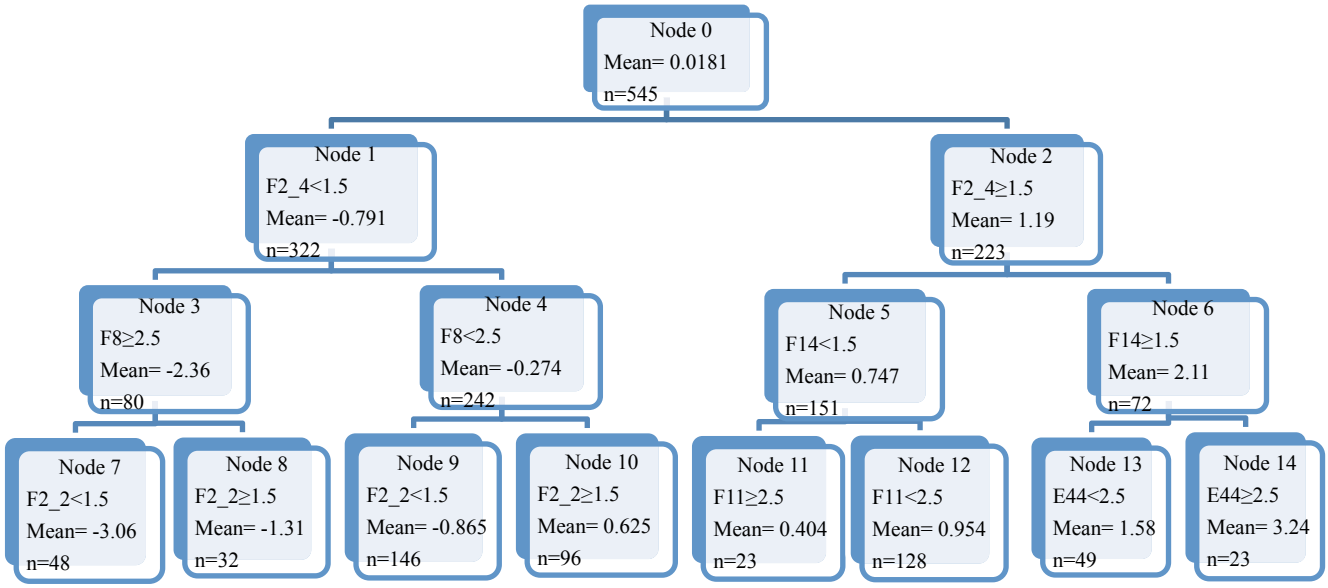
Table 4. Indices and sub-indices of vulnerability across agroecological zones

Indices	AEZ I	AEZ II	AEZ III	AEZ IV	All households	Standard deviation
Sub-Index of exposure	**0.01**	**0.02**	**-0.08**	**0.26**	**0**	**1.12**
Sub-Index of sensitivity	**-0.60**	**0.18**	**-0.01**	**0.34**	**0**	**1.33**
Sub-Index of financial capital	0	0.07	-0.03	-0.07	0	0.15
Sub-Index of physical, institutional capital and technology	0.07	0.09	-0.01	-0.18	0.02	0.17
Sub-Index of human capital	0	-0.01	0	0.03	0	0.10
Sub-Index of natural capital	0.09	0	-0.02	-0.03	0	0.07
Sub-Index of social capital	0.02	-0.41	0.14	0.68	0	1.18
Sub-Index of adaptive capacity	**0.18**	**-0.26**	**0.07**	**0.43**	**0.02**	**1.16**
Index of vulnerability	**0.76**	**-0.47**	**0.17**	**-0.16**	**0.02**	**1.90**

The optimal tree generated by the CART model has 15 terminal nodes. The model's predictions are relatively good, because the normalized mean squared error is 0.28, with a value below 1. This result confirms the meaningfulness of the method used to compute the indices. The upper level of the tree (Figure 2) shows that households that have experienced heat waves ($F2\_4 < 1.5$) are more vulnerable than those that did not experience them ($F2\_4 \geq 1.5$). These most vulnerable households are further split into two subgroups; the first group accounts for 76.16% of the households. The first group is composed of those that have experienced during the 20 years prior to the survey either an increase or a decrease in the intensity of rainfall ($F8 < 2.5$) appear to be less vulnerable than the second group which accounts for those that either are unable to indicate the change they experienced over the same period or did not experience any change in the intensity of rainfall ($F8 \geq 2.5$). Of the latter group, 60 per cent have suffered from droughts ($F2\_2 < 1.5$) and appear to be more vulnerable, whereas the remaining 40 per cent did not experience droughts and are less vulnerable ($F2\_2 \geq 1.5$).

Moreover, the method used turned out to be sufficiently robust in terms of sensitivity and uncertainty. To explore the impact on the vulnerability index, the values of some sensitivity indicators have been changed or some indicators have been simply disregarded. For the MC analysis, the vulnerability index was computed 1000 times to map its probability distribution. For each sub-index of vulnerability, random values were generated between its minimum and maximum values. The reliability of the originally calculated vulnerability index is estimated through determination of the range of the standard deviation around the mean. The Student Test showed that the original vulnerability index lies within the range ($p < 0.01$).

Figure 2. Upper bound regression tree generated by classification and regression tree



Note: $F2\_4 < 1.5$: farm households that experienced heat waves; $F2\_4 \geq 1.5$: farm households that did not experience heat waves; $F8 \geq 2.5$: farm households that experienced both an increase or a decrease in the intensity of rainfall; $F8 < 2.5$: farm households that experienced either an increase or a decrease in the intensity of rainfall; $F14 < 1.5$: farm households that experienced a change in planting date; $F14 \geq 1.5$: farm households that did not experience a change in planting date; $F2\_2 < 1.5$: farm households that experienced droughts; $F2\_2 \geq 1.5$: farm households that did not experience droughts; $F11 \geq 2.5$: farm household that experienced both an increase and a decrease in temperature; $F11 < 2.5$: farm households that experienced either an increase or a decrease in temperature; $E44 < 2.5$: farm households that will be very or somewhat likely criticized or sanctioned if they do not participate in community activities; $E44 \geq 2.5$: farm households that will be neither be likely nor likely, somewhat unlikely or very unlikely criticized or sanctioned if they do not participate in community activities. In each box, the number indicates the average vulnerability index and n, the number of farm households.

4.2 Exposure

Farmers in AEZ IV are more exposed to climate shocks, followed by AEZ II, AEZ I, and AEZ III (Table 1). It was not possible to distinguish exposure between AEZs, except between AEZs III and IV ($p < 0.01$). The high exposure level of farmers in AEZ IV is due to a combination of two elements: (i) the fact that most of the farmers (82 per cent) experienced a change in the rainfall period during the last 20 years or so, prior to the year of the interview; and (ii) 69 per cent experienced an increase in the intensity of rainfall throughout the period. The combination of these three elements leads to floods that impact adversely on livelihoods. The situation of farm households in AEZs I and II is similar, and lies between those of AEZs III and IV.

4.3 Sensitivity

Sensitivity is highest among farm households in AEZ IV, followed by AEZs II, III and I (Table 1). It varies significantly between (i) AEZs I and II ($p < 0.01$), (ii) AEZs I and III ($p < 0.01$), (iii) AEZs I and IV ($p < 0.01$), and (iv) AEZs III and IV ($p < 0.1$). The high sensitivity of farmers in AEZ IV is due to the fact that all of them were obliged to change the planting date during the last 20 years or so. Moreover, 47 per cent of these farmers experienced a decrease in yields and 2 per cent experienced an increase due to climate shocks; 51 per cent of them did not indicate any change in yields. Though farmers in AEZ I experienced more floods than farmers in other areas, they have the lowest sensitivity to climate shocks. This is due to the fact that they practice irrigated and supplementary irrigated agriculture, and that only 61 per cent of them changed the planting date (as compared to 80 per cent, 82 per cent and 100 per cent in AEZs II, III and IV, respectively).

4.4 Adaptive capacity

On average, farmers in AEZ IV have the highest adaptive capacity, followed by farmers in AEZs I, III and II (Tables 2 and 3). Adaptive capacity varies significantly between (i) AEZs I and II ($p < 0.01$), (ii) AEZs II and III ($p < 0.01$), (iii) AEZs II and IV ($p < 0.01$), and (iv) AEZs III and IV ($p < 0.1$). Though farmers in AEZ IV lack financial capital; physical, institutional capital and technology; and natural capital, they have the highest adaptive capacity because they have the largest amount of human and social capital. Farmers in AEZ II have the lowest adaptive capacity due to their lack of human and social capital. Therefore, all five components are important because a lack in one lowers adaptive capacity.

Fertilizer and herbicide use indicates the level of financial capital. A farm household that does not have enough financial capital uses less fertilizer and herbicide, as is the case for farm households in AEZ IV. Tractor use, plough use and access to extension services explain the differences in physical, institutional capital and technology. Lower levels of tractor and plough use and less access to extension services decreases physical, institutional capital and technology. Access to extension services depends generally on cotton and rice production. Depending on

their location, farmers can benefit from the advice of extension officers when they produce either cotton or rice. The education level of the household head is important in building human capital (in other words, the differences in human capital are due to differences in education level). Irrigation helps farmers to cope with rainfall variability. Irrigated and supplementary irrigated land ownership is very important for natural capital formation. A lack of irrigated and supplementary irrigated land leads to a lower level of natural capital.

4.5 Econometric analysis of vulnerability index and forecasts

Ten variables used in the tree construction were employed to run the regression. The variance inflation factors are all very low, so there is not a multicollinearity problem with the explanatory variables. The model is useful for forecasting the vulnerability index, so it helps to deal with the main shortcomings of the multivariate model that is used to build the indices. The model was estimated for the whole data set and then for each AEZ (Table 5). The results of the regression are almost the same.

Table 5. Regression results of vulnerability

Dependent variable: vulnerability index					
Independent variables	All households	AEZ I	AEZ II	AEZ III	AEZ IV
Worked for benefit of the community during the last 12 months (1=yes and 0=No)	-0.92** (-9.23)	-1.19*** (-4.68)	-0.87*** (-4.79)	-0.87*** (-5.84)	-0.91*** (-2.85)
People that do not participate in community activities will be criticized (1=Very likely and 0 otherwise)	-0.94** (-8.41)	-0.77** (-2.18)	-0.62*** (-2.94)	-1.37*** (-7.39)	-0.18 (-0.48)
Proportion of people in the community that contribute time or money towards common development goals (1=Everyone and 0 otherwise)	0.01 (0.08)	-0.46 (-1.46)	-0.23 (-1.00)	0.14 (0.45)	0.38 (1.16)
Change in temperature during the last 20 years or so (1=Yes and 0 otherwise)	1.02** (9.51)	0.87*** (3.26)	1.08*** (5.70)	1.06*** (5.63)	0.87 (1.64)
Change in planting dates throughout the years (1=Yes and 0=No)	-1.15** (-9.28)	-1.31*** (-6.28)	-1.46*** (-4.56)	-0.95*** (-5.05)	

Change in yield (1=Increase and 0 otherwise)	0.09 (0.87)	0.06 (0.28)	0.34** (2.00)	-0.09 (-0.51)	0.75* (1.87)
Areas prone to droughts (1=Yes and 0=No)	-1.09** (-10.01)	-1.21*** (-4.15)	-0.61*** (-3.21)	-1.30*** (-7.63)	-1.61*** (-3.40)
Areas prone to heat waves (1=Yes and 0=No)	-1.24** (-12.40)	-0.84*** (-3.84)	-1.44*** (-7.66)	-1.21*** (-6.93)	-0.78** (-2.45)
Areas prone to erratic rainfall (1=Yes and 0=No)	-1.23** (-9.83)	-1.21*** (-3.47)	-1.54*** (-7.87)	-1.08*** (-3.32)	-1.04*** (-2.89)
Increase in the intensity of rainfall over the years (1=Yes and 0 otherwise)	0.90** (8.70)	0.55** (2.24)	1.04*** (5.87)	0.79*** (4.64)	1.03*** (2.76)
Constant	2.82** (14.09)	3.30*** (8.34)	2.84*** (7.85)	2.81*** (6.23)	0.97** (2.03)
Adjusted R-squared	0.68	0.82	0.72	0.59	0.55

***, **, * Significant at the 1%, 5% and 10% levels, respectively. Numbers in parentheses are robust t-statistics. Lower values of the dependent variable (vulnerability) indicate improvement in vulnerability.

One variable was disregarded for AEZ IV due to multicollinearity (change in planting dates throughout the years). Working for the benefit of the community during the last 12 months increases vulnerability to climate shocks, *ceteris paribus*. On average, the effect of working for the benefit of the community is highest for the farmers of AEZ I. This could be explained by the fact that it reduces the available labour for farming. Even the belief that people who do not participate in community activities will be criticized increases vulnerability, as this puts pressure on farmers to participate. Indeed, social capital "may enhance the outcomes of a few at the expense of others" (Ostrom and Ahn, 2007, p. 20).

The sensitivity variables seem to have the expected impacts on vulnerability. The vulnerability of households that experienced droughts, heat waves and erratic rainfall is respectively 1.09, 1.24 and 1.23 points higher than the vulnerability of farmers that did not, *ceteris paribus*. Heat waves have the largest effect. These variables are used as proxies for the effect of climate shocks on income (or any other proxy for livelihood). Farmers resort to different means to cope with

climate shocks, including income and social capital. This could lead to a decrease in farm household assets and negatively influence the livelihood of farmers, which increases vulnerability to further shocks. In this case, farm households could fall into a poverty trap (Carter and Barrett, 2006). However, if the asset base is not significantly degraded, the farm household would be expected to recover to its pre-shock level of well-being, even if income momentarily drops below the poverty line (Carter and Barrett, 2006).

Experiencing an increase in crop yields reduces vulnerability levels – by about -0.34 and -0.75 points respectively in AEZs II and IV – whereas there is no significant difference for farmers in the remaining AEZs. This effect is even positive for farmers in AEZ III. Moreover, an increase in temperature during the last 20 years or so is beneficial for farmers, except for those in AEZ IV. This could be explained by a gain from carbon fertilization. However, a change in planting dates throughout the period increases the vulnerability levels of farm households. Furthermore, experiencing an increase in intensity of rainfall over years reduces the vulnerability levels. In fact, an increase in the intensity of rainfall means more precipitation, which benefits farmers, provided it does not lead to floods.

On average, if everyone in the community contributes time or money towards common development goals, it decreases the vulnerability levels. However, the effect differs across AEZs. It leads to an increase in vulnerability for farmers in AEZs I and II and to a reduction of vulnerability for those in AEZs III and IV. This could be explained by the fact that contributing money to development goals reduces the financial capital of farmers in AEZs I and II, and/or that these efforts are not effective in reducing vulnerability. It is worth noting that the effect of the variable is not significantly different from zero.

Using the regression results, Table 6 shows predictions of the level of vulnerability as a function of three sensitivity variables (households that experienced droughts, heat waves and erratic rainfall). All the other variables of the models are held equal to their mean. Four changes are used for each variable. The level of vulnerability varies for each climate shock. On average, heat waves will have the largest effect, followed by droughts and erratic rainfall. During droughts, farmers will shift quickly from cropping to non-agricultural off-farm activities, including migration. Whereas, during heat waves they will wait longer for rainfall and will only decide late on to look for income from other activities. However, the situation differs across AEZs. For AEZ I farmers, droughts and erratic rainfall will have the largest effect (almost equivalent in both zones). Erratic rainfall will most affect AEZ II farmers, whereas droughts will have the largest effect on AEZs III and IV farmers.

Table 6. Predictions of vulnerability index

Variables	Changes[a]	AEZ I	AEZ II	AEZ III	AEZ IV	All households
Droughts	0.05	0.70	-0.49	0.10	-0.25	-0.03
	0.10	0.64	-0.52	0.03	-0.33	-0.08
	0.15	0.58	-0.55	-0.03	-0.41	-0.08
	0.20	0.52	-0.58	-0.10	-0.49	-0.19
Heat waves	0.05	0.72	-0.53	0.10	-0.21	-0.04
	0.10	0.68	-0.60	0.04	-0.25	-0.10
	0.15	0.63	-0.67	-0.02	-0.29	-0.09
	0.20	0.59	-0.75	-0.08	-0.33	-0.22
Erratic rainfall	0.05	0.70	-0.53	0.11	-0.22	-0.04
	0.10	0.64	-0.61	0.05	-0.27	-0.10
	0.15	0.58	-0.69	0.00	-0.33	0.02
	0.20	0.52	-0.77	-0.05	-0.38	-0.22

[a] The changes refer to the increases of the proportion of farm households that experience climate shocks. Lower values indicate improvement in vulnerability.

5. Discussion

This paper assesses the vulnerability of farm-based livelihoods to the impacts of climate shocks using indicators of exposure, sensitivity and adaptive capacity. Adaptive capacity is divided into five components: financial capital; physical, institutional capital and technology; human capital; natural capital; and social capital. This paper provides an important contribution towards directing future research and the implementation of adaptation initiatives in developing countries, especially those with similar agricultural systems and conditions to Benin.

The levels of exposure of farm households to climate shocks differ between AEZs. Farm-based livelihoods in AEZ IV households have the highest exposure to climate shocks. The sensitivity of livelihoods to climate shocks is determined by dependency on rain-fed agriculture, which is characterized by a lack of financial capital and access to water for irrigation, a lack of institutional support through extension services and access to credit, etc. and a lack of human capital. Farm households rely on social capital when they lack the other four kinds of capital. Therefore, the components of vulnerability to climate shocks are interrelated. The increase of physical capital or livelihood diversification cannot be possible when households lack financial capital (Islam et al., 2014). It appears that poverty and vulnerability to climate shocks are linked; these findings are in line with previous studies (for example, Shewmake, 2008; Deressa et al., 2008 and 2009; Islam et al., 2014).

Low adaptive capacity does not necessarily coincide with high exposure and sensitivity. Climate shocks, therefore, affect farm households in different ways. The results are in line with research on the vulnerability of fishery-based livelihoods, which found that the most exposed communities are not necessarily the most sensitive and the least able to adapt (Islam, 2014). Vulnerability levels also depend on the types of shocks farm-based livelihood systems face. Farm households that are similarly exposed to climate shocks, and that have the same level of sensitivity, do not necessarily have the same level of vulnerability. Therefore, vulnerability levels vary relatively across farm household characteristics (Shewmake, 2008). Farm households headed by women are less vulnerable than those headed by men ($p < 0.10$).[4] Indeed, males are less risk averse than females. Female-headed households invest relatively less than male-headed households in activities that rely too heavily on climate conditions – they therefore have a lower vulnerability to climate shocks. They are more likely to develop off-farm activities such as processing soybean, groundnut and millet. They are therefore able to draw income from different sources. The highest levels of vulnerability of male-headed households to climate change may be due to issues of land ownership (Quisumbing et al., 2011). Goh (2012) argued that the gender-differentiated impacts of climate change are not always inflexible, clear or predictable; they depend on the context and may be mediated by sociocultural, economic, ecological and political factors.

Education also appears to be somewhat correlated with vulnerability. Higher formal education levels of the household head are associated with lower vulnerability to climate shocks. Moreover, among farm households whose heads completed less than six validated school years, those that are able to read and write in local languages are less vulnerable than those whose heads cannot either read or write in any language. Through a higher level of education, farmers have access to information regarding appropriate adaptation strategies that can be developed to cope with climate shocks. These findings are in line with those of previous studies (for example, Deressa et al., 2008; Etwire et al., 2013), which found that lower levels of vulnerability are associated with higher levels of literacy. However, access to relevant information in terms of appropriate adaptation strategies also depends on a number of other factors including communication infrastructure, settlement location and access to communication devices such as mobile phones.

Farm-based livelihood systems in the Niger Basin of Benin are predicted to experience difficult climate conditions in the coming decades (Hulme et al., 2001). Therefore, their vulnerability to climate shocks will increase, in the absence of adaptation. As farm households in the basin are largely subsistence farmers, their vulnerability to climate shocks will, in turn, lead to vulnerability to food insecurity.

[4] This paper tests also differences in vulnerability levels between farm households with respect to the sex of the household heads. However, the results are not explicitly presented but are available upon request.

6. Conclusion

This paper analyses vulnerability of farm-based livelihoods to climate shocks using indicators. The findings suggest that vulnerability to climate shocks differs across household characteristics and AEZs. Low adaptive capacity does not necessarily coincide with high levels of exposure and sensitivity. Thus, the highest levels of exposure or sensitivity do not necessarily lead to the highest levels of vulnerability, and the highest adaptive capacity does not necessarily lead to the lowest vulnerability. Adaptive capacity is disaggregated into financial capital; physical, institutional capital and technology; human capital, natural capital and social capital. Social capital is very important in building the resilience of farm-based livelihood systems; farm households rely on it when they lack the other four kinds of capital. The vulnerability of farm-based livelihoods also depends on the nature of climate shocks: heat waves, droughts and erratic rainfall, have the greatest effect on vulnerability to climate shocks.

This paper provides an important contribution for directing future research on the appropriate adaptation strategies to strengthen the resilience of farm-based livelihood systems to climate shocks. This local-scale study gives important information that can improve our understanding of drivers of vulnerability to climate shocks, and therefore to global climate change that is, to some extent, responsible for the increase in the likelihood of climate shocks. Based on these findings, building the resilience of farm-based livelihood systems should encompass all three components of vulnerability – exposure, sensitivity and adaptive capacity. Adaptive capacity should be strengthened through financial capital; physical, institutional capital and technology; natural capital; human capital and social capital. The specific adaptation potentialities of the different AEZs should also be taken into account in building resilience to climate shocks.

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Economic growth and poverty reduction in the Democratic Republic of the Congo

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Abstract

According to the Congolese government, the Democratic Republic of Congo (DRC) achieved economic performance over the past few years, with respect to strong economic growth, price stability, raising state revenues and increasing investment. The main question of this paper is whether such economic growth led to poverty reduction and an improvement in Congolese's living conditions. Notwithstanding significant achievements with regard to the macroeconomic framework, the Millennium Development Goals especially the eradication of extreme poverty and hunger, have not yet been achieved. Explanatory factors include the lack of diversification in economic activities and weak implementation of income redistribution policy. Efforts focused on human and social inclusive development are still required.

1. Introduction

According to the reports of the World Bank, the International Monetary Fund (IMF) and the United Nations Development Programme (UNDP), there has been high economic growth in the Democratic Republic of the Congo (DRC) over the past decade. The Government of the DRC is satisfied with the macroeconomic performance achieved (Ponyo and Mai, 2013: 3-4): indeed, the average growth rate exceeded 5 per cent between 2000 and 2010, reaching 7.2 per cent in 2012 and 9.5 per cent in 2014 (Banque centrale du Congo, 2015). Investments are increasing. Inflation is under control and has been under 2 per cent in recent years, whereas it was 46 per cent in 2009. The Congolese franc remains generally stable on the foreign exchange market after more than a decade of strong depreciation. Public revenues are also increasing. According to the Government, these indicators of stability of the macroeconomic framework and GDP growth demonstrate that the country is returning to economic and social development.

What is the current situation on poverty reduction? In 2011, the Congolese Government made the following assessment:

> *Most of the Congolese population (about two-thirds) are poor. This poverty manifests itself in the still-high mortality of women and children, due to poor nutrition, high morbidity, limited access to social services, (...) low levels of education, a lack of modern employment, exposure to an unhealthy environment, inadequate housing, etc. Education and health care systems, as well as other sectors (water, electricity, infrastructure, etc.) are structurally inadequate, which does not allow to improve the well-being of the population. The lack of employment aggravates the situation.* (Ministry of Planning, 2011:38).

Economic growth contributes to the improvement of the quality of life and, consequently, to human development and poverty reduction. The Africa Progress Panel 2013 report appropriately stated:

> *Africa's performance in growth has made the headlines of international economic news. Pundits have been fascinated by figures on exports, foreign investment and GDP growth. They have been less interest in the relationship between growth and the factors that matter to the lives of the poor in Africa, such as employment, healthcare and education* (Africa Progress Panel,

2013:21).

Growth in the DRC undoubtedly creates wealth. However, the question is whether it is accompanied by a reduction in poverty. Do macroeconomic performances trigger a virtuous circle in terms of improving the living conditions of populations? It is precisely this question that this paper discusses. However, given the unavailability of comprehensive data and monitoring of the trend in poverty and standard of living of the Congolese population due to the lack of regular household surveys in the DRC, this analysis relies on the UNDP's human development indicators.

The first part of this paper presents a brief theoretical summary of the notion of "growth in development". The second part concerns the socio-economic trend of the DRC. The third part questions the impact of growth on poverty.

2. Growth in development and poverty reduction: a theoretical summary

Development has many facets, but it is measured by indicators of the material and social living conditions of populations, such as per capita income, food, health care, education and housing. Improvement of these socio-economic indicators is largely conditioned by economic growth and redistribution. Only a growing economy can reduce poverty. For example, the World Bank's Commission on Growth and Development argues that poverty cannot be eradicated without growth: "In the last 30 years, absolute poverty has fallen substantially. This is almost entirely due to sustained growth. ... In a very poor country, it is arithmetically impossible to reduce poverty without growth (Commission on Growth and Development" (2008: 17).

> The development paths of several countries corroborate this observation. This is particularly the case in emerging countries such as China, whose poverty rate fell from almost 64 per cent in the early 1980s to 17 per cent in 2001. Economic growth has been the main cause of this rapid decline in poverty (Ravallion, 2004:1).

Among these factors contributing to growth in Asia, particularly in the four Asian dragons -- the Republic of Korea, Singapore, Taiwan Province of China and Hong Kong (Special Administrative Region of China), it is worthwhile to mention high domestic savings, high public investment in infrastructure and education, and the opening up the economy to the world market by promoting the export of high value-added goods (Sullivan, 2012). As a result, the terms of trade have improved, and incomes and foreign exchange reserves

have increased, thus privileging imports of intermediate goods, machinery, spare parts, etc. for production purposes. This is the application of the "trickle-down economics" theory of international trade. Indeed, openness promotes growth, which generates wealth, which benefits society.

However, the issue is not to seek growth solely for its own sake, but to reduce poverty. It is in this context that in the early 2000s, a large number of African countries, including the DRC, developed growth plans to eradicate poverty through the *Document de la stratégie de croissance et de réduction de la pauvrété* (DSNCR, Growth and Poverty Reduction Strategy Paper). It was understood that good macroeconomic indicators should necessarily contribute to improving the economic and social conditions of the populations. It is also in this context that the notions of "pro-poor growth" and "growth in development" have emerged. Referring to Dudley Seers, Ignacy Sachs noted that economic growth only leads to development if it creates jobs, generates income and contributes to the reduction of poverty and inequality Sachs (2004a :183-185). According to this author, only economic growth with a positive social and environmental impact deserves to be labelled as development; otherwise, this would be an exclusive or perverse development, as was the case in Latin America in the 1980s and 1990s, when there was growth, but leaving behind a large part of the population who lived precariously while most of the income and wealth was concentrated in the hands of a few. Therefore, economic growth alone is not satisfactory, for, as Ignacy Sachs points out, if development cannot be achieved without growth, growth itself does not necessarily lead to development and is equally likely to generate poor growth, in which GDP growth goes hand in hand with rising social inequalities, unemployment and poverty (Sachs, 2004b:1802).

Inclusive development implies that the population as a whole has equitable access to adequate incomes and basic social services.

Poverty is a polysemic term encompassing several concepts, the most common of which are *income poverty*, which is determined in relation to the income threshold needed to live on, and *subsistence poverty,* which is measured by living conditions and linked to the lack of access to basic goods and services (Glaude, 1998:38). These two approaches are complementary since monetary poverty limits access to basic socio-economic opportunities. The poor are generally classified in the lowest income quintile on the income distribution scale of a country, which corresponds to the lowest standard of living. Although the Human Development Index takes into account life expectancy and

education, improvement in these indicators depends on income and hence on the level of GDP, that is, on economic growth. Indeed, growth increases the average level of income of the population and the state. The latter has, if need be, greater financial capacity to organize redistribution, produce public goods and invest in infrastructures of common interest. It is estimated that per capita GDP growth of at least 3 per cent per year is needed to double the average income within a generation (Delleur, 2005: 376).

There are several meanings of the concept of *pro-poor growth*, all of which have one thing in common: growth that leads to a significant reduction in poverty. The difficulty is to agree on the amount of this reduction. However, growth is pro-poor when the income growth rate of poor individuals is higher than that of non-poor individuals (Boccanfuso and Menard, 2009: 4-5). In general, pro-poor growth encompasses economic growth, and the policies and institutions that support it benefit, on average, the poorest as well as all other groups in society (Dollar and Kraay, 2002: 28). The question, therefore, is essentially whether growth benefits the poor. This can only be the case if it is inclusive; if not, it benefits a wealthy minority and widens the income gap between the social classes. For inclusive economic development, expansionary policies should be accompanied by income redistribution and the implementation of social protection to reduce poverty and inequality. Indeed, "*the reduction in absolute poverty depends mechanically on two factors: on the one hand, the increase in the average income of the population, with a relative distribution of unchanged incomes leads to a reduction in poverty; on the other hand, with an unchanged average income, any redistribution of income towards the poor produces the same effect*" (Cling et al., 2004: 148).

Thus, growth alone is not sufficient to reduce poverty. It must be accompanied by policy measures of redistribution to reduce inequalities and allow access to a greater number of people to food, education, healthcare, housing, etc. It is in this regard that it is necessary to understand the concepts of *pro-poor growth* and *growth in development*.

It is important here to examine the situation in the DRC.

3. The macroeconomic and social trend

3.1 Economic growth and the macroeconomic framework

Economic activity in the DRC is experiencing significant growth. Since 2003, the growth rate has exceeded 5 per cent. Although it was negative in the years prior to 2002, it

reached 9.5 per cent in 2014,[1] thus recording one of the highest rates in Africa. Several factors explain this phenomenon. Growth is primarily driven by the mining sector, the driving force behind the Congolese economy, with mining production accounting for more than a quarter of GDP. [2] In 2014, the primary sector accounted for 44 per cent of economic activity; the secondary sector, 16 per cent; and the services, sector, 33 per cent. The increase in mining output is linked to the rise in demand from emerging industrializing countries, particularly China and India. Thus, copper production, one of DRC's main exports, rose from 97,360 tonnes in 2006 to 1,065,744 tonnes in 2014. Investments in this sector essentially took the form of partnerships between the Congolese State and subsidiaries of multinational companies. However, this dependence on the mining sector is a factor contributing to the vulnerability of the Congolese economy to external shocks, in particular falling prices and a downturn in the economy.

Also, there has been an increase in foreign direct investment: US$3,296,147,156 in 2010, US$6,592,645,954 in 2012 and US$2,952,333,506 in 2014.[3] On average, in recent years, excluding the mining sector, more than US$2 billion has been invested annually in the DRC. In addition to this sector, trade, construction, hotels and telecommunications are the most attractive sectors of the economy. The sectoral composition of investment affects that of growth. In contrast, low investment in agriculture can be observed, even though this sector has always been considered a priority by successive governments. For pro-poor growth, it would be expected that this sector, which employs more than 60 per cent of the working population, would attract more investment and create more income. But there are probably constraints on profitability and risks related to production and the agricultural market.

However, regrettably, the inequality in the spatial distribution of investment should be highlighted. The provinces of Kinshasa and Katanga received more than 44 per cent of the investments invested in the DRC from 2003 to 2012. Several factors favour the capital city: viable demand, relative ease of access to electricity and credit, and a more skilled workforce. In Katanga, the presence of international mining companies attracts subcontractors, while North Kivu and South Kivu experience permanent insecurity. The agro-pastoral provinces of the north and the centre are experiencing a contraction of their economy due to a lack of road, river, rail and energy infrastructures, which increases their

[1] Banque Centrale du Congo reports
[2] www.investindrc.cd/fr/spip.php?article107
[3] See *Agence nationale pour la promotion des investissements* (ANAPI), www.investindrc.cd

isolation.[4] From this investment map, a geographic concentration of growth, employment and income emerges, which generates inequalities between provinces. An effective "regional convergence" policy would reduce these regional disparities.

Since the 2000s, the DRC has been implementing reforms supported by the International Monetary Fund and the World Bank. These relate mainly to improving the governance of public finances, the macroeconomic framework, the legal security of investments, the business environment, and performance of public enterprises, and so on. To reduce its deficits, the Congolese State has opted for a gradual withdrawal from trading activities for the benefit of the private sector. The aim is to make public enterprises viable, competitive and profitable. This recovery concerns companies such as *Générale des carrières et des mines* (Gécamines), *Minière des Bakwanga* (MIBA*), Société nationale d'électricité* (SNEL), *Régie de production et de distribution d'eau* (REGIDESO), *Caisse d'épargne du Congo,* (CADECO)*, Société nationale des chemins de fer du Congo* (SNCC) and *Régie des voies aériennes* (RVA), among others.

The Congolese economy has also experienced a stable exchange rate of the Congolese franc as a result of the monetary policy of the *Banque centrale du Congo* (Central Bank of the Democratic Republic of the Congo) and its intervention on the foreign exchange market. The Central Bank steadily lowered its policy interest rate, which helped to lower the cost of money thus stimulating credit and investment. In 2010, the DRC reached the completion point under the Heavily Indebted Poor Countries (HIPC) Initiative. Its external debt has thus been considerably reduced from about 136 per cent of GDP in 2009 to around 35 per cent by the end of 2010 (IMF, 2010). As a result, the DRC should allocate more resources to human development.

3.2 The socio-economic trend

GDP per capita in the DRC has seen an upward trend in recent years, from US$198 in 2008 to US$272 in 2012, according to data from the World Bank. This indicates that the Congolese population have on average less than one dollar a day to acquire basic goods and services. With such a low income, more than 70 per cent of the Congolese live below the poverty line. This GDP is among the lowest on the continent, with an African annual average of $1,636 per capita, a stark difference from countries such as Botswana and Gabon whose per capita GDP is over $7,000.

Moreover, incomes in the DRC are unevenly distributed (Africa Progress Panel, 2013:27):

[4] Ibid.

the poorest 10 per cent share 2.3 per cent of national income, while the richest 10 per cent monopolize 34.7 per cent.

Most African countries are low-income and ranked at the bottom of the Human Development Index (HDI). This is also the case for the DRC, which often finds itself at the bottom of the ranking, as in 2012, where its HDI value of 0.304 was below the average of 0.466 for countries in the low human development category and below the average of 0.475 for sub-Saharan Africa countries, thus placing the country 186th, second lowest in the list of 187 countries and territories identified by UNDP. (2013: 2,3). This situation reflects the poor socio-economic conditions of a large part of the Congolese population.

In contrast, Zambia, a country close to the DRC in terms of production conditions (an economy based on mining products including copper) has improved the quality of life of its population since 2008, with its HDI rising from low to medium. This has also been the case for Rwanda since 2012, as shown in table 1:

Table 1. Trends in the Human Development Index of the Democratic Republic of the Congo, Zambia and Rwanda

	RDC	Zambia	Rwanda
HDI 1980	0.336	0.422	0.291
HDI 1990	0.319	0.407	0.238
HDI 2000	0.274	0.423	0.329
HDI 2005	0.292	0.471	0.391
HDI 2008	0.307	0.505	0.432
HDI 2010	0.319	0.530	0.453
HDI 2011	0.323	0.543	0.463
HDI 2012	0.333	0.554	0.502
HDI 2013	0.338	0.561	0.506
HDI 2012 rank	187	134	151

Source: www. hdr.undp.org/en/content/table-2-human-development-index-trends-1980-2013

The other human development indicators from the DRC have shown slight improvements, but always at low levels, as shown in table 2.

Table 2. Social Human Development Indicators

	Life expectancy at birth	Average no. of years of school
1980	45.9	1.2
1985	46.4	1.5
1990	46.9	2
1995	45.9	2.7
2000	45.7	3.2
2005	47	3.4
2010	48.1	3.5
2011	48.4	3.5
2012	48.7	3.5

Source: UNDP (2013).

Despite the high rates of growth in recent years, social indicators are not satisfactory (AfDB, 2012: 3-4): poverty affects about 71 per cent of Congolese citizens; life expectancy is still below 50 years; 75 per cent of the population experiences food insecurity; the infant mortality rate (deaths per 1,000 live births) is 114.9, compared to the African average of 80; access to health services (as a percentage of the population) is 17.6 compared to the African average of 38.5; and the average years of school does not reach four. About 80 per cent of the workforce remains outside the labour market. Although the Central Bank of Congo reports indicate that unemployment is dropping, from 64.7 per cent in 2008, it is still high. The decrease in unemployment is undoubtedly linked to the increase in production. But it would be useful to have data on the creation of real jobs by sector to assess the impact of economic growth on unemployment.

3.3 Budgetary allocation and poverty reduction

It is through its budgetary policy that the State organizes the redistribution of incomes towards reducing poverty and inequalities. However, the DRC devotes few budgetary resources to basic social needs, as shown in Table 3.

Table 3. Share of budgetary expensives, 2010, 2012 and 2014

	2010 Share in %	2012 Share in %	2014 Share in %
Health care	3.5	3.9	5.76
Education	10.3	8.9	17.9
Agriculture, forestry, hunting and fishing, and rural development	1.5	1.24	3.4
Social protection, social affairs	1.3	3.08	1.1

Source: Ministry of the Budget http://www.budget.gouv.cd

From this table of budgetary expenditures paid, it appears that the DRC is dedicate considerable towards education, but small sums are allocated to health care, agriculture and social protection. And yet, it is these three essential sectors that guarantee a decent standard of living for the population. Indeed, the budget item "social protection" includes the fight against unemployment and the fight against exclusion, two key policies to reduce poverty, but only 1 per cent of the expenditure was devoted to it in 2014. Moreover, more than 70 per cent of the rural population works in agriculture and derive their livelihoods from it, and a majority of the population is food-insecure, in 2014, the Government has devoted barely 3.4 per cent to agriculture and rural development. Yet, agricultural production generates income for the poor and reduces food prices, the main component of the consumer basket of low-income populations (Herderschee, Samba and Tshibangu, 2012: xxxi). These low allocations to basic needs contrast with the amounts allocated to administrative and security expenditure.

The assessment of progress made with respect to the Millennium Development Goals shows that in the DRC, the Gini index increased from 39 per cent in 2005 to 41 per cent in 2012, reflecting an increase in inequality despite strong growth (République Démocratique du Congo, 2015: 45). Despite this achievement, the country was experiencing a reduction with respect to the GPRSP.

In 2011, the GPRSP indicates *that "the gaps identified in terms of the allocation of resources mostly derive from the lack of a true policy of redistributing the State resources. The low impact of economic growth on poverty in the DRC is explained by the lack of a true redistribution policy*" (Ministry of Planning, 2011:44). Four years after this observation, has the Congolese State implemented a worthy policy of redistribution? Analyses have often been carried out in several sectors, together with the usual recommendations, but they

have not always been implemented.

It is important to note that the DRC budget is less than $10 billion, insufficient to meet the country's needs. Moreover, implementation rates are often low, around or below 50 per cent. With respect to revenue, an significant portion is usually expected from the contribution of external resources in the form of budgetary support or fund through investment, particularly within specific projects. Due to the weak domestic resources, country is dependent on external aid. The national aid/income ratio is therefore significant: 17.1 per cent in 2008 and 38.5 per cent in 2011.[5] By contrast, in African countries experiencing growth, this ratio has declined in recent years. For example, it has declined from over 25 percent to 6 per cent in Zambia and from 12 per cent to less than 5 per cent in Ghana (Africa Progress Panel, 2013:46).

4. Towards a growth in development?

The Report of the Commission on Growth and Development provided African countries with the following conclusion, also true for the DRC: "*African policymakers have spent several years worrying about debt, deficits and inflation. Having won the battle for macroeconomic stability, they can now afford to think about growth over the long term"* (Commission sur la Croissance et le Développement, 2008: 89).

To this end, within the DSCRP, the DRC has set[6] its objectives in line with the MDGs, which include:

- Reduce the incidence of poverty to 60 per cent by 2015;
- Create at least 1,000,000 decent jobs per year by 2015;
- Ensure an average annual GDP growth rate of 7.2 per cent for the same period;
- Increase the level of public investment in order to achieve an average annual investment rate of 19 per cent;
- Ensure universal primary education, which should lead to free primary school for all children by 2015;
- Increase the drinking water coverage rate to 38 per cent from the current 26 per cent;
- Increase the electricity supply rate from 9 per cent in 2010 to 19 per cent in 2015, etc.

To achieve these goals and reduce poverty, the DSCRP believes that there should be

[5] World Bank Open Data webpage http://data.worldbank.org
[6] Ministry of Planning (2011 :49).

robust and redistributive economic growth of between 8 and 12 per cent. But the country has not reached these rates. DSCRP rightly mentions the following factors responsible for failure to achieve this growth: weak governance, lack of financing, inadequate infrastructure, notably energy and transport, weak human capital and lack of diversification of the economy are. In recent years, the slowdown in the global economy and the consequent decline in the prices of certain products constituting the main exports of the DRC were other factors have contributed to this failure in recent years. The low level of investment must also be taken into account, which is only 4 per cent, a level well below the 27 per cent threshold required to achieve double-digit growth (Ministry of Planning, 2011:40)

The DRC's economy also has certain vulnerabilities that can hinder its sustainable growth. The most important is related to the market volatility of primary mining and agricultural products, which are its main exports. There has been weak domestic demand in the domestic economy as well as uncertainty in world markets due to the ongoing economic and financial crises in the West. In spite of the growth, the DRC mainly produces goods of low added value, which consequently generate low incomes. Sustainable growth therefore requires the production of more sophisticated goods and the diversification of export products. It is from this perspective that growth gains will be more substantial for reducing poverty. Moreover, public spending on education, health care, employment and infrastructure such as roads and electricity generates growth. If the country does not allow for sufficient efforts to be made in these sectors, it will not be possible to expect significant and sustainable growth.

Other constraints are related to Congolese fiscal policy: domestic resources are weak. Among the explanatory factors are the low level of economic activity, but also the deficit of fiscal governance. For example, the mining sector, which accounts for more than a quarter of the country's GDP, contributes barely 11 per cent of central government revenues.[7] The weakness of resources is also related to losses due to underestimation of mining assets when sold. These are the findings contained in Africa Progress Panel 2013 (Africa Progress Panel, 2013: 56):

> *The DRC has one of the richest mineral resources in the world and is often a loser because public enterprises systematically underestimate assets. The concessions were sold under conditions that proved to generate significant profits for foreign*

[7] Ministry of the Budget. See www.ministeredubudget.cd/

> *investors, most of which are registered in offshore centres, causing considerable losses to public finances. (...) Between 2010 and 2012, the DRC lost at least $1.36 billion in revenue from the underestimation of mining assets sold to offshore companies.*

In addition, in the Congolese State there is a loss of income because many tax payers do not pay their taxes.[8] Finally, the measures of exemption and repatriation of profits granted to foreign investors subtracts from the national economy large resources for the State and incomes likely to increase domestic demand.

In order for economic growth to reduce poverty, IMF makes the following recommendation with respect to the DRC to which the author agrees: "Governments should …. strive to make growth more inclusive through, in particular, reforms in favour of economic diversification and employment in order to consolidate the financial sector and tackle infrastructure gaps" (IMF, 2013: 73).

However, it is essential to combine these efforts with effective redistribution policy measures towards reducing poverty and inequality. It is under this condition that growth in the DRC will be pro-poor.

5. Conclusion

The DRC is undeniably engaged in a process of stabilizing its macroeconomic framework. In recent years, the country has experienced significant growth. However, despite a decade of growth above 5 per cent, the challenges remain in terms of poverty reduction. With a GDP per capita of less than US$300, most of the 70 million Congolese people live below the poverty threshold. The country lags behind the human development scale. Poverty reduction goals and strategies are formulated in the DSCRPs. However, efforts still need to be made to implement the measures envisaged, including significant budgetary allocations to the basic socio-economic sectors of food, health care, education and employment.

Hence, the Government has a major role to play by applying macroeconomic policies to promote a growth likely to achieve rates ranging between 8 and 12 per cent (DSCRP 2) to reduce poverty. And the public authorities must implement sectoral redistributive

[8] Observation made during the meeting on 2-4 May 2013 in Kinshasa on the losses of public revenues. www.cpcai.cd/

strategies in order to increase the access of Congolese populations to basic social goods, and also to reduce poverty and inequality. The reduction of hunger calls for increased food production. The eradication of poverty requires measures to increase the ability of the poor to develop economic activities that generate income. But increasing income requires investments in the processing units needed to produce and sell high value-added goods. This requires implementing the measures planned within the DSCRP, in particular in terms of economic diversification, the development of infrastructure (such as roads and electricity) and improved access to basic social services.

It must be recognized, however, that the country has made great progress. Before 2002, for several successive years, economic activity was experiencing negative growth rates, significant inflation and a marked deterioration in social conditions. Faced with current challenges, government responses depend on public funding, which is still insufficient. The latter, in turn, relies on the ability to mobilize tax revenues, on taxpayer honesty, but also on the economy, a large part of which is still informal, with little or no taxation, and whose added value is still insufficient due to weak industrialization. However, it is possible to increase budgetary allocations for priority social sectors towards poverty reduction. With the country's gradual pacification, defence- and security-related spending is likely to be reduced, with other priorities likely to benefit. The DRC remains a post-conflict country facing major challenges. Finally, some of the measures taken under the DSCRP will only show results in the medium to long term.

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Multidimensional analysis of inequality and polarization in Cameroon[1]

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Abstract

This paper analyzes multidimensional and monetary inequality and polarization in Cameroon using the 2007 Cameroon household consumption survey. For the multidimensional analysis of welfare, we use a composite index constructed by the multiple correspondence analysis, and for the monetary analysis of welfare we use total expenditures per adult equivalent. The Gini and generalized entropy class of indices are used for the analysis of inequality, while the Foster-Wolfson and Duclos-Esteban-Ray (DER) measures are used for the analysis of polarization. The gender and locational decomposition of the Gini index, the generalized entropy class of indices and the DER measures are also provided. Results show that multidimensional inequality and polarization are higher in rural areas and among male-headed households, while monetary inequality and polarization are higher in urban areas. To reduce inequality and polarization, there is need for government to promote balanced regional development as well as education and health for all, and involve local representatives in the formulation of development strategies.

Keywords**:** composite index, inequality, polarization, Cameroon.

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1. Introduction

The present-day economic history of Cameroon bears the marks of a major occurrence: the economic crisis of the mid-1980s. Under pressure from the Bretton Woods institutions [International Monetary Fund (IMF) and World Bank (WB)], the country undertook a huge structural adjustment programme aimed at stabilizing the economy and restoring major macroeconomic balance. Since the end of the 1990s and the early 2000s, particular attention has been paid to the social aspect and to improvement of population welfare. The Poverty Reduction Strategy Paper (PRSP) adopted in 2003 and the Growth and Employment Strategy Paper (GESP) adopted in 2009 provide information on the policies initiated by the Government. However, despite these efforts, the results obtained fall short of expectations, and poverty is still found everywhere, with inequality remaining wide.

In fact, the proportion of people living below the monetary poverty line is calculated at 39.9 per cent in 2007, as against 40.2 per cent in 2001 and 53.3 per cent in 1996 (INS, 2008). This indicates virtually stable poverty levels between 2001 and 2007. These figures also conceal large disparities between urban and rural settings, and between men and women. While poverty has gone down in urban settings over these two periods, in the rural areas not only was the drop observed between 1996 and 2001 much less, but also a slight increase has been observed over the period 2001–2007.

These results lead to the assumption that major disparities exist between the urban and the rural settings, not only on the monetary plane, but also on the non-monetary plane. Indeed, as the crisis affected Cameroon, a severe degradation has been seen in the sectors of physical infrastructure and housing facilities, and facilities for education and health (Gouvernement du Cameroun, 2009). However, theories of endogenous growth have shown the importance of these non-monetary aspects on the maintenance of strong and sustained growth. In the Cameroon context, that appears important because the significant reduction in poverty observed between 1996 and 2001 results essentially from growth (Gouvernement du Cameroun, 2003). Similarly, the virtual stagnation in poverty between 2001 and 2007 can be largely imputed to mediocre performance in the area of growth over this period (Gouvernement du Cameroun, 2009).

The objective of this paper is thus to analyze the profiles of monetary and multidimensional inequality and polarization in Cameroon and the decomposition of the indices of inequality and polarization[2], as a function of the area of residence and the sex of

[2] The concept of polarization in the wider sense refers to the existence of groups within a population/distribution (Esteban and Ray, 1994 ; Duclos et al., 2004). With regard specifically to

the head of household in 2007. The importance of associating these measurements (inequality and polarization) arises from the fact that the measurements of polarization make it possible to capture aspects which are ignored by traditional measurements of inequality (Gini or generalized entropy, for example)[3]. As for the gender dimension, with the adoption in 2000 of the Millennium Development Goals (MDGs), combating gender inequality has taken an important place in the country's agenda (Gouvernement du Cameroun, 2009).

These various groups of information should allow a better assessment of the gaps and clusterings in the distribution of welfare (monetary and multidimensional), thereby facilitating the preparation of more effective economic and social policies. For the remainder of the paper, after presenting the review of the literature, we will present the methodology used, followed by the results obtained and finally our conclusion and some recommendations on economic policy.

2. Review of the literature

While income remains the most widely used indicator to analyze the welfare of an individual, there is also evidence of a steadily growing interest in the non-monetary dimension, particularly following the work of Rawls (1971) and Sen (1981, 1985), whose inputs greatly contributed to a redefinition of the concept of welfare in economics. This interest has led to the development of measures of multidimensional inequality and also, over the past few years, development of measures of multidimensional polarization.

At the beginnings of the work on multidimensional inequality, we find Fisher (1956), who was the first to develop the concept of a matrix associated with a multidimensional distribution. He was later followed by Kolm (1977), Atkinson and Bourguignon (1982), and Walzer (1983). The proposals of Kolm (1977) include the criterion of *Uniform Majorization* which is the generalization to multidimensional analysis of the Pigou-Dalton principle[4], and *Directional/Price Majorization*. These criteria are primarily sensitive to inequality between individuals by way of the different dimensions considered to be independent.

Atkinson and Bourguignon (1982) drew attention to the fact that multidimensional inequality also depends on the correlation between the different attributes/goods (and especially between inequalities in the different dimensions). Following the same logic,

bipolarization, this is a process by which a political or social group is divided into two opposing sub-groups, with fewer and fewer members remaining neutral or taking an intermediate position (Anderson et al., 2009).

[3] Cf. Burki (2011).

[4] The Pigou-Dalton principle stipulates that any transfer of wealth from an individual to a poorer individual should not increase inequality.

Walzer developed the concept of "complex equality "on the basis of the principle according to which total equality is not only a matter of the equality within each dimension, but also the compensation (influence of the ones on the others) between the inequalities in the different dimensions, which ultimately provides advantage or disadvantage to the individual in the different dimensions. However, recent work primarily uses the approaches initiated by Maasoumi (1986) and Asselin (2002), which are less demanding in terms of properties to be observed, while also being quite robust.

Unlike multidimensional inequality, on which nowadays there are several works, multidimensional polarization is still explored only to a very small degree, and while Esteban and Ray (1994) comprehend polarization (monetary) through the concepts of identification and alienation[5], it is nevertheless accepted that the determinants of polarization may be sociological and/or cultural (ethnic group, race, etc.). Montalvo and Reynal-Querol (2002, 2005) attach particular importance to this latter approach and propose an index of non-monetary polarization which takes account only of social characteristics such as ethnicity or race. The weakness of the approach initiated by these latter-named is that it does not take account of the distances between individuals/groups, or in other words it does not allow for the phenomenon of alienation. Following on from these works, Duclos et al. (2004)[6], in their paper on generalization of the ER measure (Esteban and Ray, 1994) to continuous data, also make proposals for conception of an index of socioeconomic polarization, taking into account a monetary variable and a non-monetary variable.

This socioeconomic index has been studied and applied by Permanyer (2008). This author bases his work also on the developments of Montalvo and Reynal-Querol (2002, 2005), and the index proposed can be decomposed into intragroup and intergroup components. A further attempt seeking to bring the monetary and non-monetary dimensions together with the polarization analysis is proposed by Mogues (2008). The author proposes a generalization of the DER measure (2004) making it possible to study a population based on two characteristics, notably on the basis of a two-dimensional density function. This extension enables the study of polarization through an economic dimension and a social dimension, thereby making it possible to capture the degree of polarization in each dimension and to determine how the interaction between the dimensions contributes to the total socioeconomic polarization. The measure that it proposes, following the model of the DER index, is based on the principles of identification and alienation.

[5] Identification refers to the feeling of belonging to a particular group, while alienation may be perceived as the distance between individuals from different groups.
[6] The measure proposed by Duclos-Esteban-Ray (2004) is generally referred to as the DER index.

However, despite all of these developments regarding the perception of welfare and the measures of inequality and polarization, there is little work on multidimensional inequalities (Foko et al., 2006 ; Araar, 2009 ; Manga and Epo, 2010 ; Epo and Baye, 2011), and virtually no work at all on multidimensional polarization in Cameroon, with the few works on polarization tackling it only from a monetary point of view (Baye, 2008 ; Njong and Tchouapi, 2010 ; Ngoudji and Baye, 2011 ; Chameni, 2012). The present study attempts to close that gap and also proposes the decomposition of the DER measure and a comparison between monetary and multidimensional inequality and polarization. The multidimensional analysis, unlike the works on multidimensional polarization presented above (Permanyer, 2008 ; Mogues, 2008), is undertaken on the basis of a composite index.

It should be noted that the use of composite indices in Cameroon to grasp the non-monetary aspects of welfare is not new. As a matter of fact, Foko et al. (2006), Njong and Ningaye (2008), Araar (2009), Njong (2010), Manga and Epo (2010) are authors who have built composites indices to measure the welfare of households in Cameroon. While Foko et al. (2006) used a multiple factorial analysis (MFA), Njong and Ningaye (2008) built three indicators on the basis of principal component analysis (PCA), multiple correspondence analysis (MCA) and the fuzzy sets approach, and then compared the distributions obtained using tests for stochastic dominance. Whereas Araar (2009) and Njong (2010) used MCA, Manga and Epo (2010) turned to PCA. As for Epo and Baye (2011), they apply MCA to build and evaluate two aspects of non-monetary poverty related to human capital, namely health and education. They argue that this type of analysis serves to consolidate the discussion on the Sen capability approach. In the present paper, drafted on the basis of multiple correspondence analysis (MCA), the method used is the one proposed by Asselin (2002).

3. Methodology

3.1. Presentation of the composite index of welfare

It should be recalled that this composite index makes it possible to meld into a single value the information provided by several primary indicators of the welfare of households. Generally speaking, for each dimension of household welfare (education, health, basic infrastructure), there are several primary indicators. And for each primary indicator, there are several response modalities. If we adopt the following notations: K the number of primary indicators; J_k the number of response modalities associated with the primary indicator k; $w_{j_k}^{\alpha,k}$ the non-normalized score of the category j_k on the factorial axis α; I_{i,j_k}^{k} the binary variable which takes the value 1 when household i chooses modality j_k and otherwise 0 $(j_k \in J_k)$; λ_α the eigenvalue or the inertia associated with the

factorial axis α; F_{α}^{i} the non-normalized score of the household on the factorial axis α, then the functional form of the composite index of welfare of the household i (C_i) is defined as follows:

$$C_i = F_1^i = \frac{\sum_{k=1}^{K}\sum_{j_k=1}^{J_k}\frac{w_{j_k}^{1,k}}{\sqrt{\lambda_1}} I_{i,j_k}^{k}}{K}$$

$$= \frac{\sum_{k=1}^{K}\sum_{j_k=1}^{J_k} w_{j_k}^{*1,k} I_{i,j_k}^{k}}{K} \qquad (1)$$

where $w_{j_k}^{*\alpha,k} = \frac{w_{j_k}^{\alpha,k}}{\sqrt{\lambda_\alpha}}$ is the normalized score of the category j_k on the factorial axis α.

The choice of the first factorial axis $(\alpha = 1)$ is justified by the fact this axis has the highest inertia. In other words, it offers the best representation of the points scatter.

3.2. Measures of inequality

The Gini index

Generally associated with the Lorenz curve, the Gini index can be obtained from the S-Gini index (Duclos and Araar, 2006), which has the following form:

$$I(\rho) = \int_0^1 \big(p - L(p)\big)\kappa(p;\rho)dp \qquad (2)$$

where $L(p) = \frac{\int_0^p Q(q)dq}{\int_0^1 Q(q)dq} = \frac{1}{\mu}\int_0^p Q(q)dq$ is the Lorenz curve for the proportion p of the population; $\kappa(p;\rho) = \rho(\rho-1)(1-p)^{(\rho-2)}$ is the weighting parameter; p is the proportion of the population having a level of welfare or an income lower than or equal to $Q(p)$. When $\rho = 2$, that gives the standard Gini index.

Decomposition of the Gini index into sub-groups

Initiated by Bhattacharaya and Mahalanabis (1967), the decomposition of the standard Gini index (*I(ρ=2)*) into sub-groups has subsequently attracted the attention of numerous researchers (Rao, 1969; Pyatt, 1976; Mookherjee and Shorrock, 1982; Lambert and Aronson, 1993; Dagum, 1980, 1997a, 1997b; Mussard et al., 2006). The idea here is that the Gini index can be decomposed into intragroup component, intergroup component and residual component. The intragroup component (G_w) is the weighted average of the Gini indices obtained in each sub-population, the intergroup component (G_b) is the index of

inequality when each individual has the average level of welfare of his or her group. With regard to the residual component (*R*), Lambert and Aronson (1993) show that it is equal to twice the area between a particular concentration curve and the Lorenz curve. The particular concentration curve is obtained by ordering the poorest groups up to the richest groups and then ordering the individuals/households within each of these groups as a function of their increasing welfare. This justifies this component's being still considered as the inequality obtained when the distributions overlap. The Gini index is then expressed as follows:

$$I(\rho = 2) = G_w + G_b + R \qquad (3)$$

Generalized entropy class of indices $\left(\boldsymbol{GE(\alpha)}\right)$

The generalized entropy indices are calculated from the following formula:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{c_i}{\mu}\right)^{\alpha} - 1\right], \quad \alpha \neq 0,1 \qquad (4)$$

In the particular cases in which α takes the value 0 or 1, $GE(0)$ corresponds to the mean logarithmic deviations and is particularly sensitive to the low values in the distribution. $GE(1)$ is the Theil index of inequality that allocates the same weight to all the observations in the distribution and $GE(2)$ allocates more weight to the differences in the upper part of the distribution.

Decomposition of the generalized entropy class of indices into sub-groups

The generalized entropy indices can also be decomposed into intragroup component and intergroup component (Theil, 1967). Here, the particular feature, unlike the Gini index, is that a residual term is not allowed for, which makes this a particularly revealing measure for observing the contributions of the different groups to the total inequality Thus, if the population is partitioned into K sub-groups, the following decomposition ensues:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[1 - \sum_{j=1}^{K} p_j \left(\frac{\mu_j}{\mu}\right)^{\alpha}\right] + \sum_{j=1}^{K} GE_j\, p_j \left(\frac{\mu_j}{\mu}\right)^{\alpha}, \qquad \alpha \neq 0,1 \qquad (5)$$

where p_j is the proportion of the population in the group j $(j = 1,2, \dots, K)$, GE_j is the inequality quality in the group j and μ_j is the average within the group j. The first term of the decomposition represents the intergroup component and the second term the intragroup component.

3.3. The measures of polarization

The Foster-Wolfson index

Wolfson (1994) proposes a measure based on the Lorenz curve, the idea being that society can be divided into two groups situated one on each side of the median. This measure has the following form:

$$POL^W = \frac{\mu}{m}\left[\frac{1}{2} - L\left(\frac{1}{2}\right) - \frac{G}{2}\right] \quad (6)$$

where m is the median welfare, μ the average welfare, G the Gini index and $L\left(\frac{1}{2}\right)$ the value of the Lorenz curve for the median welfare.

The Duclos-Esteban-Ray (DER) index

Duclos-Esteban-Ray (2004) generalize the Esteban and Ray measure (1994) so as to take account of continuous distributions. Starting from the definition of polarization as being the sum of the effective antagonisms, they propose the following index:

$$P(F) = \iint T(f(c), |c - x|)\, f(c) f(x) dc dx \quad (7)$$

where $i = f(c)$ is the degree of identification of the household whose welfare is c, $a = |c - x|$ the alienation felt by the household towards the one or ones having the welfare x and $T(a, i)$ the effective antagonism felt by the household. The axioms relating to the concept of polarization (see Duclos et al., 2004) make it possible to determine the functional form of T, which enables a polarization index to be obtained equivalent to:

$$P_\alpha(f) \equiv \iint f(x)^{1+\alpha} f(c)|c - x| dc dx \quad (8)$$

where $\alpha \in [0{,}25; 1]$, and the distribution has been normalized to unity relative to the mean. We recall that when $\alpha = 0$, the DER index is equal to the Gini index.

Decomposition of the DER index into sub-groups

The objective here is to determine how certain sociodemographic characteristics such as the area of residence, and certain human groups (men and women), contribute to the total polarization. In this stage we base our work on the methodology proposed by Araar

(2008) who, in agreement with Runciman (1966), perceives the size of the relative deprivation as the difference between the desired situation and the current situation of a person (see also Yitzhaki, 1979; Hey and Lambert, 1980).

Thus, local alienation $(a(x))$ may be decomposed into expected deprivation $(\delta(x))$ and expected surplus $(\sigma(x))$, and the DER index according to Araar (2008) is then expressed as:

$$P_\alpha(f) = \int f(x)^{1+\alpha}\,[\delta(x) + \sigma(x)]dx$$
$$= D + S \qquad (9)$$

where $D = \int f(x)^{1+\alpha}\,[\delta(x)]dx$ is the overall deprivation in the distribution, and $S = \int f(x)^{1+\alpha}\,[\sigma(x)]dx$ the overall surplus in the distribution. When the distribution is symmetrical or when parameter $\alpha = 0$, these two components are equal. But as the distribution of incomes is generally asymmetrical, it may be expected that $D > S$ (Araar, 2008).

If we note as f_j the density function of the group j, and considering equation (9), the contribution to the DER index of the group j of which the individual members have the level of welfare x is as follows:

$$C_j(x) = \frac{\pi_j(x)a(x)f(x)^{1+\alpha}}{\mu^{1-\alpha}}$$
$$= \pi_j(x)C(x) \qquad (10)$$

where $\pi_j(x)$ is the proportion of the individuals belonging to group j and having the income x and $C(x) = \frac{a(x)f(x)^{1+\alpha}}{\mu^{1-\alpha}}$ is the contribution to the DER index of the individuals having the level of welfare x. On the basis of these local contributions of the groups, the DER index may then be expressed as: $P_\alpha(f) = \sum_j \int C_j(x)dx$. Starting from the algebraic decomposition of the Gini index, Araar (2008) also shows that the DER index can be decomposed into intragroup and intergroup components.

4. Analysis data

The data used here originated with the third Cameroon Households Survey (ECAM III) carried out by the National Statistical Institute (INS, 2007). For purposes of building the composite index, the variables selected were: for the monetary dimension, households' expenditures on food and non-alcoholic drinks; for the non-monetary dimension, the

variables related to accessibility to infrastructures for housing, for health and for education (see Table 1). These variables were selected in accordance with the Sen capability approach (Sen 1985).

Processing of these variables requires the prior use of Cronbach's alpha, in order to assess the statistical quality of the aggregation that will be performed through the composite index to be built. Next, the selection of the variables is refined by way of the ordinal consistency on the first factorial axis. Observance of this criterion requires that the order of the scores generated by the MCA respect the order adopted at the stage of coding the variables. Finally the modalities of the variables are grouped (recoded) in order to limit the influence of the modalities which are too few in number in the analysis.

Observance of these criteria made it possible to select the variables shown in Table 1. These equate to a total of 16 variables and 56 modalities, for a sample of 10 684 households, the inadequate values having been removed. The composite index obtained is first normalized before calculation of the indices of inequality and polarization. The normalization method used is the min-max method which makes it possible to order the values of the composite index in the interval [0, 1], with 0 relating to the households having the lowest level of welfare and 1 relating to those with the highest.

For the purposes of the monetary analysis, the variable used is each household's total or aggregate consumption expenditure per adult equivalent. Total expenditure comprises food and non-food expenditures and is obtained by normalizing the aggregate of consumption, by dividing it first by the number of adult equivalents in the household, and then by a spatial deflator that takes cost-of-living differences between regions into account.

5. Empirical results and interpretation

5.1. Interpretation of the MCA and building of the composite index

Table 1: Scores, correlations and contributions of the modalities

	Scores		Correlations		Contributions	
	Axis 1	Axis 2	Axis 1	Axis 2	Axis 1	Axis 2
Residential infrastructures and facilities					**0.441**	
Principal source of lighting:					**0.065**	
1"oil+similar"	-1.651	0.333	0.622	0.010	0.039	0.001
2"collective AES-SONEL meter without division meter+without direct meter"	0.720	-1.890	0.059	0.162	0.005	0.020
3"collective AES-SONEL meter with division/main user meter "	1.119	-0.465	0.121	0.008	0.010	0.001
4"individual AES-SONEL meter"	1.220	2.177	0.128	0.164	0.011	0.021
Principal source of energy for cooking:					**0.064**	
1"wood collected/received+similar"	-1.474	0.362	0.554	0.013	0.034	0.001
2"wood purchased"	0.529	-0.922	0.039	0.047	0.003	0.006
3"oil/coal/sawdust/wood shavings /no cooking done"	0.854	-2.049	0.047	0.109	0.004	0.015
4"gas+électricity"	1.827	2.258	0.274	0.168	0.023	0.022
Principal mode of supply of drinking water:					**0.062**	
1"well/stream/lake/backwater/non-improved source+rainwater"	-1.948	0.966	0.412	0.041	0.033	0.005
2"well with pump & improved well/sources"	-0.491	-0.558	0.019	0.010	0.002	0.001
3"public standpipe/sinking and other collective tap+similar"	0.082	-1.026	0.001	0.041	0	0.005
4"SNEC/CAMWATER water seller"	0.920	-1.925	0.094	0.166	0.007	0.021
5"collective & individual tap+mineral water"	1.767	3.164	0.237	0.305	0.020	0.041
Principal material of the floor:					**0.062**	
1"earth+wood/similar"	-1.648	0.261	0.604	0.006	0.039	0.001
2"cement+tile"	0.974	-0.154	0.604	0.006	0.023	0.000
Type of facility for the WC:					**0.054**	

1"no WC" 2"non-improved latrines" 3"improved latrines" 4"WC with water flush"	- 2.571 - 0.733 0.990 2.122	2.120 - 0.585 - 0.954 5.166	0.157 0.214 0.182 0.178	0.043 0.055 0.068 0.424	0.015 0.011 0.012 0.016	0.006 0.004 0.007 0.062
Principal material of the walls: 1"adobe/pressed earth+matting/thatch/leaves+similar" 2"simple earth/brick" 3"plank/carabot" 4"concrete/breeze block/fired bricks+freestone"	- 1.316 - 0.949 0.341 1.301	0.275 - 0.304 - 2.052 0.811	0.081 0.231 0.005 0.390	0.001 0.010 0.074 0.061	**0.046** 0.007 0.014 0 0.025	0.000 0.001 0.011 0.006
Principal material of the roof: 1"matting/thatch/leaves" 2"metal/tile+cement"	- 2.548 0.369	1.563 - 0.226	0.354 0.354	0.054 0.054	**0.036** 0.031 0.005	0.008 0.001
Mode of waste disposal: 1"thrown into the natural surroundings+buried/burnt/recycled & other" 2"pickup by rubbish lorry/bin"	- 0.456 1.651	- 0.146 0.529	0.283 0.283	0.012 0.012	**0.029** 0.006 0.023	0.000 0.001
Type of housing: 1"concession/saré" 2"single house" 3"house with several dwellings " 4"apartment building/modern villa "	- 0.997 - 0.346 0.716 1.902	0.125 0.272 - 0.923 4.508	0.094 0.030 0.107 0.062	0.001 0.007 0.071 0.139	**0.023** 0.008 0.002 0.007 0.006	0.000 0.001 0.007 0.021
Health					**0.097**	
Distance between dwelling and the district hospital: 1"6 km and more" 2"[3, 5] km" 3"at most 2 km"	- 1.830 0.254 0.911	0.813 - 0.233 - 0.342	0.472 0.008 0.286	0.037 0.003 0.016	**0.051** 0.035 0.001 0.015	0.004 0.000 0.001
Average time to reach the district					**0.046**	

hospital:	-	1.297	0.313	0.048	0.027	0.006
1"more than 45 min"	2.100	-	0.053	0	0.004	0.000
2"[21, 45] min"	-	0.063	0.118	0.030	0.006	0.003
3"[6, 20] min"	0.774	-	0.109	0.001	0.009	0.000
4"at the most 5 min"	0.578	0.463				
	1.206	0.182				
Education					**0.07**	
Level of education of the head of household:					**0.039**	
	-	0.273	0.200	0.003	0.016	0.000
1 "no education "	1.329	-	0.026	0.031	0.002	0.003
2 "primary"	-	0.644	0.025	0.021	0.002	0.003
3 "secondary 1st cycle"	0.374	-	0.091	0	0.008	0.000
4 "secondary 2nd cycle"	0.518	0.749	0.114	0.176	0.011	0.026
5 "higher"	1.148	0.048				
	1.855	3.637				
Average time to reach the nearest public primary school:					**0.015**	
	-	1.746	0.109	0.034	0.010	0.005
1"more than 30 min"	1.972	0.150	0.028	0.001	0.002	0.000
2"[16, 30] min"	-	-	0.022	0.023	0.001	0.002
3"[6, 15] min"	0.578	0.401	0.029	0.002	0.002	0.000
4"at the most 5 min"	0.245	0.187				
	0.464					
Distance between dwelling and the nearest public primary school:					**0.009**	
	-	2.222	0.083	0.034	0.008	0.005
1"4 km and over"	2.213	0.790	0.005	0.023	0	0.003
2"[2, 3] km"	-	-	0.042	0.052	0.001	0.002
3"at the most 1 km"	0.241	0.331				
	0.188					
Principal means used to reach the nearest public primary school:					**0.007**	
	-	-	0.063	0.025	0.001	0.000
1"walking"	0.146	0.145	0.022	0.003	0.002	0.000
2"moped/bicycle/motorbike"	0.854	0.512	0.044	0.033	0.004	0.005
3"car"	1.681	2.295				
Monetary dimension					**0.005**	
Expenditure on food and non-alcoholic drinks:					**0.005**	
	-	-	0.016	0.052	0.001	0.005
1"[0.410194["	0.256	0.720	0.007	0.004	0	0.000

2"[410194.764577[" 3"[764577, [" 	- 0.180 0.662	- 0.213 1.450	0.055	0.106	0.004	0.013
Total					**0.613**	

Source**:** Authors' calculations based on data from ECAM III (2007).

The major shift between the inertia of the first factorial axis and that of the second (15.04 per cent of total inertia for the first as against 6.05 per cent for the second) and the total of the contributions of the variables on the first axis (61.3 per cent of the inertia of the axis) allow the conclusion that the latter well summarizes the information contained in the data, and justifies its selection as the axis of household welfare. The results of the MCA undertaken on all the variables selected are presented in Table 1[7] (we are presenting here only the results of the two first factorial axes).

These results make it possible to draw up a classification of the households as a function of the degree to which they possess the various attributes (modalities). The first premier factorial axis contrasts two types of household at global level: poor households and non-poor households. The second axis, on the other hand, introduces a differentiation within each class. Within the poor class, it makes it possible to distinguish the poor households from the very poor households. Likewise, within the non-poor class, it distinguishes the rich households from the very rich households.

Generally speaking, the least well-off households have very low access to education, to health, to housing infrastructures and facilities and to food, unlike the most well-off households.

5.2. Profiles of monetary and multidimensional inequalities

Table 2 gives a picture of the inequality in the distribution of expenditures per unit of consumption and in the distribution of the composite index by group examined. The results given by the Gini index show that multidimensional inequality increases with the passage from the urban setting to the semi-urban setting and from the semi-urban setting to the rural setting. The opposite phenomenon is observed in the monetary dimension, where the inequality of expenditure is greater in the urban areas and lower in the rural

[7] The scores on the first axis have been multiplied by -1 with the result that the households are classified from the poorest to the non-poor, moving from left to right on the first factorial axis. The correlations are squared, and represent the contributions of the axes to the formation of the column profiles.

ones. Foko et al. (2006) and Araar (2009)[8] also observe that the level of multidimensional inequality is higher for the rural setting.

Table 2: Indices of inequality by residential setting and region and the sex of the head of household

	Composite indicator				Expenditure by adult equivalent			
	Gini	Entropy			Gini	Entropy		
		α=0	α=1	α=2		α=0	α=1	α=2
Residential setting								
Urban	0.1049 (0.0015)	0.0212 (0.0006)	0.0191 (0.0005)	0.0179 (0.0005)	0.3525 (0.0058)	0.2059 (0.0068)	0.2283 (0.0097)	0.3418 (0.0245)
Semi-urban	0.1447 (0.0037)	0.0375 (0.0020)	0.0342 (0.0017)	0.0323 (0.0016)	0.3271 (0.0087)	0.1740 (0.0092)	0.1892 (0.0111)	0.2532 (0.0209)
Rural	0.2655 (0.0038)	0.1333 (0.0062)	0.1130 (0.0033)	0.1147 (0.0034)	0.3065 (0.0054)	0.1506 (0.0058)	0.1709 (0.0098)	0.2504 (0.0302)
Residential region								
Douala	0.0701 (0.0025)	0.0086 (0.0007)	0.0082 (0.0006)	0.0080 (0.0006)	0.3404 (0.0123)	0.1894 (0.0137)	0.2195 (0.0189)	0.3408 (0.0454)
Yaoundé	0.0742 (0.0024)	0.0088 (0.0006)	0.0086 (0.0006)	0.0085 (0.0005)	0.3334 (0.0120)	0.1829 (0.0136)	0.2083 (0.0194)	0.3139 (0.0447)
Adamaoua	0.3502 (0.0134)	0.2436 (0.0206)	0.1966 (0.0151)	0.1894 (0.0157)	0.3395 (0.0126)	0.1847 (0.0137)	0.2139 (0.0181)	0.3155 (0.0451)
Centre	0.2209 (0.0058)	0.0789 (0.0044)	0.0753 (0.0039)	0.0760 (0.0041)	0.2842 (0.0085)	0.1299 (0.0078)	0.1443 (0.0094)	0.1948 (0.0201)
Est	0.2946 (0.0094)	0.1463 (0.0106)	0.1353 (0.0088)	0.1382 (0.0092)	0.3295 (0.0109)	0.1725 (0.0113)	0.1919 (0.0137)	0.2656 (0.0286)
Extrême-Nord	0.3182 (0.0069)	0.1969 (0.0173)	0.1610 (0.0072)	0.1704 (0.0076)	0.3643 (0.0094)	0.2117 (0.0109)	0.2483 (0.0140)	0.3791 (0.0282)
Littoral	0.1444 (0.0070)	0.0395 (0.0038)	0.0353 (0.0033)	0.0328 (0.0030)	0.3242 (0.0165)	0.1724 (0.0173)	0.1999 (0.0232)	0.2988 (0.0478)
Nord	0.3372 (0.0089)	0.1949 (0.0127)	0.1833 (0.0099)	0.1999 (0.0114)	0.3532 (0.0124)	0.2006 (0.0142)	0.2458 (0.0201)	0.4032 (0.0482)
Nord-Ouest	0.2584 (0.0050)	0.1090 (0.0045)	0.1037 (0.0040)	0.1072 (0.0043)	0.3809 (0.0094)	0.2337 (0.0117)	0.2755 (0.0157)	0.4528 (0.0396)
Ouest	0.2230	0.0863	0.0779	0.0752	0.2981	0.1446	0.1591	0.2139

[8] His results, like those of Foko et al. (2006) relate to the data from ECAM II (2001).

	(0.0047)	(0.0039)	(0.0032)	(0.0032)	(0.0078)	(0.0075)	(0.0095)	(0.0175)
Sud	0.1982 (0.0087)	0.0730 (0.0109)	0.0630 (0.0062)	0.0752 (0.0032)	0.3435 (0.0297)	0.1964 (0.0355)	0.2345 (0.0567)	0.3893 (0.1372)
Sud-Ouest	0.2620 (0.0075)	0.1263 (0.0080)	0.1088 (0.0062)	0.1039 (0.0060)	0.3409 (0.0104)	0.1900 (0.0115)	0.2091 (0.0141)	0.3056 (0.0362)
Sex								
Male	0.3006 (0.0032)	0.1799 (0.0054)	0.1450 (0.0030)	0.1147 (0.0034)	0.3870 (0.0047)	0.1506 (0.0058)	0.2749 (0.0090)	0.4362 (0.0272)
Female	0.2653 (0.0045)	0.1383 (0.0053)	0.1141 (0.0037)	0.1061 (0.0036)	0.3882 (0.0080)	0.2456 (0.0106)	0.2773 (0.0160)	0.4339 (0.0459)
Total								
Population (households)	0.2934 (0.0027)	0.1716 (0.0044)	0.1385 (0.0025)	0.1301 (0.0025)	0.3881 (0.0041)	0.2455 (0.0053)	0.2768 (0.0078)	0.4381 (0.0235)
The values in parentheses represent standard deviations.								

Source: Authors' calculations based on data from ECAM III (2007).

Booysen et al. (2005)[9], in their comparative study covering seven African countries (Ghana, Kenya, Mali, Senegal, Tanzania, Zambia and Zimbabwe) use a composite index built from data from demographic and health surveys. They also observe that the inequalities (measured by the Gini index) are greater in the rural areas. Thus, while expenditure inequality appears to be an urban phenomenon, multidimensional inequality on the contrary appears as an essentially rural phenomenon, and this situation does not seem to be specific to Cameroon, but to apply to most of the countries of sub-Saharan Africa. This result is confirmed by the generalized entropy class of indices, whether more weight is attached to the differences at the bottom, in the middle or at the top of the distribution.

These results reveal the fact that the rural environment is poorly provided with dwelling, education or health infrastructures as compared with the semi-urban and urban environments. The low level of expenditure inequality in the rural environment by comparison with the urban environment is explained by the shortage of employment opportunities which forces the great majority of the rural population to pursue agriculture or cattle-raising. It can also be seen, in line with the work of Labar (2006) in her study of multidimensional inequality in China, that multidimensional inequality is lower than unidimensional (monetary) inequality. This supports her hypothesis under which taking

[9] Cited by Foko et al. (2006).

account only of the monetary dimension generally leads to overestimation of the level of inequality in society.

The analysis by residential region shows that for the Gini index and the generalized entropy class of indices, the city of Yaoundé is more unequal than the city of Douala, in the area of multidimensional inequality. The low level of multidimensional inequality in these two towns compared to the various regions reveals a quite large homogeneity and a high provision in the populations of goods and infrastructures for dwelling, education and health. This situation differs from the one shown by the monetary analysis, for which these towns, far from being the least unequal, even demonstrate levels of expenditure inequality higher than those observed in certain regions (Centre, Est, Littoral, Ouest).

It may be observed also that on the multidimensional plane, the northern part[10] of the country is the most unequal. The Gini index enables the following ordering to be made: Adamaoua in the lead, followed by Nord then by Extrême-Nord. While in these three regions the level of multidimensional inequality remains lower than that of monetary inequality, these two types of inequality are nevertheless very close together. The regions of Centre, Sud and Littoral, for their part, present the lowest levels of multidimensional inequality, while in the case of the monetary analysis the lowest levels are observed in the regions of Ouest and Centre.

The generalized entropy class of indices provides similar results to those of the Gini index. However, while the multidimensional inequality for the total population goes down with the passage from GE(0) to GE(1) and to GE(2), for certain regions (Centre, Est, Extrême-Nord, Nord, Nord-Ouest), the highest levels are recorded for GE(0) and GE(2). It may also be remarked that apart from the Sud region, multidimensional inequality is more pronounced when more weight is attached to the individuals located at the bottom of the distribution. The totally opposite phenomenon is observed with the monetary analysis, where the expenditure inequality tends to be greater when more weight is attached to the individuals located at the top of the distribution.

Turning to the gender dimension, multidimensional inequality is greater among men than among women. The generalized entropy class of indices indicates a level of multidimensional inequality higher for GE(0) and lower for GE(2). By contrast, the monetary approach gives different results, with an expenditure inequality higher among women and a higher level of inequality when more weight is attached to the variations at the top of the distribution. It may be noted, however, that for GE(2), expenditure

[10] The northern part covers the regions of Adamaoua, Nord and Extrême-Nord.

inequality behaves like multidimensional inequality, in other words it is at a higher level among men. These results make it possible to establish the difference between the monetary approach and the multidimensional analysis of inequality, and thus to underline the importance of this latter factor.

5.3. Static decomposition of inequality

Tables 3 and 4 show the decomposition of inequality depending on residential setting and the sex of the head of household.

The decomposition by residential setting shows that it is the rural setting that contributes the most to the intragroup component of multidimensional inequality. This is then followed by the urban setting and finally the semi-urban. This configuration is slightly different from that observed in the monetary analysis, where the greatest share of the intragroup component is due to the urban setting, followed by the rural setting and ultimately the semi-urban. It also appears that the intergroup component represents the most significant share of multidimensional inequality. In the case of expenditure inequality, for the generalized entropy class of indices it is the intragroup component that takes the lead role. Thus, any policy seeking to reduce multidimensional inequality should place its emphasis on the rural environment or on the inequalities between the urban and rural environments, whereas any policy seeking to reduce monetary inequality should rather focus on the urban environment or on the inequalities within the urban and rural environments.

Table 3: Decomposition of inequality depending on residential setting

	Proportion of the population	**Composite indicator**				**Expenditure per adult equivalent**			
		Gini	**Entropy**			**Gini**	**Entropy**		
			***α*=0**	***α*=1**	***α*=2**		***α*=0**	***α*=1**	***α*=2**
Residential setting									
Urban	0.3551 (0.0064)	0.0199 (0.0006) [0.0679] (0.002	0.0075 (0.0003) [0.0440] (0.001	0.0102 (0.0003) [0.0739] (0.002	0.0144 (0.0004) [0.1106] (0.000	0.0671 (0.0024) [0.1728] (0.005	0.0731 (0.0027) [0.2978] (0.008	0.1224 (0.0059) [0.4421] (0.012	0.2765 (0.0218) [0.6311] (0.016

		4)	9)	5)	6)	6)	3)	3)	4)
Semi-urban	0.1018 (0.0037)	0.0018 (0.0001) [0.0063] (0.0005)	0.0038 (0.0002) [0.0222] (0.0015)	0.0043 (0.0002) [0.0310] (0.0018)	0.0050 (0.0003) [0.0385] (0.0004)	0.0033 (0.0003) [0.0086] (0.0007)	0.0177 (0.0011) [0.0721] (0.0721)	0.0189 (0.0014) [0.0684] (0.0055)	0.0249 (0.0027) [0.0569] (0.0029)
Rural	0.5431 (0.0071)	0.0490 (0.0017) [0.1670] (0.0052)	0.0724 (0.0035) [0.4217] (0.0120)	0.0384 (0.0384) [0.2770] (0.0076)	0.0244 (0.0009) [0.1874] (0.0014)	0.0606 (0.0023) [0.1561] (0.0060)	0.0818 (0.0033) [0.3330] (0.0126)	0.0622 (0.0040) [0.2248] (0.0145)	0.0611 (0.0080) [0.1394] (0.0084)
Intragroup		0.0708 [0.2412]	0.0837 [0.4879]	0.0529 [0.3819]	0.0438 [0.3365]	0.1310 [0.3375]	0.1726 [0.7030]	0.2035 [0.7353]	0.3625 [0.8274]
Intergroup		0.2133 [0.7268]	0.0881 (0.0003) [0.5134]	0.0858 (0.0005) [0.6196]	0.0863 (0.0008) [0.6635]	0.1982 [0.5106]	0.0729 (0.0003) [0.2970]	0.0733 (0.0003) [0.2647]	0.0756 (0.0005) [0.1726]
Residual		0.0094 [0.0320]				0.0590 [0.1519]			
Total									
Population (households)	1	0.2934 (0.0027) [1]	0.1716 (0.0044) [1]	0.1385 (0.0025) [1]	0.1301 (0.0025) [1]	0.3881 (0.0041) [1]	0.2455 (0.0053) [1]	0.2768 (0.0078) [1]	0.4381 (0.0235) [1]

We present here the absolute contributions, the standard deviations in round brackets and the relative contributions in square brackets.

Source: Authors' calculations based on data from ECAM III (2007).

Table 4: Decomposition of inequality by sex of the head of household

	Proportion of the population	Composite indicator				Expenditure per adult equivalent			
		Gini	Entropy			Gini	Entropy		
			α=0	α=1	α=2		α=0	α=1	α=2
Sex									
Male	0.7865 (0.0053)	0.1827 (0.0032) [0.6226] (0.0085)	0.1415 (0.0044) [0.8247] (0.0081)	0.1121 (0.0024) [0.8088] (0.0067)	0.1038 (0.0023) [0.7983] (0.0030)	0.2330 (0.0046) [0.6004] (0.0098)	0.1919 (0.0050) [0.7814] (0.0105)	0.2105 (0.0074) [0.7605] (0.0161)	0.3251 (0.0214) [0.7421] (0.0166)
Female	0.2135 (0.0053)	0.0129 (0.0007) [0.0439] (0.0023)	0.0295 (0.0014) [0.1721] (0.0085)	0.0259 (0.0010) [0.1872] (0.0070)	0.0257 (0.0009) [0.1973] (0.0014)	0.0194 (0.0011) [0.0500] (0.0028)	0.0524 (0.0026) [0.2135] (0.0097)	0.0650 (0.0046) [0.2349] (0.0149)	0.1117 (0.0139) [0.2549] (0.0137)
Intragroup		0.1956 [0.6665]	0.1711 [0.9968]	0.1380 [0.9960]	0.1295 [0.9957]	0.2524 [0.6505]	0.2443 [0.9949]	0.2755 [0.9954]	0.4368 [0.9970]
Intergroup		0.0138 [0.0469]	0.0005 (0) [0.003	0.0006 (0) [0.004	0.0006 (0) [0.004	0.0209 [0.0539]	0.0012 (0) [0.005	0.0013 (0) [0.004	0.0013 (0) [0.003

			2]	0]	3]		1]	6]	0]
Residual		0.0841 [0.2866]				0.1147 [0.2957]			
Total									
Population (households)	1	0.2934 (0.0027) [1]	0.1716 (0.0044) [1]	0.1385 (0.0025) [1]	0.1301 (0.0025) [1]	0.3881 (0.0041) [1]	0.2455 (0.0053) [1]	0.2768 (0.0078) [1]	0.4381 (0.0235) [1]
We present here the absolute contributions, the standard deviations in round brackets and the relative contributions in square brackets.									

Source: Authors' calculations based on data from ECAM III (2007)

Decomposition by gender shows that males contribute more to the intragroup component of inequality, whether based on the monetary or the multidimensional approach. It can be observed also that the intragroup component represents the greatest share of inequality. The low level of the intergroup component reveals here the proximity between these two groups. Thus, any policy seeking to reduce inequality here should therefore focus on the gaps between the different groups (men, women).

5.4. Profiles of monetary and multidimensional polarization

Table 5 presents the results obtained for the Foster-Wolfson index (1992) and the DER index. Overall, monetary polarization appears greater than multidimensional polarization. Whereas multidimensional polarization is higher in the rural setting and lower in the urban one, monetary polarization shows opposite results. These results are similar to those observed when inequality is analyzed. Thus, like multidimensional inequality, multidimensional polarization appears to be an essentially rural phenomenon. For its part, monetary polarization, which is generally more accentuated in the urban setting, can produce the opposite result for certain values of α.

If consideration is given to the regions of residence, whether with the monetary approach or the multidimensional approach, the city of Yaoundé appears more polarized than the city of Douala. Comparison with the other regions enables the observation that these two towns have the lowest levels of multidimensional polarization, whereas they have higher levels of expenditure polarization than those observed in certain regions (Centre and

Ouest, for example). The DER index, as in the preceding case, increases along with α in the multidimensional analysis and decreases in the monetary analysis.

Analysis by gender shows a higher level of multidimensional polarization among males. The monetary approach presents more variety in its results: on the one hand the Foster-Wolfson index is higher among men, on the other hand the DER index is higher among women where $\alpha = 0.5$. Where $\alpha = 1$, these two groups present identical levels of polarization. It may also be noted that the DER index decreases when α increases, whether the monetary approach or the multidimensional approach is considered.

Table 5: Indices of polarization depending on residential setting, region of residence and sex of the head of household

	Composite indicator			Expenditure per adult equivalent		
	Foster-Wolfson	DER		Foster-Wolfson	DER	
		α=0.5	*α*=1		*α*=0.5	*α*=1
Residential setting						
Urban	0.0823 (0.0016)	0.1156 (0.0010)	0.1422 0.0007	0.2927 (0.0067)	0.2240 (0.0029)	0.1805 (0.0029)
Semi-urban	0.1229 (0.0050)	0.1409 (0.0025)	0.1468 0.0022	0.2775 (0.0109)	0.2182 (0.0047)	0.1800 (0.0047)
Rural	0.2402 (0.0056)	0.1877 (0.0017)	0.1479 0.0013	0.2628 (0.0061)	0.2123 (0.0029)	0.1831 (0.0033)
Region of residence						
Douala	0.0528 (0.0024)	0.0956 (0.0023)	0.1454 (0.0021)	0.2639 (0.0137)	0.2254 (0.0076)	0.1897 (0.0073)
Yaoundé	0.0656 (0.0030)	0.1027 (0.0026)	0.1512 (0.0040)	0.2729 (0.0135)	0.2230 (0.0076)	0.1866 (0.0073)
Adamaoua	0.3881 (0.0410)	0.2450 (0.0083)	0.1813 (0.0085)	0.2720 (0.0213)	0.2346 (0.0076)	0.2105 (0.0090)
Centre	0.2225 (0.0120)	0.1852 (0.0044)	0.1669 (0.0058)	0.2378 (0.0129)	0.2049 (0.0047)	0.1831 (0.0062)
Est	0.3184 (0.0246)	0.2238 (0.0068)	0.1840 (0.0083)	0.2933 (0.0210)	0.2331 (0.0079)	0.2061 (0.0114)
Extrême-Nord	0.3137 (0.0140)	0.2174 (0.0037)	0.1710 (0.0047)	0.3205 (0.0137)	0.2488 (0.0065)	0.2283 (0.0098)
Littoral	0.1191 (0.0078)	0.1463 (0.0057)	0.1594 (0.0056)	0.2425 (0.0164)	0.2226 (0.0108)	0.1919 (0.0101)

Nord	0.3442 (0.0248)	0.2423 (0.0061)	0.2036 (0.0087)	0.2867 (0.0199)	0.2428 (0.0081)	0.2285 (0.0125)
Nord-Ouest	0.2493 (0.0110)	0.1949 (0.0032)	0.1612 (0.0035)	0.3353 (0.0131)	0.2488 (0.0057)	0.2159 (0.0071)
Ouest	0.2213 (0.0083)	0.1817 (0.0032)	0.1545 (0.0032)	0.2425 (0.0090)	0.2055 (0.0042)	0.1742 (0.0041)
Sud	0.1908 (0.0130)	0.1740 (0.0057)	0.1606 (0.0053)	0.2887 (0.0200)	0.2334 (0.0217)	0.1927 (0.0193)
Sud-Ouest	0.2902 (0.0149)	0.2062 (0.0049)	0.1685 (0.0053)	0.2888 (0.0166)	0.2240 (0.0058)	0.1817 (0.0057)
Sex						
Male	0.3361 (0.0072)	0.2205 (0.0020)	0.1685 (0.0021)	0.3485 (0.0064)	0.2455 (0.0025)	0.2022 (0.0031)
Female	0.2883 (0.0093)	0.2050 (0.0027)	0.1640 (0.0026)	0.3448 (0.0103)	0.2458 (0.0044)	0.2022 (0.0051)
Total						
Population (households)	0.3266 (0.0057)	0.2169 (0.0017)	0.1665 (0.0017)	0.3457 (0.0055)	0.2451 (0.0022)	0.2015 (0.0026)
The values in parentheses represent standard deviations.						

Source: Authors' calculations based on data from ECAM III (2007).

The relation between monetary polarization and multidimensional polarization thus appears to be fairly complex and it is difficult at this level to make a clear statement on the linkage between these two approaches.

5.5. Static decomposition of the polarization

The rural setting, which houses the majority of the population, is also the one that contributes most to the intragroup component of the DER index, whether the monetary approach or the multidimensional approach is considered (see Table 6). Next in line are the urban and semi-urban settings. The D/S ratio (deprivation to surplus) shows that in the rural setting, individuals' deprivation is at least five time higher than their surplus; it thus tends more towards the masses at the bottom of the distribution. This reflects the fact that the rural setting comprises a very significant share of poor households.

Table 6: Decomposition of the DER index by residential setting

	Proportion of the population	Composite indicator		Expenditure per adult equivalent	
		DER and D/S ratio		DER and D/S ratio	
		α=0.5	α=1	α=0.5	α=1
Residential setting					
Urban	0.3551 (0.0064)	0.0137 [0.0631] (0.1241)	0.0098 [0.0588] (0.1286)	0.0333 [0.1359] (0.8444)	0.0240 [0.1190] (1.4906)
Semi-urban	0.1018 (0.0037)	0.0014 [0.0063] (0.3956)	0.0010 [0.0062] (0.3983)	0.0022 [0.0089] (2.0850)	0.0018 [0.0088] (3.1511)
Rural	0.5431 (0.0071)	0.0369 [0.1703] (5.2162)	0.0289 [0.1733] (5.6324)	0.0471 [0.1920] (5.1712)	0.0412 [0.2043] (6.9070)
Intragroup		0.0520 [0.2397] (1.1048)	0.0397 [0.2383] (1.2231)	0.0825 [0.3368] (2.4001)	0.0669 [0.3322] (3.9240)
Intergroup		0.1649 [0.7603]	0.1268 [0.7617]	0.1626 [0.6632]	0.1346 [0.6678]
Total					
Population (households)	1	0.2169 [1]	0.1665 [1]	0.2451 [1]	0.2015 [1]

We present here the absolute contributions, the relative contributions in square brackets and the D/S ratio in parentheses of the DER index. The D/S ratio represents the relationship between the deprivation or deficit (D) and the excess component or surplus (S) of the households, as captured by the DER index.

Source: Authors' calculations based on data from ECAM III (2007).

Table 7: Decomposition of the DER index by sex of the head of household

	Proportion of the population	Composite indicator		Expenditure per adult equivalent	
		DER and D/S ratio		DER and D/S ratio	
		α=0.5	α=1	α=0.5	α=1
Sex					
Male	0.7865 (0.0053)	0.1348 [0.6218] (1.1704)	0.1035 [0.6218] (1.2963)	0.1490 [0.6080] (2.5248)	0.1229 [0.6098] (4.0917)
Female	0.2135 (0.0053)	0.0096 [0.0441] (0.8909)	0.0073 [0.0441] (0.9848)	0.0117 (0.0479] (1.9951)	0.0095 [0.0474] (3.3547)
Intragroup		0.1444 [0.6659] (1.1048)	0.1109 [0.6659] (1.2231)	0.1608 [0.6559] (2.4001)	0.1324 [0.6571] (3.9240)
Intergroup		0.0725 [0.3341]	0.0556 [0.3341]	0.0843 [0.3441]	0.0691 [0.3429]
Total					
Population (households)	1	0.2169 [1]	0.1665 [1]	0.2451 [1]	0.2015 [1]
We present here the absolute contributions, the relative contributions in square brackets and the D/S ratio in parentheses of the DER index. The D/S ratio represents the relationship between the deprivation or deficit (D) and the excess component or surplus (S) of the households, as captured by the DER index.					

Source: Authors' calculations based on data from ECAM III (2007).

The urban and semi-urban settings, for their part, tend more towards the masses at the top of the distribution in the case of multidimensional polarization. Monetary polarization on the other hand shows more variety in results. Where $\alpha = 0.5$, it is observed that the urban setting contains a significant proportion of non-poor individuals, whereas where $\alpha = 1$ this setting tends more towards the groups at the bottom of the distribution. The semi-urban setting seems to be mostly dominated by poor individuals.

This decomposition shows also that the most significant share of the polarization is, as in the case of multidimensional inequality, due to the intergroup component. Thus, any policy seeking to reduce polarization to a significant degree should place more emphasis on the gaps between the different settings.

Decomposition by gender shows that men contribute more to the intragroup component of polarization than women (Table 7). The D/S ratio, which indicates the presence of a significant proportion of poor individuals among men, is higher in the case of monetary analysis than with multidimensional analysis, and increases with α. With regard to female individuals, this ratio indicates that they tend more towards the values at the bottom of the distribution in the case of monetary analysis, and towards the values located at the top of the distribution in the case of multidimensional analysis. Remaining with the gender dimension, it may be observed, in a similar manner to multidimensional inequality, that the contribution of the intragroup is higher than that of the intergroup. Thus, a significant drop in polarization may also be obtained as a result of a reduction in the differences within the different groups, and more particularly between individuals of the male sex.

6. Conclusion and implications for economic policy

In the present study, we are concerned with problems of inequality and polarization, combining the monetary and non-monetary approaches, with the objective of evaluating and decomposing the multidimensional and monetary inequalities and polarization in Cameroon in 2007. To that end, we use a composite index created on the basis of multiple correspondence analysis for the multidimensional analysis, and the expenditure per adult equivalent for the monetary analysis. The inequality and the polarization are then analyzed as a function of the residential setting and region, and also based on the sex of the head of household. The indices selected are the Gini coefficient and the generalized entropy class of indices for the inequality, and the Foster-Wolfson index (1992) and the class of Duclos-Esteban-Ray measures (2004) for the polarization. The indices of inequality (Gini and entropy) and the DER index are also decomposed by residential setting and by sex of the head of household. The data used are those from ECAM III.

At the end of this analysis, it appears, overall, that multidimensional inequality is greater in the rural environment, in the regions of Adamaoua, Nord and Extrême-Nord, and in male-headed households. Monetary inequality, on the other hand, is greater in the urban environment, in the regions of Nord-Ouest, Extrême-Nord and Nord, and in female-headed households (except in the case of GE(2)). This is explained by the fact that, given the size of their populations, the northern part of the country and the rural environments are less provided with physical infrastructure and housing facilities, and facilities for education and health. Enormous efforts still need to be made in these areas.

These regions and environments suffered enormously from the lack of interest of the Government in the social sectors during the crisis period of the 1980s-1990s. The weak development potential of these sectors (physical infrastructure and housing facilities, and

facilities for education and health) also makes them not very attractive to private investors. The high level of multidimensional inequality in male-headed households is also a matter for concern. As for monetary inequality, the simultaneous presence of high-income and low-income individuals explains why it is greater in the regions and environments cited above as well as in female-headed households.

Decomposition of inequality by residential setting shows the preponderance of the intergroup component in the case of multidimensional inequality, whereas in the case of monetary inequality the intragroup component is of more significance. As for the decomposition by sex of the head of household, the intragroup component is the more significant, whether the monetary or multidimensional approach is taken. This leads to the assumption that in Cameroon the distinctions between the residential settings are very significant whereas if the gender aspect is taken into consideration, it is the differences within each of the sub-groups (male-headed households, female-headed households) that are of significance. Here, policies should therefore concentrate on the intergroup component of inequality between the residential settings and on the intragroup component of gender inequality, whether the monetary approach or the multidimensional approach is taken.

Analysis of the multidimensional polarization shows that it is higher in the rural setting, in the regions of Adamaoua, Nord and Est, and in male-headed households. For its part, monetary polarization is higher in the urban environment, in the regions of Nord-Ouest and Extrême-Nord, and in male-headed households in the case of the Foster-Wolfson index, although the DER index is slightly higher for female-headed households. The high level of polarization in the regions, environments or groups that already have high levels of inequality reflects the existence of groupings at different levels of the distribution of wealth and of quite significant shifts between these groups. This applies here to the rural environment, to the regions of Adamaoua and Nord, and to male-headed households in the case of multidimensional polarization, and to the urban environment, Nord-Ouest and Extrême-Nord, and female-headed households in the case of monetary polarization. Here, in order to be effective, policies should therefore also seek to combat polarization and reduce inequality.

Decomposition of the DER index by residential setting shows the greater significance of the D/S ratio in the rural environment and the high level of the intergroup component of polarization, whether the monetary approach or the multidimensional approach is taken. Decomposition by sex of the head of household shows a higher D/S ratio for male-headed households and a predominating intragroup component. These results highlight the

significant presence of poor households both on the monetary and the multidimensional plane in the rural environment and among male-headed households where already a high level of inequality and of multidimensional polarization is found.

These observations testify to the degree of deprivation which rural households are suffering because of the lack of infrastructures for housing, education and health, and of the limited possibilities to gather income. The same applies to male-headed households, which are more subject to poverty than female-headed ones. The differences between the characteristics of the rural environments as compared with the semi-urban and urban ones also explain, as in the case of inequality, the high level of the inter-residential-setting component of polarization relative to the intra-residential-setting component.

These results show clearly the importance of combining these two approaches in the fight against poverty and social injustice. Because while the multidimensional approach emphasizes the existence of large disparities in the rural environment, in the northern part of the country, in the Est region and among persons of the male sex, the monetary approach for its part stresses, rather, the seriousness of the problems of distribution in the urban environment and in the regions of Nord-Ouest and Extrême-Nord. To ignore one or other of these approaches would be tantamount to neglecting an important segment of households' welfare.

In order to reduce these social disparities and poverty, the Government should promote a form of development that is regionally more balanced, facilitate access to education, health and decent housing, and increase employment opportunities in both the urban and the rural environments. It is also important for the Government, with a view to effectiveness, to take account of the specific characteristics of the regions and/or environments in the actions that it takes. For example, to consider solely the case of education, while in most of the regions the populations are aware of its importance, in others, such as those in the northern part of the country, they have still not attached great importance to education. For that part of the country, there is a need, for example, over and above investments in education infrastructures, for campaigns to raise households' awareness of the importance of education and the impact that it can have on their day-to-day activities. Other examples can be given relating to other regions. It is known in particular that in the Ouest region the populations' natural tendency to come together in associations can make it easier to set up Common Initiative Groups (CIGs) in fields such as that of health.

In order to take account of all the specific local characteristics, the Government could draw support from local elected officials such as parliamentary representatives or mayors. The

decentralized territorial units (mayoral administrations) thus have an important role to play here, because they are closer to the people and thereby better informed about their difficulties. In this sense, if it is handled well, the process of decentralization ongoing in the country, one of whose objectives is indeed to build the capacity of these units, could have a positive effect on household welfare. Infrastructures and facilities for housing can be improved through programmes to build apartments or houses priced to be affordable by middle-income households, which is at present far from being a reality. Efforts must therefore be made to facilitate access to housing.

Improvement of the incomes of the least well-off households is equally necessary, because it can have a ripple effect on the other dimensions of household welfare (infrastructures and facilities for housing, education, health). And when the monetary and non-monetary dimensions are taken into account simultaneously, effectiveness in terms of poverty reduction and improvement in household welfare is bound to increase.

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Is more chocolate bad for poverty? An evaluation of cocoa pricing options for Ghana's industrialization and poverty reduction

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Abstract

This study establishes the cocoa pricing subsidization options that will stabilize processors' throughput while meeting the multiple, but possibly conflicting, public policy objectives of maximizing government revenue and reducing poverty among cocoa bean producers. To evaluate these options, we construct and numerically simulate a structural dynamic stochastic model of a representative cocoa processor who maximizes the present value of current and expected future profits, given prevailing market conditions and cocoa pricing policies. Our results indicate that, given current processing capacity, the Ghana Cocoa Board would have to offer a 92% discount to processors on main-crop beans in order to achieve the industrial goal of locally processing 40% of annual production. This would cause light-crop beans used in processing to be completely displaced by main-crop beans carried over as inventory. It would also increase mean processor revenues by 167%, but cause the Ghana Cocoa Board to operate at a significant deficit, implying that the stated goal could only be achieved through massive government subsidies.

1. Background

Cocoa production in Ghana occurs in the forested areas of the country, namely the Ashanti, Brong-Ahafo, Central, Eastern, Western, and Volta regions, which receive between 1,000 and 1,500 millimeters of rainfall per year. The marketing year begins in October, when harvest of the "main crop" begins, followed by the harvest of a smaller "light crop" in July. Light-crop beans are smaller than the main-crop variety, but are identical in quality and are grown on the same trees. The main crop typically accounts for 90% of total annual cocoa bean production in Ghana, and the light crop accounts for the remaining 10%.[1]

Ghana was the world's largest cocoa producer in the early 1960s. However, by the early 1980s, Ghana's share of world production had dwindled almost to the point of insignificance, in large part due to the catastrophic bushfires of 1983 that destroyed most of Ghana's cocoa-producing forests. Cocoa bean production in Ghana began to recover in the early 1990s, exhibiting an average annual rate of growth of 6% between 1990 and 1999, and 8% between 2000 and 2012. Many actors involved in the cocoa sector have attributed this production boom to an increase in fertilizer use and government-sponsored mass spraying beginning in 2001. Today, Ghana produces slightly less than 733,000 tonnes of cocoa beans per year on average, making it the world's second largest cocoa bean producer after neighboring Côte d'Ivoire.

The cocoa bean sector in Ghana is heavily regulated. The Ghana Cocoa Board (Cocobod) serves as the exclusive marketing intermediary between primary producers, processors and exporters of cocoa beans in Ghana. Cocobod buys cocoa beans from producers through Licensed Buying Companies (LBCs) and sells them to processors, in both cases at prescribed discounts from the prevailing world cocoa bean price, and liquidates any surplus on the international cocoa bean market at the prevailing world price through its wholly owned subsidiary, the Cocoa Marketing Company (CMC). Cocobod provides input subsidies and

[1] It is important to note this distinction, as it forms the basis of Ghana's industrial policy on cocoa.

guaranteed prices to farmers, and as a result, Ghanaian cocoa farmers enjoy far greater price stability than in free market–oriented regimes such as Côte d'Ivoire.

Value addition in the cocoa marketing chain is regulated by the Ministry of Trade and Industry (MoTI), which regulates all of Ghana's manufacturing activities. It is estimated that less than 24% of the cocoa beans grown in Ghana are locally processed, allowing Ghana to capture only 5% of the $28 billion global intermediate cocoa processing industry, even though it accounts for 20% of the $9 billion global cocoa bean market. The large gap between Ghana's share of global cocoa bean production and its share of processed intermediate cocoa products are the result of issues associated with the infancy of the cocoa processing sector that Ghana's cocoa industrial policy is seeking to address. While Ghana had been processing cocoa beans for many years, markets have failed to correct for the gains that accrued over time from declining unit costs and learning-by-doing. A number of factors such as poor local market demand for cocoa-based products, high overall manufacturing cost, and increasing import tariffs for intermediate cocoa products exported to Europe are behind this.

Current government cocoa value chain policies are tilted toward maximizing revenue from cocoa bean exports, which are generated by Cocobod's retention of 9% of the cocoa freight on board (FOB) price. Cocobod's efforts to ensure quality, traceability, and social responsibility have awarded Ghanaian cocoa a 4-6% price premium on the international market. However, the only policy in place for attracting and encouraging local cocoa processing is a 20% discount given to processors on the purchase of light-crop cocoa beans, which has had little impact on quantities processed because of the negligible share of total production light-crop cocoa beans represent.

Whether to export cocoa beans or to process them locally is an industrial policy question that has faced several successive Ghanaian governments. Predictably, in recent years, public policy has shifted toward raising earnings through increased local processing. MoTI has attempted to promote local processing by subsidizing the price paid by local processors for locally grown beans, a strategy in line with Brander and Spencer (1985) for encouraging domestic reallocation of increasing return industries for global market share rivalry purposes. However,

this subsidy has come at the cost of reduced revenue for farmers and other upstream value chain players, including Cocobod, undermining Cocobod's mission to make cocoa farming an adequate source of income for farmers. The inability to strike the right balance between industrialization and poverty reduction has been and still is at the heart of the failed efforts to address the market incompleteness.

In an attempt to promote economic transformation through agro-processing, the government of Ghana is keen to address the large gap between Ghana's share of global cocoa beans production and its share of processed intermediate cocoa products. However, the current Cocobod cocoa pricing model appears inadequate for encouraging processors to increase their current capacity, despite the various tax breaks processors enjoy by being designated free-zone companies[2]. The nature of Ghana's cocoa value chain is such that a revision of the current cocoa pricing model will have repercussions not only for cocoa bean processors but also for Cocobod and cocoa farmers.

The purpose of this study is to understand how Cocobod's pricing policies affect local processors' cocoa acquisition, processing, and inventory decisions. The ultimate goal is to ascertain which policies best meet the multiple, but possibly conflicting, public policy objectives of maximizing Cocobod revenue, maximizing and stabilizing processor profits and throughput, and reducing poverty rates, especially among cocoa bean producers.

To conduct our analysis, we proceed in two steps. First, we construct a structural dynamic stochastic model of a representative cocoa processor who maximizes the present value of current and expected future profits, given prevailing market conditions and Cocobod pricing policies. The model is calibrated to reflect historical processor processing and inventory decisions and simulated to assess the expected market impacts of increasing main-crop discounts offered to processors. Second, we examine the impact of the proposed cocoa pricing options on poverty among cocoa producers. This is done by applying Deaton's 1989 "net buyer, net seller" approach to the 2014 Ghana Living Standards Survey 6 (GLSS6) for cocoa farmers only.

[2] Details regarding these tax breaks are provided in the online appendices.

The literature is filled with analyses of cocoa farmers' production and marketing activities, and the role of regulating institutions such as Cocobod in influencing the quality and/or quantity of farmers' outputs (Quarmine et al, 2012; Kolavalli et al, 2012; Marhizal et al, 2014). However, analyses of the consequences of cocoa value chain actors' reactions to public policies, to our knowledge, have never been performed. Our paper's contribution lies in its novel analysis of the impact of public policies on the entire cocoa value chain, distinguishing it from other papers, which focus mainly on the impact of policies on farmers.

2. The Model

2.1 Representative Processor

The Ghanaian cocoa bean marketing year is punctuated by a "main crop", whose harvest begins in October and typically accounts for 90% of annual production, and a "light crop", whose harvest begins in July and typically accounts for 10% of annual production. Cocoa beans are processed continuously throughout both harvest seasons, with significant quantities of main-crop beans carried over for processing during the light-crop season, despite the fact that processors typically pay lower prices for light-crop beans. This is due to the relatively small size of the light-crop harvest, which yields insufficient quantities to maintain optimal processing throughput. Between 2009 and 2014, of the 733,000 tonnes produced annually in a typical main-crop, 18.3% were processed locally during the main-crop season, 7.5% were carried over for local processing during the light-crop season, and the remainder were sold on the international market. Of the 62,000 tonnes produced annually in a typical light-crop, 88% were processed locally. Processors hold negligible inventories at the end of the light-crop season, partly because of the limited shelf-life of cocoa beans, but primarily because the subsequent marketing year's main-crop harvest provides supplies that far exceed the quantities needed in processing[3].

[3] Cocoa beans are highly susceptible to infestation that reduce their fat content. For this reason, processors have preference for storing processed products, rather than beans, over long periods because processed products have longer shelf life (at least 2 years) and offer the processor greater marketing flexibility.

Consider, now, a representative cocoa processor who maximizes the expected present value of profits over the marketing year and who, in the presence of uncertain prices and quantities harvested, must decide what quantities of cocoa beans to acquire, process, and store in each of the main-crop season, denoted by $i = 1$, and the light-crop season, denoted by $i = 2$. We analyze the processor's optimal decisions beginning with the light-crop season, and work recursively backward.

During the light-crop season, the processor observes the quantity of main-crop cocoa beans it holds in inventory s, the quantity of cocoa beans offered for sale by Cocobod $\tilde{y}_2$, the prevailing international price of cocoa beans $\tilde{p}_2$, and the gross margin for processed cocoa beans offered on the international market $\tilde{m}_2$. The processor then chooses the quantity of cocoa beans $a_2 \geq 0$ to acquire from Cocobod and the quantity of cocoa beans $q_2 \geq 0$ to process, so as to maximize its profits

$$\pi_2 = \tilde{m}_2 \tilde{p}_2 q_2 - (1 - \alpha_2)\tilde{p}_2 a_2 - g_2\left(\frac{a_2}{\tilde{y}_2}\right) a_2 - c_2(q_2), \tag{1}$$

subject to the additional constraints

$$a_2 \leq \tilde{y}_2, \tag{2}$$

$$s + a_2 \geq q_2. \tag{3}$$

Here, α_2 is the discount offered by Cocobod to the processor on light-crop cocoa beans, $c_2(q_2)$ is the processor's total cost of processing, and $g_2\left(\frac{a_2}{\tilde{y}_2}\right)$ is an additional unit cost of acquisition that arises as quantities acquired begin to approach quantities available. Constraint (2) requires that the quantity of light-crop cocoa beans acquired by the processor not exceed the quantity offered for sale by Cocobod and constraint (3) requires that the quantity of cocoa beans processed during the light-crop season not exceed the quantity of light-crop cocoa beans acquired by the processor plus the quantity of main-crop cocoa beans it holds in inventory at the beginning of the season.

Solution of the processor's profit maximization problem allows us to write its light-crop season profits

$$\pi_2 = \pi_2(s; \tilde{m}_2, \tilde{p}_2, \tilde{y}_2) \tag{4}$$

as a function of initial inventory s, the quantity of cocoa beans available $\tilde{y}_2$, the prevailing price of cocoa beans $\tilde{p}_2$, and the gross margin for processed cocoa beans $\tilde{m}_2$. This, in turns, allows us to compute the profits the processor expects to earn during the light-crop season, conditional on the inventories it holds at the end of the main-crop season, before the light-crop season price, processing premium, and available quantities are known:

$$f(s) = E_1\pi_2(s; \tilde{m}_2, \tilde{p}_2, \tilde{y}_2). \tag{5}$$

During the main-crop season, the processor observes the quantity of cocoa beans offered for sale by Cocobod $\tilde{y}_1$, the prevailing international price of cocoa beans $\tilde{p}_1$, and the gross margin for processed cocoa beans offered on the international market $\tilde{m}_1$. The processor then chooses the quantity of cocoa beans $a_1 \geq 0$ to acquire from Cocobod, the quantity of cocoa beans $q_1 \geq 0$ to process, and the quantity of cocoa beans $s \geq 0$ to commit to inventory, so as to maximize the sum of current main-crop season profits and discounted expected light-crop season profits

$$\pi_1 = \tilde{m}_1\tilde{p}_1 q_1 - (1-\alpha_1)\tilde{p}_1 a_1 - c_1(q_1) + \delta f(s), \tag{6}$$

subject to the additional constraints

$$a_1 \leq \tilde{y}_1, \tag{7}$$

$$s + q_1 \leq a_1. \tag{8}$$

Here, α_1 is the discount offered by Cocobod to the processor on main-crop beans, $c_1(q_1)$ is the processor's total cost of processing, and δ is a discount factor reflecting the time value of money. Constraint (7) requires that the quantity of main-crop cocoa beans acquired by the processor not exceed the quantity offered for sale by Cocobod and constraint (8) requires that the quantity of cocoa beans processed during the main-crop season plus inventories held at

the end of the main-crop season not exceed the quantity of main-crop cocoa beans acquired by the processor.

Quantities of cocoa beans acquired by Cocobod but not purchased by the processors are sold on the international market at the prevailing international price. As such, Cocobod does not hold inventories and its net income in season *i* is given by

$$\pi_i^C = \widetilde{p}_i(\widetilde{y}_i - a_i) + (1 - \alpha_i)\widetilde{p}_i a_i - (1 - \beta_i)\widetilde{p}_i \widetilde{y}_i. \tag{9}$$

Here, β_i is the discount levied on the international cocoa bean price by Cocobod in determining the price it offers to producers.

1.1. Functional Form Specification

We assume the total cost of processing in each season i is a convex quadratic function of the quantity processed:

$$c_i(q_i) = \overline{c_i} + \eta_i q_i + \tfrac{1}{2}\gamma_i q_i^2, \tag{10}$$

where $\overline{c_i} > 0, \eta_i > 0$, and $\gamma_i > 0$.

The assumption of a convex total cost function is not made arbitrarily, but in light of both the capital-intensive nature of cocoa processing in Ghana and the short-run nature of our analysis, which keeps processing capacity fixed. Cocoa processing may well be characterized by an increasing-return-to-scale technology, with plants of greater capacity able to achieve lower average cost of production at their technical optimal throughput. However, in the short-run, the scale of the plant is fixed and designed to operate most efficiently at a technically prescribed optimal throughput. In the short run, the plant can operate at higher throughputs, but at diminished efficiency and thus higher average cost of production, justifying a convex short-run cost function. We ignore fixed cost in our analysis, as they do not affect the optimal quantities acquired, processed, or stored.

We assume the unit cost of acquisition in the light-crop season begins to rise as the quantity acquired approaches the quantities made available from Cocobod. In particular, we assume

$$g_2(r) = \frac{\theta_1 e^{\theta_2 r}}{e^{\theta_2} - e^{\theta_2 r}} \tag{11}$$

where $\theta_1 > 0$, $\theta_2 > 0$, and r is the ratio of quantities acquired to quantities available during the light-crop season. This assumption is made to capture the fact that although virtually all light-crop beans are acquired for processing in a typical year, a relatively small portion of the light-crop is not acquired. The assumption is intuitive, given the difficulty of exhaustively locating and acquiring all available quantities, perhaps due to having to travel further from the processing plant to acquire product from more secluded growers. Additional acquisition costs are assumed to be negligible during the main crop season, as quantities available generally far exceed quantities acquired.

2.2 Parameterization

The model was parameterized using price and quantity data for both the main- and light-crop seasons drawn from various sources, including Cocobod, the International Cocoa Organization (ICCO), and the African Center for Economic Transformation (ACET). The model parameters and their base values are presented in table 1.

Table 1: Model Parameters

Parameter	Season 1	Season 2	Units
Mean production	731.0	62.4	thousand tonnes
Standard deviation of production	122.4	15.0	thousand tonnes
Mean international cocoa bean price	2.75	2.86	thousand USD per tonne
Standard deviation of international cocoa bean price	0.42	0.35	thousand USD per tonne
Gross processing margin (m_i)	1.91	1.91	unitless
Processor marginal cost function constant (η_i)	0.0099	0.0251	thousand USD per tonne
Processor marginal cost function slope (γ_i)	7.0×10^{-6}	7.4×10^{-6}	thousand USD per tonne-squared
Acquisition cost function constant (θ_1)	N.A.	7.89	thousand USD per tonne
Acquisition cost function rate (θ_2)	N.A.	20.0	unitless

Cocobod processor discount (α_i)	0.0	0.2	unitless
Cocobod producer discount (β_i)	0.3	0.3	unitless
Inter-season discount factor (δ)	0.97	N.A.	unitless

Source: Cocobod, ICCO, ACET

Cocoa bean production and the international cocoa bean price are assumed to be log-normally distributed with parameters calibrated to match the means and standard deviations of the values observed from 2009 to 2014, which are given in table 1. The cocoa processing margin is fixed at its mean during the same period.

The discount offered by Cocobod to processors for light- and main-crop beans were set to 0.0 and 0.2, respectively, the values prevailing between 2009 and 2014. The discount levied by Cocobod on producers on light- and main-crop beans were set to 0.3 and 0.3, respectively, the values prevailing between 2009 and 2014.

The discount factor between the main- and light-crop seasons was set to 0.97, consistent with an annual discount rate on funds of 5% over a 33 week period, the length of time between the midpoints of the main- and light-crop seasons. The parameters of the processor's marginal cost functions and light-crop acquisition cost function were calibrated so as to replicate the empirical means and standard deviations of quantities processed, acquired, and stored by processors between 2009 and 2014.

A sensitivity analysis was performed with respect to the model parameters. Specifically, the gross processing margin, marginal processor cost function parameters, and acquisition cost function parameters were individually varied 10% below and above their base case values, and the inter-season discount factor was varied 0.02 below and above its base case value, to ascertain the impact on expected quantities processed during the main- and light-crop seasons and expected annual Cocobod and processors net revenues. Quantities processed varied by as much as 14% and processor net revenue varied by as much as 29% with respect to the changes in the gross processing margin. Quantities processed varied by as much as

11% and processor net revenue varied by as much as 11% with respect to the changes in the slope of the processor marginal cost function. Values of the endogenous variables varied by less than 3% with respect to changes in the remaining parameters. Complete results of the sensitivity analysis are documented in the supplementary online materials appendix.

2.3 Solution and Simulation Methods

The optimal quantities acquired, processed, and stored by processors, which are characterized by equations (1)-(3) for the light-crop season and equations (6)-(8) for the main-crop season, were computed by solving the first-order conditions using a safeguarded Newton method. Standard Gaussian quadrature techniques were used to replace the continuous distributions of the driving exogenous random variables, production and international cocoa bean prices, with highly accurate 31 point discrete approximations. The function f that expresses the expected light-crop season profits conditional on main-crop carryout was approximated using cubic spline interpolation of values computed at 2000 equally-spaced nodes. Given the relatively small number of discrete values used for the driving exogenous random variables, the distribution of the model's endogenous variables under alternative parametric specifications were explicitly computed without having to resort to Monte Carlo methods. All computations were performed using standard routines available as part of the CompEcon Toolbox, which is fully documented in Miranda and Fackler, 2002[4].

3. Policy Analysis

3.1 Policy Simulations

Figures 1 through 4 illustrate the impacts of increases in the main-crop discount offered by Coccobod to processors, the policy being considered for increasing the proportion of locally-grown beans that are processed locally. Figure 1 shows that the quantities of beans processed during both the main- and light-crop seasons rise as the main-crop discount increases, and at a faster rate for the former. However, as seen in Figure 2, although quantities processed in the light season rise with the main-crop discount, the quantities of light-crop

[4] See Bellman (1957) for an earlier treatment of dynamic programming

beans acquired by processors decline, as they are displaced by increasingly cheaper main-crop beans carried over as inventory. This is more clearly illustrated in Figure 3, which shows significant increases in inter-season carryover as the main-crop discount rises. Figure 4 shows that processor net revenue rises and Cocobod net revenue falls, as the main-crop discount rises.

Figure 1 further indicates (dashed lines) that achieving the goal of locally processing 40% of the mean 733 million tonnes of cocoa beans produced annually, as set by MoTI, will require a main-crop discount of 92%. At this discount, as seen in Figure 1 (dashed lines), mean quantities processed in the main-crop season rise 68%, from 135 thousand tonnes to 226 thousand tonnes, and mean quantities processed in the light-crop season rise 68%, from 55 thousand tonnes to 93 thousand tonnes. The increase in quantities processed is accomplished, as seen in Figure 2 (dashed lines), through a 99% increase in mean quantities acquired during the main-crop season, from 160 thousand tonnes to 318 thousand tonnes, and a 100% decrease in mean quantities acquired during the light-crop season from 29 thousand tonnes. The impact of a 92% main-crop discount on processor and Cocobod mean annual revenues is illustrated in Figure 4 (dashed lines). At this discount, mean processor revenue rises 167%, from 377 million dollars to 1,008 million dollars. Mean Cocobod revenue, however, falls 126%, from 632 million dollars to a loss of 164 million dollars.

Figure 1. Quantity Processed vs. Processor Main-Crop Discount

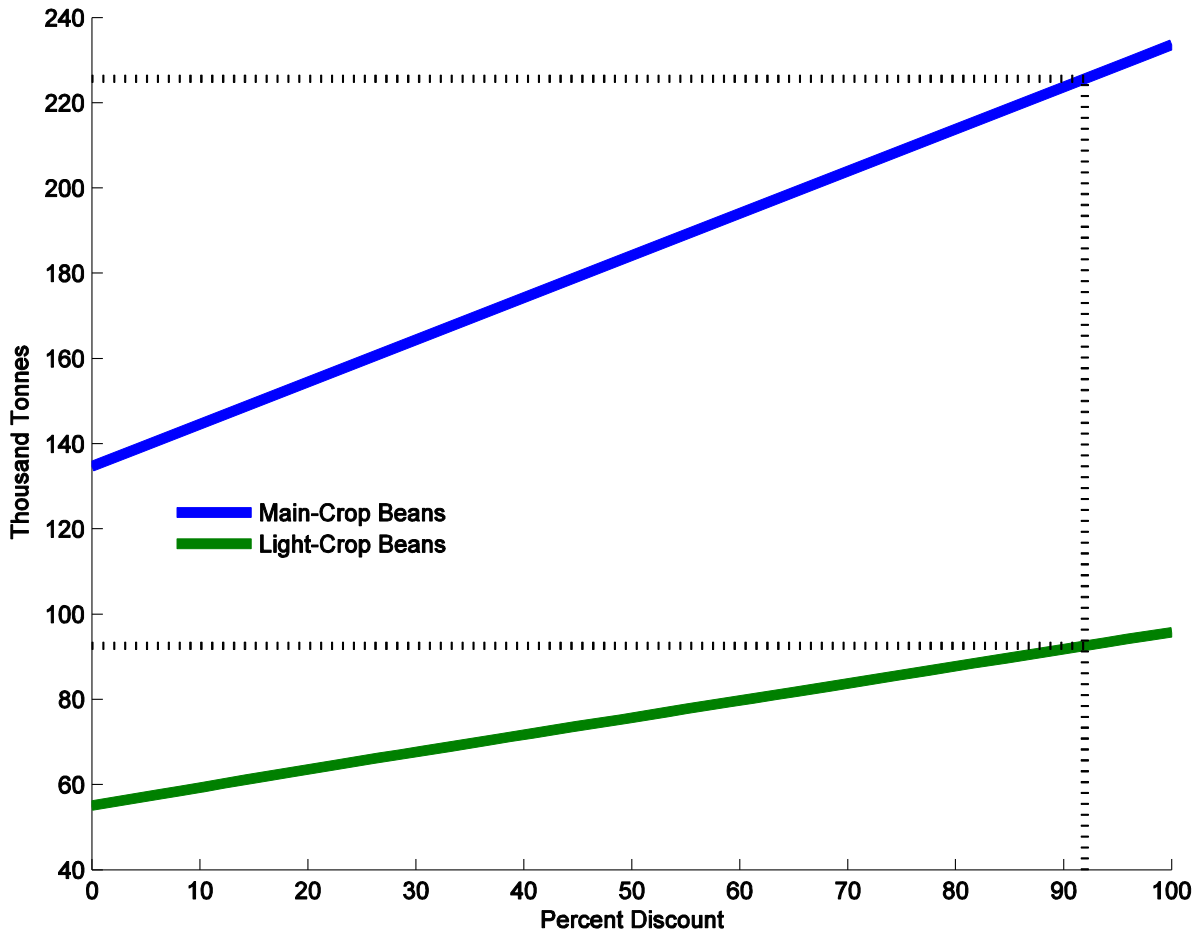


Figure 2. Quantity Acquired by Processors vs. Processor Main-Crop Discount

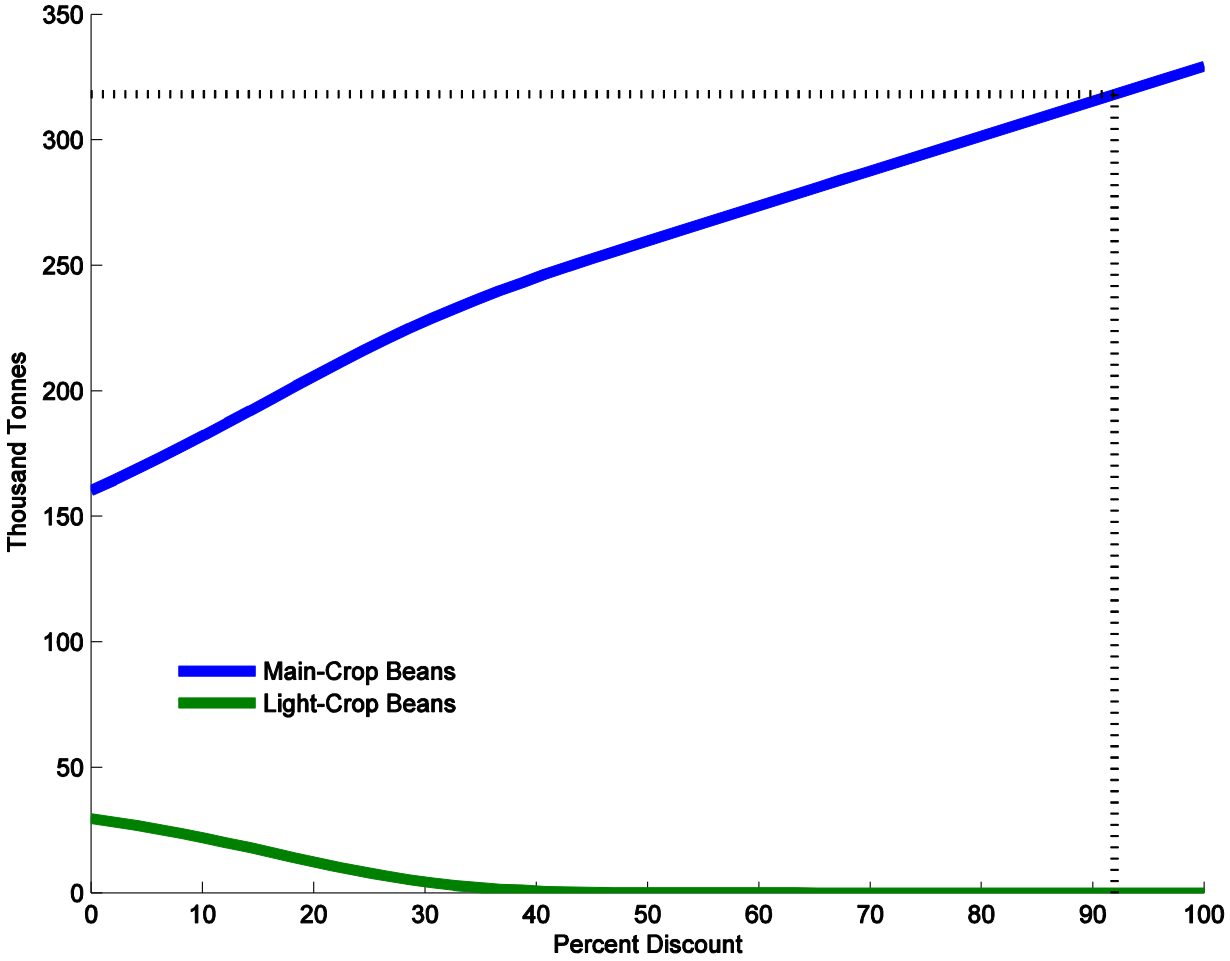


Figure 3. Processor Inter-Season Carryover of Main-Crop Beans vs. Processor Main-Crop Discount

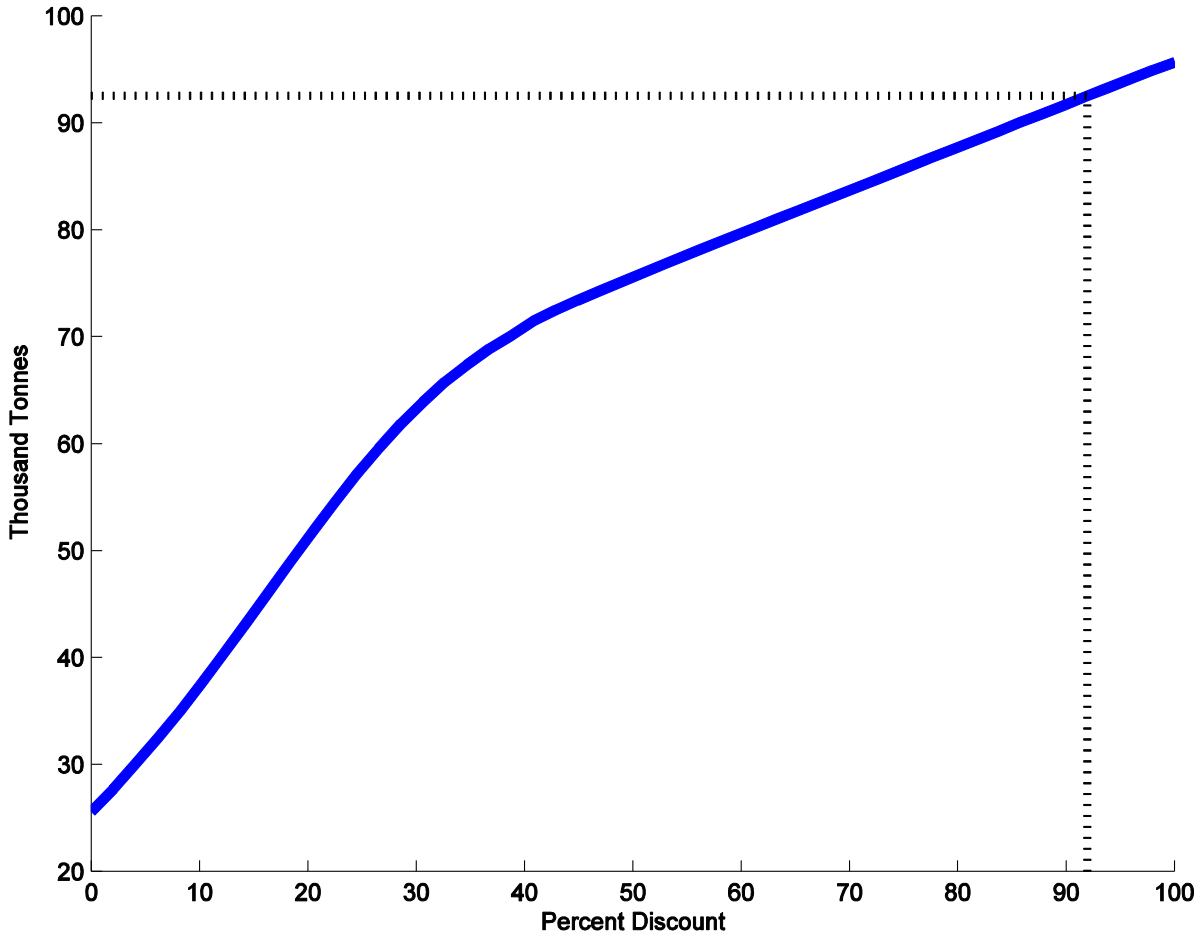
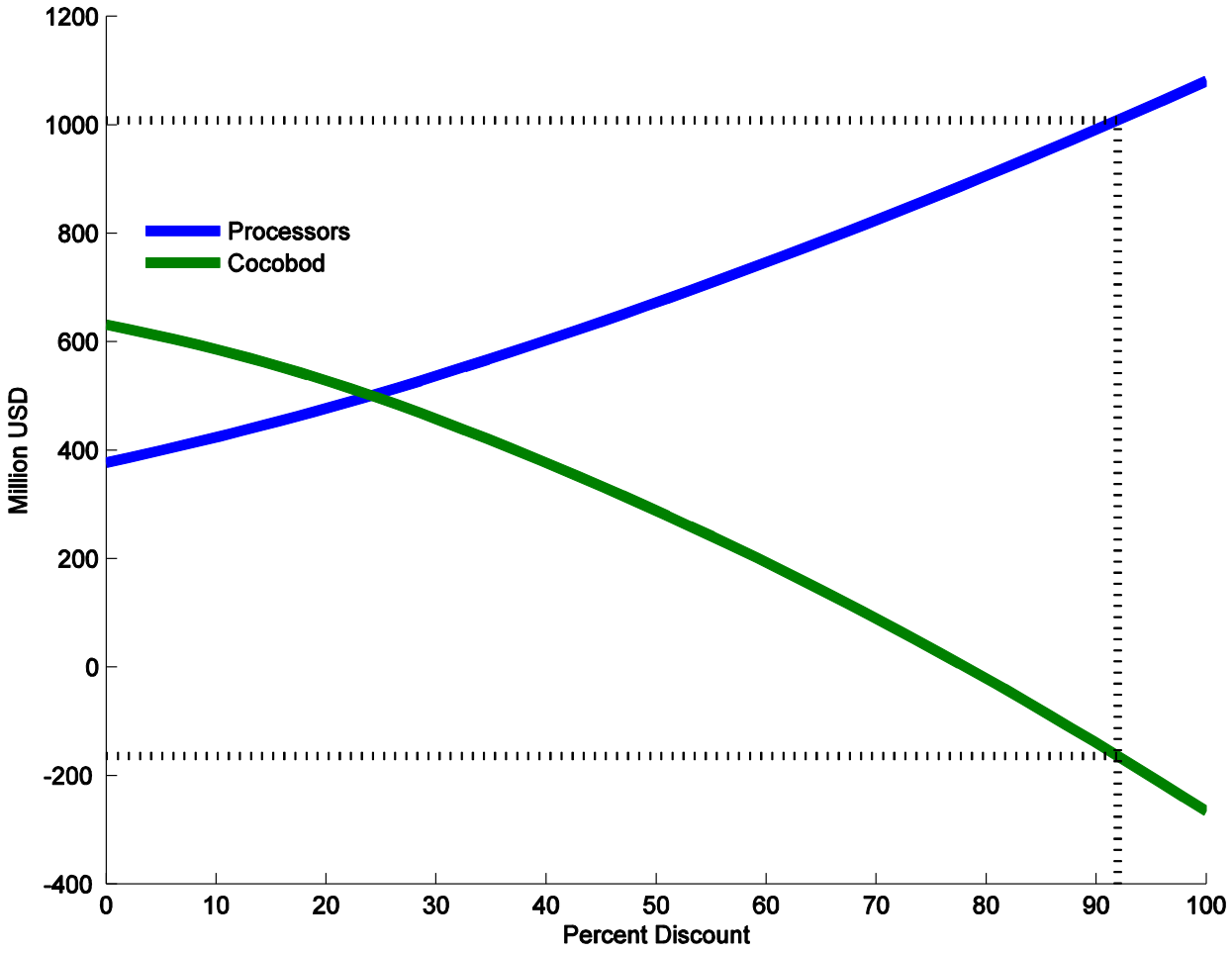


Figure 4. Annual Net Revenue vs. Processor Main-Crop Discount



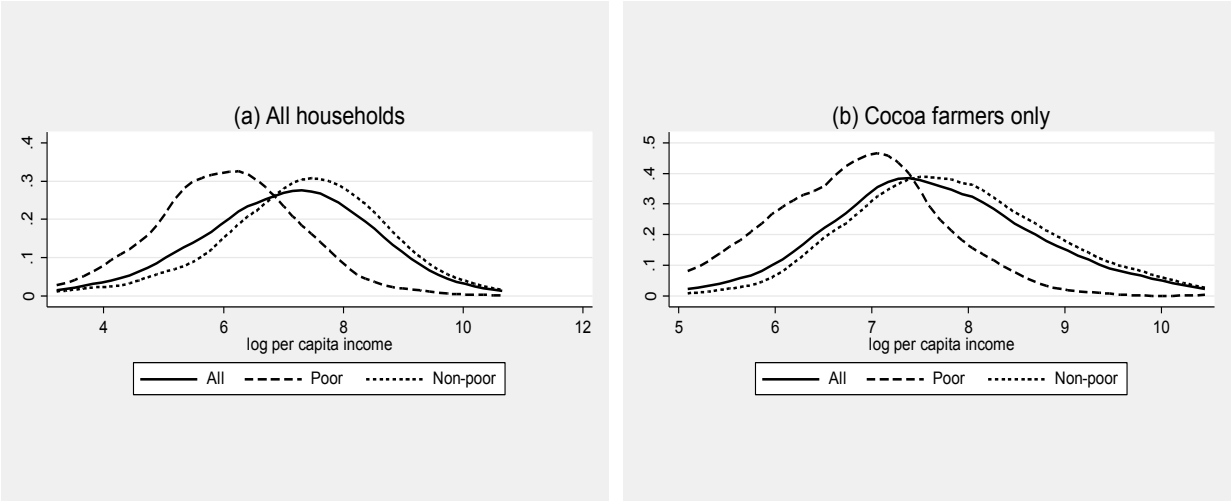
3.2 Implications for Cocoa Farmers' Welfare

The proposed industrial policy will have a first-order effect on both the price farmers receive and the wages generated from the newly created jobs in the cocoa processing sector. Söderbom and Teal (2004) identified the creation of more and higher-wage jobs as the sole pathway through which industrial policy will impact poverty. Job creation is directly linked to the firms' demand for labor, which in turn is determined by the technology with which firms operate. However, capital-intensive firms such as cocoa processors are not expected to generate many new jobs. The only way that Ghanaian cocoa policy will affect poverty is through the farm-gate price, which is determined by Cocobod. Cocobod may maintain the share of the international market price that is guaranteed to farmers in a given industrial

policy regime, but the reduced profit to Cocobod identified earlier will exert indirect negative impacts on producers. In fact, farmers may experience a reduction in annual bonuses, social services such as mass spraying, social security contributions, housing, and other technical supports. If Cocobod gives discounts to processors, it is fair to assume that farmers will receive lower prices if the auxiliary services provided by Cocobod are maintained. Depending on the share of income cocoa bean sales represent for individual farmers, the anticipated price changes will affect the poverty status of cocoa bean producers.

To understand how Cocobod's pricing policies impact poverty, consider first the income distribution in Ghana. The household data in the analysis comes from the GLSS 6. Figure 5 shows the estimated density function of the logarithm of household per capita income for all households and for cocoa producers between poor and non-poor. As expected, the density for non-poor lies to the right of the density for poor, thus indicating that non-poor enjoy, on average, a higher level of income per capita than poor households and this pattern remained identical when estimating the density function for only cocoa producers.

Figure 5: Distribution of Log Per-Capita Household Income



Source: Ghana Living Standard Survey 6 (2014)

The conventional approach proposed by Deaton (1989) to evaluate the impact of price changes on household welfare can overestimate the impacts, however, as it fails to incorporate second order effects (Minot and Dewina, 2015). If consumption responses to a

price change are sufficiently strong (because households can substitute easily with other products), and/or if supply responses are large enough, then a net consumer can in principle become a net producer and benefit from an increase in prices and vice versa. The standard argument is that second-order adjustments of the type described here are often small and thus unlikely to change the implications of the first-order calculations especially for our case of cash crop with no direct substitute (Porto, *forthcoming*).

Let us consider the patterns in sources of income across cocoa producers in Table 2. In general, agriculture constitutes about 30% of cocoa farmers' income. However, cocoa constitutes 43.5% and 40.5% of farmers' agricultural income for poor and non-poor, respectively.

Table 2: Percent Cocoa Farmer Income Shares

	Poor	Non-poor	All
Sources of income	**100.0**	**100.0**	**100.0**
Agriculture	32.3	30.1	30.1
Wage	34.0	31.1	31.5
Enterprises	29.7	32.7	32.2
Remittances	0.7	1.4	1.3
Other	3.3	4.7	4.9
Total cereal income (as share of agricultural income)	**27.6**	**10.7**	**13.9**
Sorghum (as share of cereal income)	0.0	0.0	0.0
Maize (as share of cereal income)	90.6	93.1	92.7
Millet (as share of cereal income)	0.0	0.2	0.1
Rice (as share of cereal income)	4.5	2.4	2.8
Cocoa (as share of agricultural income)	43.5	40.5	41.1

Source: Ghana Living Standards Survey 6 (GLSS6) (2014)

To better contextualize the results to ongoing policy debates, we determined the minimum subsidy necessary to allow Ghana reach MoTI's goal of locally processing 40% of cocoa beans produced and its value chain impacts. One way of reaching this goal would be to issue a 92% discount to processors on main-crop beans, as simulated and discussed in the previous section. This will result in a reduction of Cocobod's revenue by 126%, an increase in processors' revenue by 167%, and no impact on farmers, as we have assumed in our model that Cocobod bears the full cost of the discount. However, if Cocobod were to pass on the cost of the full discount rate to cocoa farmers, cocoa producers' agricultural income and total income would be reduced by a maximum of 37.8% and 11.4% as illustrated in table 3, respectively. Although poor farmers will be most hurt, the difference with non-poor ones is not significant.

Table 3: Percent Change in Cocoa Farmers' Income from 4. 92% Discount on Main-Crop Beans

	Poor	Non-poor	All
Change in agricultural income	40.0	37.3	37.8
Change in total income	12.9	11.2	11.4

4. Conclusion

The purpose of this study was to understand which cocoa pricing option best meets the multiple, but possibly conflicting, public policy objectives of maximizing the government's tax revenue, maximizing and stabilizing processor profits and throughput, and reducing poverty rates, especially among cocoa bean producers. To conduct our analysis, we proceeded in two steps. First, we evaluated how the industrial policy regime would have to be changed to attain the objective of increasing Ghana's cocoa processing to 40% of its annual production. We found that, given current processing capacity, Cocobod would have to offer a 92% discount to processors on main-crop beans in order to achieve this goal. This would increase mean processor revenues by 167%, but cause the Ghana Cocoa Board to run

at a deficit, implying that the stated goal will only be achieved through massive government subsidies to the detriment of farmers.

Although a discount on main-crop beans may be used to generate sufficient incentives for processors to increase their capacity, the reality is that it reduces the sum of profits across both processors and Cocobod by about 16.4%. In addition, cocoa processors already benefit from tax breaks, given that they are mostly designated free-zone companies, as discussed in the supplemental online materials. This prevents the government from compensating producers with any additional income tax revenue collected from processors, since designated free-zone companies are not required to pay income taxes for 10 years.

The capital-intensive nature of the cocoa processing industry does not guarantee substantial job creation. The number of workers per factory has decreased, from 442 in the early 2000s to 117 today, due to the capital-intensive nature of cocoa processing activities. Finally, other sectors may benefit from spillover effects, such as technology transfer, associated with the expansion of the cocoa processing sector. While this impact is hard to measure, we believe that the enclave nature of designated free-zone companies may reduce their spillover effects on the rest of the economy outside the free-zone enclave.

If Ghana wants to increase the quantity of cocoa it processes locally, it must either revise cocoa processing firms' free-zone incentives before adjusting their cocoa pricing options or seek to attract more processing firms to enter the market. However, Ghana should not expect to gain much in terms of employment or tax revenue as expected for most processing activities as long as it keeps attracting new cocoa processing firms via the free-zone benefit.

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Impact of School Feeding Programmes on Educational Outcomes: Evidence from Dry Cereals in Schools in Burkina Faso

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Abstract

Food for Education (FFE) programmes have been implemented in developing countries since the 1960s. This paper examines the impact of the Catholic Relief Services (CRS) school feeding programme on pupils' attendance and girls' enrolment rate within primary schools in northern Burkina Faso. Using difference-in-difference (DID) estimation with the data set on the Beoog Biiga programme, we find that take home rations (THRs) increased school attendance for both boys and girls. Moreover, the findings show that girls' enrolment rate within schools increased by 3.2 percent. This is driven by the increase in the number of newly enrolled girls compared with boys. We conclude that THRs have the potential to increase girls' educational attainment and gender equality within schools.

JEL Classification: D04, I21, I25, O15
Key words: school feeding programme, take home ration, enrolment, attendance, Burkina Faso

1. Introduction

Improving educational outcomes is one of the top priorities in most countries, especially in the developing world, which lags behind high-income countries with respect to many educational indicators (Galiani and Perez-Truglia, 2011). This concern is partially driven by the idea that the training of human capital through education is one of the main drivers of economic growth. In the late 1980s and early 1990s, the endogenous growth theories (Romer, 1990; Aghion and Howitt, 1998) argued that differences in economic growth over time and across countries stems mainly from differences in investment in human capital including in terms of education, health and nutrition. For Lucas (1988), human capital is labour-augmenting and characterized by constant returns to scale which entail self-sustained growth driven by human capital accumulation. In the author's model, the 'engine' of growth is human capital, as human capital accumulation raises the productivity of both labour and physical capital. According to the human capital theory, there is a positive relationship between education (human capital accumulation) and economic growth (Schultz, 1961; Denison, 1962). Using school enrolment as a proxy of human capital accumulation, some empirical studies have found a positive linkage between the rate of human capital accumulation and economic growth (Barro, 1991; Lucas, 1988). Thus, Barro (1991) shows that a 10 percent increase in educational attainment is associated with a 0.2 percent increase in the growth rate per year.

To improve their human capital through education, many developing countries embarked on the path of universal education, joining the Education for All (EFA) by 2015 movement and working on the second Millennium Development Goal (MDG).[1] Policymakers have since undertaken measures to overcome the opportunity costs of sending children to school among poor and vulnerable households and increase enrolment and attendance among school-age children. Thus, some authors have found that Food for Education (FFE) programmes can be appropriate to improving school attendance and enrolment, particularly among the poor population. Indeed, Grantham-McGregor et al. (1998) found that, because the provision of school meals reduces the parents' costs of sending children to school, it promotes early enrolment and improves attendance. School Feeding Programmes (SFPs) are intended to alleviate short-term hunger, improve the nutrition and cognition of children, and transfer income to families (Jomaa et al., 2011).

School canteens were first introduced in the 1960s in Burkina Faso by the Catholic Relief Services (CRS)/Cathwell during severe famine which affected the Sahel region of West

[1] The EFA movement not only calls for an investment in the duration of schooling, it also recommends that children acquire skills that they need to improve the quality of their social and economic later life.

Africa and several SFPs have been implemented since this period. FFE is implemented in two forms: an on-site meal called daily meal (DM) and a take home ration (THR). Under the DM programme, breakfast and/or lunch is served at the school every school day and is available to both boys and girls. Under THR, a pupil receives a certain amount of food staples each period conditional on maintaining a specified attendance rate during that period.

These efforts in Burkina Faso raised the primary school gross enrolment rate from 45.9 percent in 2000 to 81.3 percent in 2012. Despite this increase, 13.7 percent of pupils drop out before reaching the final grade (MENA, 2013). Furthermore, until 2012, the primary school completion rate stood at only 59.5 percent (MENA, 2013). This result calls for further investigation into the circumstances under which SFPs could increase enrolment and attendance. In particular, this study assesses the impact of THR in comparison with on-site DM canteens to address the question of the impact of SFP on educational outcomes within schools in northern Burkina Faso. More specifically, it aims to address the extent to which THR affects 1) pupils' attendance rate and 2) girls' enrolment within schools.

The study uses data drawn from the CRS's latest School Feeding Programme in Burkina Faso, which provided assistance to more than 130,000 primary school pupils (grades 1-6). Two schemes were introduced: only DM versus a complementary THR for girls in schools where their enrolment rate is below 40 percent. This allows us to compare the two schemes of programme intervention. The present study therefore differs from the previous by comparing an additional intervention — the THR — with DM or on-site meals. The study will contribute to orientating policymakers on the effectiveness of SFPs by assessing their attainment in a poverty context. Its results also have broader implications for the literature on efforts to improve educational outcomes through the implementation of SFPs.

Using the DID on the data set, we find that THR increased school attendance for both boys and girls. Also, girls' enrolment rate within schools increased. This means that THR leads parents to send more girls than boys to school because girls benefit more from THR. In addition, sending more girls means more food for the household. We perform robustness checks on the results, including regression on a second comparison group constructed with the third province in the northern region, where no school received a feeding programme.

The remainder of the paper is organized as follows: Section 2 provides a review of the

literature surrounding theoretical and empirical research on SFPs; Section 3 gives a background of FFE and the feeding programme design in Burkina Faso; Section 4 summarizes the data and descriptive statistics; Section 5 reports on econometrics methods used; Section 6 discusses the estimations results and robustness checks; and Section 7 presents the conclusion.

2. Literature review

2.1. Theory on impact of school feeding on schooling

It has been claimed that SFPs increase school participation among people who are poor or facing food insecurity. Three goals are associated with SFPs as the pathways by which school meals could affect pupil learning (Levinger, 1986; Kazianga et al., 2009; Bundy et al., 2009). Firstly, SFPs are a conditional transfer to pupils. They may induce families and motivate parents to enrol their children, to enrol them sooner or, following enrolment, encourage regular attendance. Secondly, SFPs improve the nutritional status of school-age children over time, and alleviate short-term hunger in malnourished or otherwise well-nourished schoolchildren. As malnourishment has been shown to affect learning (Taras, 2005), SFPs can be expected to improve educational outcomes. Thirdly, SFPs improve cognitive functions and academic performance via reduced absenteeism and increased attention and concentration due to improved nutritional status. Indirectly, by increasing the amount of food available to the household, SFPs could improve the nutritional status of household members who are not in school, especially when SFPs entail THRs. In this way, SFPs are appealing because if properly designed and implemented they lead to an increased number of children being enrolled and improve their academic performance (Kazianga et al., 2009).

In general, two schemes constitute SFPs and each scheme has its specific values. Meals served at schools (DMs) go directly to the pupils who are supposed to benefit from the programme. However, parents could react by reallocating food in the household away from these children. Food received by the household under THR is more likely to be shared by other household members, possibly reaching children who may be in as much or even greater need of additional food. For Kazianga et al. (2012), because the nutritional benefits are diluted within the household, THR may have a lower impact on learning outcomes such as academic performance than a DM programme has.

Many works have attempted to confirm school feeding goals on educational outcomes and also on the health status of school pupils. Studies generally consider the following elements as school outcomes: enrolment, attendance, lateness, classroom behaviour,

cognition, grade repetition, attainment levels and drop-out rate. Previous empirical works have found mixed evidence for the simultaneous impact of school feeding on enrolment, attendance and academic performance. Some evaluations of FFE programmes have shown that they can lead to increased access (of girls in particular), reduced drop-out rate, particularly in the lower primary school grades, and improved learning among pupils (Drèze and Kingdon, 2001; Ahmed, 2004; Taras, 2005; Vermeersch and Kremer, 2004; Kristjansson et al., 2007). This study focuses in particular on the impact of FFE programmes on enrolment and attendance.

2.2 Impact of FFE programmes on enrolment and attendance

Results are most compelling for school enrolment and attendance, particularly where initial rates of participation are low. Ahmed and del Ninno (2002) used a non-experimental design to assess the FFE programme set up in Bangladesh designed to transfer food to the poorest households through THR programmes in primary schools. The authors found that enrolment increased by 35 percent over the one-year period between the programme start date and the end of its first year. This increase was driven by a 44 percent increase in girl's enrolment and by a 28 percent increase for boys. Ahmed and del Ninno (2002) also looked at the drop-out rate as affected by the programme, and found that from 1999 to 2000, 15 percent of pupils from households who did not receive a THR dropped out, while only 6 percent dropped out among those receiving the THR. Under the THR programme, food received is to be shared by other members in the household where pupils live, so using means as a method to evaluate the impact allows external factors that can influence the effect of the programme to be controlled.

Using an experimental design, Ahmed (2004) conducted a study in food-insecure areas of Bangladesh to assess the impact of SFP on school participation. The author found that SFPs have statistically significant positive impacts on both gross and net enrolment rates, with 14.2 percent and 9.6 percent increases respectively. Furthermore, pupils participating in the SFPs increased their attendance by 1.34 days per month. However, this finding does not take account of other unobservable characteristics of households in the treatment area that could affect a household's decision to enrol children. Therefore, without considering unobserved factors, it appears inconclusive to claim that the difference in enrolment between treatment and control groups was the result of the programme.

Afridi (2007) examined by non-experimental design the effects of the feeding programme on school enrolment and attendance. Using DID estimation, the author showed that girls' attendance increased by 10.5 percent in schools that implemented the SFP in grade 1 in

Madhya Pradesh (India). In Burkina Faso, Kazianga et al. (2009) found in their study of "girl-friendly" schools in the Burkinabé Response to Improve Girls' Chances to Succeed (BRIGHT) school construction programme that both THR and DM interventions had a statistically significant impact on overall enrolment and on the enrolment of girls.[2] The reviews by Bundy et al. (2009) also found that the provision of FFE programmes increases the access to learning and education for schoolchildren by improving enrolment and attendance rates. However, using a quasi-experimental design, Buttenheim et al. (2011) did not find a consistent effect of SFPs in Lao PDR. Indeed, they found minimal evidence that the school feeding schemes increased enrolment or improved children's nutritional status. Using the DID method, Cheung and Berlin (2014) found that school enrolment increased but the impact was largest from the full programme including on-site feeding, THR and de-worming.

3. Background of FFE programmes in Burkina Faso

School canteens were first introduced in 1962 in Burkina Faso by the Catholic Relief Services (CRS)/Cathwell in the aftermath of severe famine which affected the Sahel region of West Africa. Since this period, CRS has provided educational assistance and implemented several SFPs in vulnerable areas. The dry THR, which is a more recent intervention, was also initiated in Burkina Faso by the CRS/Cathwell. Only girls who attend school on a regular basis receive a food ration (flour) that they can take home each month. However, little is known about the effect of SFPs, because there have been no effective evaluations of their impact on education outcomes and pupil learning in Burkina Faso. Our present study aims to address this gap.

Our study covers the region served by the CRS, and all schools that were listed in the academic year 2011–2012, focusing on the central part of the northern region of Burkina Faso. Northern Burkina Faso is an appropriate context to evaluate the impact of FFE programmes for two main reasons. First, the region has low primary school participation. On average only 53.5 percent of school-age children (6 to 11 years old) attend school (MENA, 2012). Therefore, there is much scope for increasing enrolment. Second, income levels are very low and severe food shortages are frequent. Hence, the value of the food offered should be a sufficient incentive to attract children to school. Households are largely dependent upon subsistence agriculture, and malnutrition is extremely high in the target area, with stunting occurring in 40 percent of children under 5 years of age due to diet, poor hygiene practices and illness (ENAIM, 2009).[3] The project was implemented in two of

[2] The BRIGHT programme placed relatively well-resourced schools with a number of amenities directed at encouraging the enrolment of girls in 132 rural villages in Burkina Faso.

the three provinces of the northern region: Bam and Sanmatenga.

The two provinces are characterized by periods of erratic rainfall, which result in food insecurity and increasing migration. Following the poor harvest of 2011, the northern region was declared an area prone to food insecurity risk. Additionally, Bam and Sanmatenga are characterized by low levels of girls' educational enrolment and achievement. In 2008, school enrolment stood at 75 percent, with gender disparities (81 percent boys and 70 percent girls) and inequities between urban and rural areas (MENA, 2009). There are many challenges in access to education, including prohibitive school distances, financial costs, cultural barriers and the opportunity costs of sending girls to school who are expected to perform household chores and look after other children (such as siblings). These factors contribute to a high number of drop-outs at an early age. The grade five drop-out rate is 17 percent in Bam and 15 percent in Sanmatenga, often due to early marriage, puberty (and lack of proper sanitation facilities in schools) and work duties at home. In the last few years, gold mining has become widespread in the two provinces. This phenomenon has increased the pull of children from school, and households from their crops. In 2011, a new mine was implemented in Bam province which can hinder SFP impact.

Through its programme called Beoog Biiga ("Tomorrow Child" in the local language), CRS aimed to respond to food insecurity through the education, health and capacity-building sectors and to increase school access and continuation by improving pupil health and the school environment in Burkina Faso. This multisectoral programme was funded from 30 September 2011 to 31 December 2014 by the United States Department of Agriculture (USDA) and implemented in partnership with the Government of Burkina Faso and local development organizations.[4] The SFP and health initiatives were implemented in close collaboration with the Ministry of Primary Education and Literacy (MENA), the Ministry of Health (MoH) and the Ministry of Social Action and National Solidarity (MASSN).

The project targeted the provinces of Bam and Sanmatenga, covering 684 schools and 134,128 pupils, including 62,442 girls, in its first year. The project covered all schools in the two provinces served by the CRS in the academic year 2011–2012.[5] In this way, two main activities were carried out as project schemes under the project objectives. First, CRS distributed a DM to all pupils throughout the school year. Primary school pupils received a

[3] National Food Security Survey
[4] United States Department of Agriculture (USDA)
[5] The 2011-2012 school year is from October 2011 to June 2012

daily ration of 136 grams (g) of soy-fortified bulgur, 27 g of lentils and 18 g of vegetable oil per pupil, for a total of 726 kilocalories (kcal) and 31 g of protein per day. The second main activity was the distribution of THRs. CRS provided THRs to improve girls' enrolment and attendance and decrease drop-out rates in Bam and Sanmatenga. In each school where girls' enrolment rate was under 40 percent, female pupils were given a food ration consisting of 10 kilograms (kg) of corn soy blend (CSB) for each month in which their attendance was 90 percent or above. According to current figures, approximately 150 schools (excluding schools in the two big cities) had girls' enrolment rates of less than 40 percent and benefit from THRs.

We wish to stress at this point that the Beoog Biiga programme was not a randomized intervention. The schools were selected based on administrative criteria, which may correlate with other characteristics potentially influencing school enrolment and pupil attendance. Additionally, the local community was asked to voluntarily provide some wood or help preparing the food to complement the meals. As the programme was implemented at the school level, the potential biases will be negligible (whether or not a pupil brought wood, he/she received the DM at school).

4. Data and descriptive statistics of the SFP

4.1 Data

The data used in this study come from two main sources: CRS/Burkina Faso and MENA. Schools characteristics data are drawn from the annual MENA school survey (2010–2011 and 2011–2012 school years). The survey data set includes information on school location, status, number of teachers by gender, and other school facilities. Through the Beoog Biiga programme, CRS provides data on education outcomes such as enrolment and attendance. Attendance is measured by the average number of half-days of classes not missed by pupils in each school. Girls' enrolment rate is measured by the percentage of female pupils in each school. CRS's baseline data for the project was collected in 2011 prior to the beginning of the school year.

Two steps were used to select schools. Step 1 consisted of dividing schools into two groups; the first group comprised all schools located in urban areas and the second group all schools in rural areas. In step 2, all rural schools where girls' enrolment rate was below 40 percent were selected to benefit from the DM and THR for girls, while the remaining schools received only DMs. The baseline was constructed using data from MENA based on 2010–2011 and 2011–2012 school years and consisted of collecting school characteristics

to complete data on enrolment and attendance already collected in the CRS database. Then we matched the two data sets by school name at the district level. Table 1 reports all school characteristics such as school facilities, location and school status. To all these variables, we added an exogenous variable to capture its impact on school enrolment and pupil attendance. Indeed, as noted in Section 3, Bam and Sanmatenga provinces are affected by gold mining, which can hinder the programme impact. Taking account of this factor would enable us to avoid a misleading estimation of programme impact. We identified our treatment and comparison group of schools on the basis of whether they received only a DM or a DM and THR during the 2011–2012 school year.

4.2 Descriptive statistics in baseline

Table 1 summarizes the key baseline characteristics of schools and pupils in all targeted schools. In Panel A, the statistics show that schools are characterized by a low attendance rate (51 percent). On average, girls' enrolment rate is 45.67 percent in each school, showing a persistent gender gap (about 0.881). Ninety-two percent of schools are located in rural areas and 88 percent of them are public schools. Pupil-teacher ratio is 58.33, meaning that there are on average 58 pupils in each class in each school. According to the Education for All Fast-Track Initiative (EFA-FTI), the standard ratio must be 40.6 In this case, school classes are oversized.

Panel B shows the pupil characteristics in a sub-sample. MENA randomly interviewed pupils in grade 6 and grade 3 in selected schools, for details on their socio-economic characteristics such as parents' occupation, parent literacy, the distance from school and household chores. Panel B also shows that on average, pupils live 1.62 km from school, 82 percent of pupils have a father who is a farmer, and that only 46 percent of these men are literate. It appears here that mothers are less literate.

Table 2 reports the average school characteristics of the treatment and comparison group at the baseline. Prior to the treatment, schools were similar on some variables including attendance level for boys and girls, and pupil-teacher ratio. Also, before treatment, it appeared that there was no significant difference between schools in terms of the presence of electricity, a latrine, a library and an external restaurant. However, we observed significant differences in girls' enrolment, school status and location, and number of female teachers. On average, 36 percent of girls were enrolled in THR schools against 48 percent in the comparison group, because schools received THRs based on the girls'

[6]FTI is established in 2002
Available on : http://www.oecd.org/dac/37819963.pdf

enrolment rate being below 40 percent.

5. Methodology

Any impact evaluation attempts essentially to answer a counterfactual question (Duflo and Kremer, 2003): how would individuals who participated in the programme have fared in the absence of the programme? How would those who were not exposed to the programme have fared in the presence of the programme? Studies on impact evaluation usually resort to experimental and non-experimental evaluation methods, depending on the study design. Considered as the "gold standard", experimental design randomly assigns individuals to treatment and control groups, thus overcoming the counterfactual problem by ensuring that the treatment status is uncorrelated with other variables so that the potential outcome can be attributed only to the programme. Other quasi-experimental and non-experimental methods can also be used to overcome the counterfactual problem. Our study uses difference-in-difference (DID) to estimate the THR impact on enrolment and attendance.

An important assumption of the DID method is the common time trend for both the treated and control groups. This assumes that in the absence of treatment, the average change in the outcomes would be the same for treated schools as for untreated schools. Thus, it means that unobserved heterogeneity between the treated and control groups are time invariant and uncorrelated with the treatment over time. This paper analyses a programme in which school participation was not randomized, as all schools received at least one SFP scheme. Indeed, based on administrative criteria, schools are divided into two groups. Our treatment group consists of 134 schools where all pupils received a DM and girls in addition received a THR. The second group, our comparison group, includes 550 schools where pupils only received a DM.

Therefore the paper analyses the effect of THRs, an additional school feeding scheme, on pupil enrolment and attendance.

Denote by Y_1 the outcome conditional on participation and by Y_0 the outcome conditional on non-participation, so the impact of participating in the programme is:

$$\Delta = Y_1 - Y_0$$

For each individual, only Y_1 or Y_0 is observed, so Δ is not observable. This missing data problem lies at the heart of the evaluation problem. So, let T = 1 for the group of

individuals who applied and got accepted into the programme for whom Y_1 is observed and T = 0 for individuals who did not enter the programme for whom Y_0 is observed. Let *X* denote a vector of observed individual characteristics used as conditioning variables. The most common evaluation parameter of interest is the mean impact of treatment on the treated (TT):

$$TT = E(\Delta|X,T=1) = E(Y_1 - Y_0|X,D=1) = E(Y_1|X,T=1) - E(Y_0|X,T=1) \quad (1)$$

TT estimates the average impact of the programme among those participating in it.

As the programme was offered at the school level, we estimate the average intent to treat (AIT), which is the impact of the programme, on the average of all pupils in a given school.

$$AIT = E(y_{1i}|T_i = 1) - E(y_{0i}|T_i = 1) \quad (2)$$

Or

$E(y_{1i}|T = 1) = E(y_{0i}|T_i = 0)$, so

$$AIT = E(y_{1i}|T_i = 1) - E(y_{0i}|T_i = 0)$$

DID estimation on attendance and enrolment rate can be written as:

$$Y_i = \beta_0 + \beta_1 t_i + \beta_2 THR_i + \beta_3 t_i * THR_i + \beta_k X_{k,i} + \cup_p + e_i \quad (3)$$

Where Y_{it} is the outcome of interest (attendance or enrolment) for school$i$.

t_i takes value 1 for all schools if observation is in follow-up and 0 for baseline. THR_i takes value 1 for all schools where all pupils received a DM and girls received a THR and 0 in schools where all pupils received only a DM. $X_{k,i}$ is a school characteristic, $\cup_p$ is a province-specific factor. The interaction $t_i * THR_i$ estimates the DID effect of THR on school attendance and enrolment.

The present study makes a contribution to the quasi-experimental literature in impact evaluation in developing countries. Indeed, the use of a retrospective analysis to evaluate an SFP differs from previous studies in a developing country such as Burkina Faso, where Kazianga et al. (2012, 2013) used randomized design. It also uses a unique data set from the first SFP in Burkina Faso on which there has been no previous evaluation.

6. Results

We now discuss our results from estimating equation (3). Table 3 and Table 4 show the effect of THRs on attendance and enrolment respectively, including control for all school characteristics. The coefficient of interest is the interaction term $THR\ x\ Year1$ which is the DID estimate of the THR effect on school enrolment and attendance. For all regressions, we estimate firstly the THR effect on attendance and enrolment with all schools; secondly we run the same estimation with rural schools. Given that, as shown in descriptive statistics, THR schools are all rural, the choice of the right comparison group follows this criterion in order to avoid some biases in the programme impact. Therefore, we restrict our interpretation to rural schools only. Nonetheless, we present the results alongside all schools and observe that results are similar.

6.1. Impact of THR on school attendance

Attendance is measured by the average number of half-days of classes not missed by pupils in each school as reported by the CRS survey. Table 3 presents the effect of THRs on school attendance. While column 4 shows the attendance rate for all pupils in rural schools, columns 5 and 6 report boys' and girls' attendance rates respectively. The DID results suggest that on average the THR programme has a positive impact on pupils' attendance rate, which shows an increase of 8.4 percent. When estimating separately, both boys' and girls' attendance rates increased. However, boys' attendance rate is higher than that of girls. Indeed, girls' attendance rate increased by 6 percent against 8.4 percent for boys, showing that school attendance in the THR programme is driven by boys. This can be explained by the fact that initially the boys' attendance rate was lower than that of girls and the presence of girls after the programme implementation keeps more boys. Also, boys in either DM schools or in THR schools received a meal.

While controlling for school characteristics, we find that pupil-teacher ratio has a negative and significant effect on overall and boys' attendance. Meanwhile, public school has a positive impact on overall attendance, increasing all pupils' attendance by 9 percent, although its effect is not significant on girls' attendance. Parents may prefer to send their boys to public schools in which school fees are generally affordable. At the province level, we control for the presence of an additional exogenous factor which affects pupils and their household, particularly vulnerable ones. Indeed, newly opened mines can lead to absenteeism and thus drop-out, as the presence of mining increases child labour. Table 1 shows that 82 percent of fathers are farmers, so poor harvests can act as an incentive for parents to send more children to work in mines to increase household financial resources. Mining is thus considered a source of income to support family needs. Further results show

that the presence of mining impacts negatively on attendance, decreasing boys' and girls' attendance by 25 percent and 15 percent respectively.

6.2. Impact of THR on school enrolment

Table 4 reports the impact of THRs on enrolment. Enrolment rate is defined as the number of boys or girls enrolled as a percentage of all pupils within schools. So, interpreting change in girls' enrolment rate or boys' enrolment rate has the same significance. Results reveal that girls' enrolment rate increased significantly — by 3.2 percent — with THR. This means a simultaneous decrease in boys' enrolment rate by 3.2 percent. However, we know that enrolment could increase if girls' numbers increased more than boys or if boys' numbers decreased significantly. To check this, we compute the change in pupil numbers within schools. Columns 4, 5 and 6 report the change in the number of pupils within schools, the change in girls' number and the change in boys' number respectively. While girls' enrolment rate increased with THRs, the number of enrolled girls increased more than boys (six girls versus five boys). We conclude that girls' enrolment rate increased due to the fact that their numbers increased more than boys' numbers within the schools.

The presence of female teachers has a positive and significant impact on girls' enrolment rate, as parents have more confidence sending their daughters to school if there are female teachers. Girls and their parents may regard a female teacher as proof of success, demonstrating that girls are not confined only to domestic tasks but can become more literate and practice a good job in the future. In contrast, mining has a negative impact on boys' enrolment, decreasing the number of boys by three pupils per school on average.
Nevertheless, these numbers need to be interpreted with caution. Indeed, in some cases, enrolment numbers cannot be trusted because the schools might have incentives to inflate them in order to receive more funds. On the other hand, it is possible for a child to attend without being enrolled, perhaps because of incomplete school records (Cheung and Berlin, 2014). Although column 4 shows that pupil numbers increased on average by 11 pupils per school, while girls' figures increased significantly, the number of boys did not.

These results are in line with previous findings. Indeed, Cheung and Berlin (2014) found that THRs boosted school enrolment in the short term by 5 percent, while Ahmed and del Ninno (2002) found that THRs were effective in increasing enrolment and attendance in Bangladesh. The authors found that the increased enrolment was driven by a 44 percent increase in girl's enrolment and by a 28 percent increase for boys. Contrary to Kazianga et al. (2009) in the Sahel region, who found that THRs increased enrolment for girls by six percentage points at the household level, our results show that the CRS food programme

had a smaller effect. This is due to the fact that this particular programme targeted the school level, thus reducing the effective impact.

Overall, these results appear to be consistent with those shown in previous works and can be explained by the fact that THRs can be considered a reallocation of food between girls and their household members. As households receive more food to be shared with all members, this could lead parents to enrol other girls not yet in school in order to increase the food ration. At the same time, parents may retain some boys for labour, either in farming or in mining, in order to increase household resources. However, the increase in the school attendance rate for boys is due to the fact that by sending them to school parents can at least ensure that they receive a meal.

6.3. Robustness

Given that as described earlier, all schools in our sample received at least one SFP scheme, we used in addition an external comparison group to check the robustness of our results. Indeed, for the programme that was implemented in two of the three provinces of the northern region, we can use the third province where no school received the programme as another comparison group: the non-feeding (NF) schools. Prior to using the third province, we have to ensure that this province can be considered as similar to the other provinces in order to form a good NF comparison group. On the one hand, the administrative zoning in Burkina Faso forms regions with provinces based on their geographic and socio-economic characteristics, thereby suggesting that the third province is comparable to the other provinces. Table 5, on the other hand, shows that on average the third province is similar to the targeted ones. Columns 2 and 3 show that girls' enrolment rate, proportion of rural schools, and the number of schools where girls' enrolment is low (below 40 percent as defined in programme criteria) are similar. In this section we therefore use the NF schools as a second comparison group in two different ways.

Firstly, we took all the NF schools and the previous DM group and ran the DID estimation on the number of newly enrolled pupils. The results in Table 6 show that we obtained the same results as our main results in Table 4 (with only DM as the comparison group). This means that taking the NF schools in the third province into account did not change our results. The previous findings reflect the programme impact on newly enrolled figures well. Indeed, pupil numbers increased significantly by 12, but while the number of girls rose significantly (6.53), the number of boys did not. Also, public schools increased their

numbers by 24 new pupils (against 22 in Table 4).

Secondly, our robustness check involved comparing THR schools and NF schools where girls' enrolment rate was below 40 percent. In Table 7, the results show that girls' enrolment rate increased by 3.8 percent (against 3.2 percent in Table 4). Controlling for public schools, we found that public schools increased girls' enrolment rate by 1.8 percent. As shown in Table 4, the THR programme had the same effect on enrolment. So, we found that the value of the coefficient of interest THR *x* year1 did not differ from our main results and that the impact of THRs on educational outcomes was causal.

Our robustness check also compared only schools where girls' enrolment was below 40 percent i.e. THR schools in rural areas compared with DM schools in urban areas (which did not receive THRs for girls due to their location in urban areas). Table 8 shows that the results do not vary widely from the results found in Table 4. Indeed, girls' enrolment rate increased by 2.5 percent (against 3.2 percent in Table 4). Overall, the group of NF schools allowed us to corroborate the study's main results on enrolment: the THR programme improves school enrolment.

7. Conclusion

This study provides an ex-post evaluation of a Food for Education (FFE) programme implemented in Burkina Faso. It is an insight into the impact of an additional feeding scheme on educational outcomes. Specifically, the study evaluates the impact of take home rations (THRs) on school attendance and girls' enrolment in northern primary schools. THRs were targeted only at girls where their enrolment rate was below 40 percent and were conditional on 90 percent attendance. As we rely on a baseline and follow-up, we use DID regression to estimate the impact of the THR programme. As we have no experimental data, we control for schools and province-level characteristics to find an estimated impact that can be interpreted as causal. We find that attendance rate within schools increased by 8.4 percent more in the THR group (6 percent for girls and 8.4 percent for boys). In addition, the results show that girls' enrolment rate increased by 3.2 percent and was driven by the increase in the number of girls in THR schools. Moreover, our results suggest that school characteristics influenced the extent to which THR improved school attendance and girls' enrolment. Pupils in schools that had more female teachers and pupils in public schools gained significantly more from the programme.

Overall, our results show that school feeding through the THR programme in a specific context of food insecurity can increase school attendance and girls' enrolment. However,

the impact of this programme on nutrition and health remains to be investigated. Moreover, given that THRs are targeted at the school level, this calls for more investigation at the household and individual levels of the circumstances under which THRs impact attendance and enrolment. Indeed, programmes succeed when they consider household or individual behaviour. This, combined with programme design, is a major determinant of a programme's impact. These are open questions for future research. The findings of this research have policy relevance: THRs improve school attendance for both boys and girls and increase girls' enrolment within schools. This carries long-term implications for gender equality in schools and girls' educational attainment.

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Tables

Table 1: ***Summary baseline statistics of school characteristics in targeted provinces***

	Variables	Mean	SD[2]	Min	Max
Panel A	Public schools	0.881	0.322	0	1
	Rural schools	0.917	0.275	0	1
	Pupil attendance	0.506	0.218	0	
	Enrolled students	216.68	140.97	18	755
	Girls' enrolment rate	0.456	0.079	0.18	0.80
	Gender gap	0.881	0.306	0.22	4
	Teachers	3.53	2.33	0	11
	Female teachers	1.35	1.64	0	7
	Pupil/teacher ratio	58.33	19.29	11.5	154
	Schools facilities (presence or not)				
	Electricity	0.099	0.299	0	1
	Running water	0.542	0.498	0	1
	Library	0.055	0.229	0	1
	Latrine	0.644	0.448	0	1
	Parents' association	0.902	0.297	0	1
	External restaurant	0.742	0.437	0	1
	Mining area in 2011	0.358	0.479	0	1
	Pupils characteristics (sub-sample)				
Panel B	Distance from school (km)	1.625	0.668	1	3
	Repeaters	0.376	0.515	0	1
	Keeping child at home	0.604	0.489	0	1
	Household chores	0.785	0.410	0	1
	Father is farmer	0.820	0.384	0	1
	Father is literate	0.463	0.499	0	1
	Mother is literate	0.293	0.456	0	1

Notes: Panel A shows summary statistics for the 684 targeted schools where 134,128 pupils, including 62,442 females, are enrolled. Panel B shows pupil characteristics obtained for a sub-sample of 876 pupils (grades 3 and 6) in 24 schools randomly selected by MENA.
[2]SD = standard deviation

Table 2: ***Average school characteristics by treatment status***

	DM	THR	
School characteristics	**N=550**	**N=134**	**Difference**
	-1	**-2**	**(2) – (1)**
Public schools	0.896	0.824	-0.072 **
Rural location	0.896	1.000	0.104***
Pupil attendance	0.509	0.496	-0.014
Girls' attendance	0.767	0.774	0.007
Boys' attendance	0.510	0.496	-0.014
Girls' enrolment rate	0.480	0.362	-0.119***
Pupil/teacher ratio	57.827	60.256	2.429
Female teachers	1.520	0.687	- 0.833***
Drilling	0.625	0.512	-0.113**
Electricity	0.119	0.078	-0.041
Latrine	0.724	0.674	-0.050
Library	0.061	0.062	0.001
External Restaurant	0.826	0.806	-0.020
New mining area	0.389	0.231	-0.158***

Notes: Summary statistics for schools targeted in the 2011–2012 school year.

Standard errors not presented. *** Significant at 1%; ** significant at 5%; * significant at 10%.

Table 3: *Programme impact on attendance*

	All schools			Rural schools		
	[1]	[2]	[3]	[4]	[5]	[6]
	All	Girls	Boys	All	Girls	Boys
Baseline	0.648**	0.820***	0.647***	0.668***	0.863***	0.668***
	(0.041)	(0.036)	(0.041)	(0.037)	(0.034)	(0.037)
THR	-0.045*	-0.008	-0.045*	-0.046*	-0.008	-0.046*
	(0.024)	(0.022)	(0.024)	(0.025)	(0.022)	(0.025)
THR*year1	0.088***	0.064**	0.088***	0.084***	0.060**	0.084***
	(0.028)	(0.026)	(0.028)	(0.028)	(0.026)	(0.028)
Public school	0.081***	-0.004	0.082***	0.089***	-0.006	0.090***
	(0.023)	(0.021)	(0.023)	(0.025)	(0.022)	(0.025)
Rural zone	0.033	0.045**	0.034			
	(0.025)	(0.023)	(0.025)			
Pupil/teacher ratio	-0.001***	-0.000	-0.001***	- 0.001***	-0.000	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female teacher	-0.000	-0.001	-0.000	-0.002	-0.001	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Electricity	0.028	0.030*	0.029	0.032	0.032*	0.033
	(0.019)	(0.017)	(0.019)	(0.020)	(0.019)	(0.020)
Latrine	-0.021	-0.010	-0.021	-0.027*	-0.010	-0.027*
	(0.014)	(0.0183)	(0.014)	(0.015)	(0.001)	(0.015)
Running water	-0.003	0.004	-0.003	0.000	0.004	0.000
	(0.013)	(0.012)	(0.013)	(0.013)	(0.012)	(0.013)
Library	-0.016	-0.008	-0.015	-0.033	-0.019	-0.032
	(0.025)	(0.023)	(0.025)	(0.026)	(0.024)	(0.026)
Ext. restaurant	-0.083***	-0.011	-0.082***	-0.071***	-0.006	-0.071 ***
	(0.018)	(0.020)	(0.018)	(0.019)	(0.017)	(0.019)
Girl enrol.<40	-0.012	0.020	-0.012	-0.010	-0.019	-0.009
	(0.019)	(0.121)	(0.019)	(0.019)	(0.018)	(0.019)
Mining	-0.245***	-0.146***	-0.245***	-0.250**	-0.148***	-0.252***
	(0.012)	(0.011)	(0.012)	(0.013)	(0.012)	(0.013)
R-squared	**0.5636**	**0.1910**	**0.5638**	**0.5734**	**0.1963**	**0.5734**
Observations	**1131**	**1139**	**1131**	**1056**	**1060**	**1056**

Notes: Robust standard errors in parentheses, clustered at school level

*** Significant at 1%; **significant at 5%; * significant at 10%.

Regressions control for school characteristics. The dependent variable is the school average attendance rate.

Average attendance = number of half-days attended by pupils divided by the total number of half-day classes.

Table 4: *Programme impact on enrolment (newly enrolled and enrolment rate)*

	Newly enrolled						Enrolment rate			
	All schools			Rural schools			All schools		Rural schools	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	All	Girls	Boys	All	Girls	Boys	Girls	Boys	Girls	Boys
Baseline	-202.7***	-85.78***	-116.9***	-199.6***	-86.35***	-113.33***	0.431***	0.569***	0.439***	0.561***
	(7.629)	(4.243)	(4.591)	(6.782)	(3.756)	(4.182)	(0.011)	(0.011)	(0.011)	(0.011)
THR	-5.261	-8.469***	3.207	-6.166	-9.665***	3.500	-0.103***	0.103***	-0.104***	0.104***
	(4.891)	(2.721)	(2.943)	(4.723)	(2.615)	(2.912)	(0.006)	(0.012)	(0.006)	(0.006)
THR*year1	10.653*	5.600*	5.053	10.842**	5.701*	5.142	0.033***	-0.033***	0.032***	-0.032***
	(5.734)	(3.189)	(3.450)	(5.507)	(3.049)	(3.395)	(0.009)	(0.009)	(0.009)	(0.009)
Public school	26.471***	13.516***	12.955***	22.448***	10.249***	12.199***	0.036***	-0.036***	0.027***	-0.027***
	(4.028)	(2.240)	(2.424)	(4.185)	(2.318)	(2.581)	(0.006)	(0.006)	(0.007)	(0.007)
Rural zone	-10.535**	-9.263***	-1.272				-0.001	0.001		
	(4.671)	(2.598)	(2.811)				(0.007)	(0.007)		
Pupil/teacher ratio	3.065***	1.409***	1.656***	2.943***	1.331***	1.612***	-0.000	0.000	-0.000	0.000
	(0.060)	(0.033)	(0.036)	(0.059)	(0.033)	(0.036)	(0.000)	(0.000)	(0.000)	(0.000)
Teachers	59.285***	27.316***	31.969***	59.417***	27.140***	32.278***	-0.001	0.001	-0.001	0.001
	(1.018)	(0.566)	(0.613)	(1.021)	(0.566)	(0.630)	(0.002)	(0.002)	(0.002)	(0.002)
Female teacher	-3.091***	0.984	-4.076***	-4.187***	0.459	-4.646***	0.010***	-0.010***	0.009***	-0.009***
	(1.196)	(0.665)	(0.720)	(1.205)	(0.667)	(0.743)	(0.002)	(0.002)	(0.002)	(0.002)
Electricity	8.907**	6.958***	1.949	11.423***	8.817***	2.606	0.006	-0.006	0.009	-0.009
	(3.835)	(2.133)	(2.308)	(4.025)	(2.229)	(2.482)	(0.006)	(0.006)	(0.006)	(0.006)
Latrine	-6.085**	-4.230**	-1.856	-7.581**	-4.989***	-2.591	-0.010**	0.010**	-0.010**	0.010**
	(2.980)	(1.657)	(1.793)	(2.937)	(1.626)	(1.811)	(0.005)	(0.005)	(0.005)	(0.005)
Running water	2.057	-0.034	2.091	1.944	0.245	1.699	0.002	-0.002	0.003	-0.003
	(2.648)	(1.473)	(1.593)	(2.635)	(1.459)	(1.625)	(0.004)	(0.004)	(0.004)	(0.004)
Library	15.205***	6.016**	9.190***	17.377***	7.905***	9.472***	-0.013*	0.013*	-0.007	0.007
	(5.044)	(2.805)	(3.035)	(5.163)	(2.859)	(3.183)	(0.008)	(0.008)	(0.008)	(0.008)
Ext. restaurant	10.594***	4.080**	6.515***	8.788**	3.964**	4.824**	0.007	-0.007	0.012**	-0.012**
	(3.513)	(1.954)	(2.114)	(3.528)	(1.954)	(2.175)	(0.005)	(0.005)	(0.006)	(0.006)
Girl enroll.<40	0.410	-16.918***	17.328***	0.704	-15.957***	16.661***				
	(3.671)	(2.042)	(2.209)	(3.583)	(1.984)	(2.209)				
Mining	-4.916**	-1.532	-3.384**	-3.091	-0.276	-2.815*	0.020***	-0.020***	0.020***	-0.020***
	(2.492)	(1.386)	(1.499)	(2.462)	(1.364)	(1.518)	(0.004)	(0.004)	(0.004)	(0.004)
R-squared	**0.9188**	**0.9033**	**0.8886**	**0.9160**	**0.8980**	**0.8835**	**0.3692**	**0.3692**	**0.3678**	**0.3678**
Observation	**1228**	**1228**	**1228**	**1129**	**1129**	**1129**	**1228**	**1228**	**1129**	**1129**

Notes: Robust standard errors in parentheses, clustered at school level

* Significant at 10%; **significant at 5%; *** significant at 1%

Dependent variables are attendance and enrolment rates. Regressions control for school and province-specific characteristics.

Table 5: *Key school variables between provinces*

School characteristics	All provinces	Bam & Sanmatenga	Namentenga	Bam	Sanmatenga
Number of schools	**N=927**	**N=684**	**N=243**	**N=245**	**N=439**
	[1]	**[2]**	**[3]**	**[4]**	**[5]**
Public schools	0.902	0.881	0.962	0.864	0.892
Rural schools	0.922	0.917	0 .934	0.917	0.916
Girls' enrolment rate	0.460	0.456	0.458	0.470	0.448
Girls' enrolment <40	0.216	0.217	0.271	0.122	0.271
Enrolled pupils	202.26	216.68	167.25	212.76	218.89
Pupil/teacher ratio	52.62	58.33	44.59	56.20	59.63
Female teachers	1.39	1.35	1.17	1.13	1.47
Schools facilities [2]	1.435	1.34	1.58	1.35	1.33
Electricity	0.096	0.099	0.082	0.102	0.097
Running water	0.586	0.542	0.679	0.526	0.551
Latrine	0.706	0.644	0.802	0.661	0.635
Library	0.046	0.055	0.024	0.061	0.052
Parents' association	0.946	0.902	1	0.951	0.874
Mining area in year 2011^			No	Yes	No

Notes: Bam & Sanmatenga = targeted provinces.

Namentenga = third external province (as a second comparison group of schools)

[2] School facilities = electricity + running water + latrine + library

^ Mining area = Yes if newly opened in 2011 and mining area = No if mining opened before 2011

Table 6: ***Programme impact on enrolment: THR group vs. (DM + NF) group***

	Enrolled pupils					
	[1]	[2]	[3]	[4]	[5]	[6]
	All schools			Rural schools		
	All	Girls	Boys	All	Girls	Boys
Baseline	210.53***	-90.723***	-119.81***	-206.51***	-90.573***	-115.94***
	(6.800)	(3.687)	(4.088)	(6.093)	(3.270)	(3.775)
THR	-6.400	-9.893***	3.493	-5.696	-9.822***	4.126
	(4.434)	(2.404)	(2.666)	(4.209)	(2.259)	(2.607)
THR*year1	11.839**	6.618**	5.221	11.993**	6.533**	5.459*
	(5.587)	(3.030)	(3.360)	(5.303)	(2.846)	(3.285)
Public school	25.513 ***	13.671***	11.842***	24.317***	11.89***	12.419***
	(3.736)	(2.026)	(2.247)	(3.892)	(2.089)	(2.411)
Rural zone	-7.650*	-7.470***	-0.180			
	(4.111)	(2.229)	(2.472)			
Pupil-teacher ratio	3.245***	1.485***	1.760***	3.105***	1.397***	1.708***
	(0.052)	(0.028)	(0.031)	(0.051)	(0.027)	(0.031)
Teachers	53.511***	24.991***	28.519***	53.501***	24.796***	28.705***
	(0.856)	(0.464)	(0.515)	(0.851)	(0.456)	(0.527)
Female teacher	0.276	2.092***	-1.815***	-0.038	1.938***	-1.975***
	(1.018)	(0.552)	(0.612)	(1.017)	(0.546)	(0.630)
Electricity	6.029*	4.423**	1.607	8.661**	6.044***	2.617
	(3.407)	(1.847)	(2.049)	(3.544)	(1.902)	(2.196)
Latrine	-3.494	-3.235**	-0.259	-5.695**	-4.439***	-1.257
	(2.621)	(1.421)	(1.576)	(2.558)	(1.373)	(1.585)
Running water	2.023	0.004	1.737	2.681	1.057	1.624
	(2.268)	(0.012)	(1.364)	(2.226)	(1.195)	(1.379)
Library	15.922***	6.287**	9.635***	16.004***	6.833***	9.171***
	(4.696)	(2.546)	(2.824)	(4.772)	(2.561)	(2.956)
External restaurant	15.807***	6.825***	8.981***	13.843***	6.422***	7.421***
	(3.196)	(1.733)	(1.922)	(3.218)	(1.727)	(1.993)
Girl enroll.<40	3.396	-14.501***	17.897***	2.899	-14.339***	17.237***
	(2.824)	(1.531)	(1.698)	(2.712)	(1.456)	(1.680)
Mining	3.395	2.239*	1.156	4.618**	3.193***	1.425
	(2.293)	(1.243)	(1.378)	(2.249)	(1.207)	(1.393)
R-squared	**0.9062**	**0.8937**	**0.8717**	**0.9039**	**0.8903**	**0.8657**
Observations	**1714**	**1714**	**1714**	**1583**	**1583**	**1583**

Notes: Robust standard errors in parentheses, clustered at province l level. ***significant at 1%; ** significant at 5%; * significant at 10%

Table 7: ***Programme impact on school enrolment rate: THR vs. NF schools in rural areas (control for schools where girls' enrolment rate is below 40%)***

	School enrolment rate		Enrolled pupils	
	[1]	**[2]**	**[3]**	**[4]**
	Girls	Boys	Girls	Boys
Baseline	0.314***	0.686***	-67.392***	-77.468***
	(0.019)	(0.019)	(4.758)	(5.014)
THR	0.010	-0.010	8.555***	4.861*
	(0.011)	(0.011)	(2.764)	(2.912)
THR*year1	0.038***	-0.038***	5.346	-2.231
	(0.014)	(0.014)	(3.478)	(3.665)
Public school	0.018*	-0.018*	8.561***	2.544
	(0.011)	(0.011)	(2.849)	(3.002)
R-squared	**0.2183**	**0.2183**	**0.8665**	**0.9087**
Observations	**180**	**180**	**180**	**180**

Notes: Robust standard errors in parentheses, clustered at province l level

***significant at 1%; **significant at 5%; * significant at 10%

NB: all covariates are not significant, but their inclusion gives the same results

Table 8: ***Programme impact on enrolment: THR vs. DM (in only schools where girls' enrolment rate is below 40%)***

	School enrolment rate		Enrolled pupils	
	[1]	[2]	[3]	[4]
	Girls	Boys	Girls	Boys
Baseline	0.314***	0.686***	-26.776**	-43.051***
	(0.015)	(0.015)	(7.400)	(12.381)
THR	-0.031***	0.031***	-6.666	2.192
	(0.009)	(0.009)	(4.653)	(7.784)
THR*year1	0.025**	-0.025*	6.116	0.172
	(0.012)	(0.012)	(6.237)	(10.434)
Public school	0.039***	-0.039***	6.116	-6.222
	(0.008)	(0.007)	(6.237)	(6.426)
R-squared	**0.2046**	**0.2046**	**0.5803**	**0.5755**
Observations	**263**	**263**	**263**	**263**

Notes: Robust standard errors in parentheses, clustered at province level

*** Significant at 1%; ** significant at 5%; * significant at 10%. Covariates are not presented in the table

Healthcare professionals' labour income and multiple job holding in a developing country: Evidence from urban areas of Cameroon[1]

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Abstract

This paper aims to analyse the effect of labour income on the multiple jobholding behaviour of healthcare workers in urban Cameroon by estimating a binomial *Probit* or a multinomial *Logit* model according to definition of the dependent variable. The data used were collected as part of the project on *Working conditions of healthcare workers in urban areas of Cameroon* in 2013. Statistical analyses show that physicians take up a second job even when their main income is already high. Among nurses and health technicians, differences in hourly wage are not significant between multiple and single job holders. The econometric results show that the effect of the labour income from the primary job on the likelihood of healthcare workers taking up a second job is low and not significant, whereas the effect of the income from the alternative job is positive and significant.

Keywords: Labour income, multiple job holding, health workers, urban areas, Cameroon.

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1. Introduction

The standard neoclassical theory of labour supply assumes that an individual will prefer to devote his or her hours of work to the job that provides the highest income. Due to this dominant rationale in economics, the phenomenon of multiple employment has been ignored in the studies of labour economists (Heineck and Schwarze, 2004).[3] 'Multiple job holding' occurs in the case when a worker has an additional income-earning activity to his or her regular job. This behaviour has long sparked an unfinished debate about its impact within the healthcare system. While some authors acknowledge the contribution of the multiple job holding of physicians in maintaining quality healthcare professionals in public health facilities, others find this practice rather detrimental to the healthcare system.[4]

Opponents of multiple job holding among healthcare professionals believe that this behaviour leads to a reduction in the quality of care in public hospitals and creates problems of equity in access to healthcare (Zehnati and Peyron, 2013). The dual activity of healthcare professionals is often associated with an increase in induced demand for health services in the private facilities where they work in parallel. The propensity of healthcare professionals to refer patients to facilities where they have a financial interest exposes poor patients to a situation of vulnerability since private health services are often beyond their reach (Delfgaauw, 2007; Eggleston and Bir, 2006). In developing countries, multiple job holding applies to all categories of healthcare professionals, including those in the private healthcare sector. As such, it affects physicians as well as nurses and health technicians. In addition, it is not limited to the medical sector because it also takes into account secondary activities outside the healthcare sector (Ferrinho *et al*., 2004).

Some theoretical explanations have been put forward to understand why healthcare professionals decide to combine private activities with those of the primary job. Two main approaches are generally used. While the former is based on financial reasons (Boheim and Taylor, 2004; Shishko and Rostker, 1976), the latter includes other non-financial reasons (Averett, 2001; Renna and Oaxaca, 2006). The mention of financial reasons in the analysis of multiple job holding dates back to the study by Shishko and Rostker (1976), who explore multiple job holding in theoretical and empirical terms, based on the model of the constraint on hours worked on the primary job. They explain that, due to multiple contraints[5] on the hours worked, the individual is unable to work and thus earn as much

[3] Throughout this paper, the terms 'multiple employment', 'moonlighting', 'multiple job-holding' and 'dual practices' will be used interchangeably to indicate multiple employment.
[4] For the comprehensive literature on this debate, see Egglesson and Bir (2006); Biglaiser and Ma (2007); Zehnati and Peyron (2013).
[5] Notably, the economic and conditions and outlook, and the institutional factors.

income as he or she desires in the primary job in order to reach the amount of hours to maximize its utility. Therefore, he or she could work in a second job in order to reach his or her target income level. As such, multiple job holding behaviour would be seen as a consequence of a financial need (Panos, Pouliakas and Zangelidis, 2011) or as a survival strategy for the poor (Panos, 2007). Therefore, multiple job holders would earn less in their primary job than those with only one job (Boheim and Taylor, 2004).

Also, workers would be averse to uncertainty about their incomes. And in order to manage negative income shocks, a second job is a bridge against unemployment (Wu *et al*., 2008; Panos et al., 2011) or as an insurance that would smoothen consumption (Wu *et al*., 2008, Boheim and Taylor, 2004). Moreover, from the perspective of non-financial reasons, individuals could hold more than one job even in the absence of hour constraints or irregular income from the primary job. This behaviour derives from professional motives and preference for job diversification (Averett, 2001, Renna and Oaxaca, 2006). Multiple job holding can also be interpreted as an opportunity to learn new technologies in order to develop skills and competences (Jamal and Crawford, 1981; Brekke and Sorgard, 2007), or to enter into a process of occupational and/or employment transition (Zehnati and Peyron, 2013).

In view of the above, it appears that, from a theoretical point of view, the financial reasons of workers are challenged by non-financial reasons in the rationale of multiple job holding behaviour. The outcomes of financial reasons will therefore not only depend on the worker's preferences vis-à-vis these reasons, but also on the importance of non-monetary factors present in his or her environment.

In Cameroon, multiple job holding among healthcare professionals gained importance during the 1990s crisis in human resources in healthcare (MINSANTÉ, 2012), which occurred at the same time as the economic reforms and the restructuring of the healthcare system during a time of economic crisis. In addition to the 50 per cent depreciation of the national currency (CFA franc), public sector healthcare professionals experienced a double drop in salaries (50 per cent) in 1992 and 1993 (MINSANTÉ, 2012). At the same time, the liberalization of the labour market and the healthcare sector in the early 1990s led to the development of atypical forms of employment, which negatively affected the income earned from the labour market. However, in spite of the economic situation of healthcare professionals and the development of multiple job holding behaviour in the healthcare sector, studies on the multiple job holding of this group of workers are still rare in Cameroon.

This paper analyses the effect of labour income on the multiple job holding behaviour of healthcare professionals. It focuses on two aspects. First, it narrows the gap in the number

of empirical studies on multiple job holding in developing countries, in general, and the multiple job holding of healthcare professionals, in particular, by relying on an original database on the activity of healthcare professionals. Second, it makes it possible to take into account the peculiarities of the multiple job holding of healthcare professionals in developing countries by distinguishing between the secondary activities of the medical sector and those carried out outside the healthcare sector. The following sections are structured as follows. Section 2 presents the contextual framework of the practice of multiple job holding in Cameroon. Section 3 presents the methodological approach, and Section 4, the data used. The statistical and econometric results are discussed in Section 5, while Section 6 concludes.

2. Contextual framework of the practice of multiple job holding in Cameroon

An appropriate analysis of multiple job holding in the health care sector requires reviewing of its regulatory framework and identifying Cameroon's human resources structure in healthcare.

2.1. The regulatory framework of private activities in Cameroon

In Cameroon, there are no specific regulatory measures to regulate private activities both during work days and work hours and after regular hours.[6] This is true both for healthcare professionals in the public sector and for those in the private sector. However, several legal provisions contained in the Statute for Public Health Officials, the Labour Code and the codes of ethics for the medical and paramedical professions set out prohibitions against regulating the behaviour of healthcare professionals, and therefore of certain elements of multiple job holding.

As regards the general duties of medical and medical health professionals, Articles 6 and 32 of the Code of Ethics for Physicians and the Code of Ethics for Paramedical Personnel, respectively, prohibit them from practising their profession while performing any other practice incompatible with the dignity and ethics of their profession, and to have a colleague manage a healthcare office, laboratory or delivery clinic in his or her place unless this is regularly declared as per Article 11 of the Code of Ethics for Physicians and Article 36 of the Code of Ethics for Paramedics. Any illegal exchange of money between practitioners or between practitioners and other persons is also prohibited for medical and healthcare professionals. provided for in the Code of ethics for Paramedical Personnel and the Code of Professional Conduct for Physicians in Articles 38 and 15, respectively.

[6] For public healthcare professionals, dual activity is not specifically regulated. According to an official from the Legal and Legal Affairs Division of the Ministry of Public Health, "what is not prohibited is permitted".

Similarly, the codes of ethics of medical and medical healthcare professionals prohibit any diversion and any attempt to divert patients (Article 50 of the Code of ethics of Medical Personnel and Article 43 of the Code of ethics of Medical and Health Personnel).

Moreover, as regards the duties of medical healthcare professionals towards their patients, Decree No. 2001/145 of 3 July 2001 on the special status of public healthcare professionals in public health bodies states in Chapter 2 that it is prohibited (Article 145 (2), to complaisantly issue medical certificates as well as any other medical documents, to engage in the parallel sale of medicines and medical consumables, to use public facilities for private purposes, to divert patients to private health facilities or to homes, and to divert supplies belonging to public health facilities (Article 146).

As regards the control of the specific duties of the healthcare professionals indicated above, the Orders of Physicians and Other Healthcare Professionals ensure that the principles of morality and dedication that are essential for the practice of the various professions are maintained as well as compliance with the rules set out in the codes of ethic. In the event of non-compliance with these rules, penalties ranging from warnings and the removal from the Professional Order to the temporary suspension of practice may be imposed depending on the severity of the act. In the public health facilities, financial penalties are also imposed for breaches in the duties indicated above. Article 17 (1) of Order No. 003/MPS/SAB of 16 November 1994 setting out the modalities to be followed for allocating quota shares to certain medical and healthcare personnel in public health facilities specifies for this purpose that extortion or diversion of patients and the parallel sale of medicines lead to the total removal of the quota shares for the period concerned.

Finally, in reference to Article 31(1) of the Labour Code of 1992, which regulates the work relations of employees of the private sector and contractual state agents, the worker devotes his or her entire practice to the institution in which he or she is employed, except otherwise stated as stipulated in the contract. Nevertheless, it is possible for him or her, unless otherwise agreed, to practise or his or her professional activity outside his or her work schedule that is not likely to compete with the enterprise or to prejudice the effective performance of the agreed services.

2.2 Characteristics of Healthcare Provision and Multiple Employment in Healthcare

The relationship between healthcare provision and multiple employment in healthcare can be highlighted in Cameroon based on two factors: the relative rareness of skilled healthcare professionals and the rapid and "uncontrolled"[7] growth of the private medical sector.

2.2.1. *Relative rareness of qualified human resources within the healthcare system*

Despite the exponential growth of the private healthcare sector, several shortcomings persist in terms of the availability of human resources in healthcare in Cameroon. Doctors, dental surgeons and paramedics are still most scarce in Cameroon's health system (MINSANTÉ, 2012). When observing the structure of the medical staff, which had a workforce of 1,842 in 2011, it is largely made up of general practitioners (75 per cent) and a minority of specialists (25 per cent). They are concentrated mainly in the Central, West and Littoral Regions[8] (MINSANTÉ, 2012). [9] These situations favour the increase of requests and job opportunities for medical specialists, even if they already have a primary job.

When assessing the availability of human resources against national and international standards, human resources requirements are even more evident. With regard to the density of health personnel, the densities of medical staff and of all healthcare professionals, fall short of international standards. Cameroon has 0.8 doctors per 10 000 inhabitants, i.e. one doctor per 12,500 inhabitants, against the international standard of 1 doctor per 10,000 inhabitants. In addition, the health system in Cameroon has 1.07 healthcare professionals per 1,000 inhabitants, a ration that is below the World Health Organization (WHO) recommended standard of 2.3 medical and paramedical staff per 1,000 population. These shortcomings in Cameroon's health system, particularly with regard to the availability of medical and paramedical staff, can thus be a factor that favours the multiple employment in the healthcare sector. This leads to an increased

[7] Several *groupements d'initiatives communes* (GIC, common initiative groups /health NGOs are emerging in the private health subsector without the authorization of the Ministry of Public Health. They are therefore not controlled (INS, 2008).

[9] Among these medical specialists, the need is particularly important in the fields of nuclear medicine and radiotherapy, anesthesia-resuscitation and emergency medicine, public health, psychiatry and anatomopathology, among others (MINSANTÉ, 2012).

[9] Among the ten regions of Cameroon, Yaounde and Douala, in addition to being the regional capitals of the Center and the Coastal Region, respectively, are also the political and economic capitals of the country. These two cities are the two largest cities in the country.

demand for the services of the ever-rare healthcare professionals in order to meet the needs expressed by other health facilities and by the populations.

2.2.2. *Emergence of the healthcare private sector*

In the 1990s, Cameroon's healthcare sector was liberalized by Decree No. 92-252-PM of 6 July 1992, which set the conditions and modalities for establishing and opening private health facilities by natural or legal persons regulated by private law. Since then, Cameroon's healthcare system has become increasingly dichotomized between the public and private sectors due to the emergence of the for-profit private sector and the strengthening of the private, not-for-profit sector. In 2011, the Ministry of Health reported 2,472 public health facilities (65 per cent) and 1,304 private health facilities (35 per cent). This development of the private healthcare sector has led to an increase in the demand for medical and medical healthcare staff to ensure the operations of the new health facilities (MINSANTÉ, 2012). Moreover, the preference expressed by patients for private health services has contributed to an increased demand for healthcare professionals in the private health facilities.

Indeed, statements of patients indicate that the private health facilities, especially faith-based ones, are the best equipped (INS, 2010) and, as a result, treat more patients than the public health facilities,[10] even though the latter have more staff than the former. The public health facilities alone account for 65 per cent of the healthcare staff, and the remaining 35 per cent are distributed through the private healthcare sector. The high demand for health services in private health facilities has often led to the questioning of their autonomous capacities, particularly with regard to the availability of human resources (INS, 2010). This situation favours the development of multiple employment in the healthcare sector, which would lead to the use of healthcare professionals from the public health facilities practising in the private health facilities. This could therefore lead to the recruitment of part-time healthcare professionals from Cameroon's public sector to the private health facilities (MINSANTÉ, 2012) or healthcare professionals from private health facilities to other private health facilities.

3. Methodology

This section aims to propose a methodology to analyse the multiple job holding of healthcare professionals and to specify the details of the estimation techniques used. According to Foley (1997) and Guariglia and Kim (2006), the empirical strategy developed in this study assumes that each healthcare professional maximizes the utility function

[10] For example, the private health facilities receive on average 15 patients per day against 8 patients per day in the public health facilities (INS, 2010).

under budgetary and temporal constraints as well as non-negativity constraints of work hours in the primary and secondary jobs. From this programme of optimization, the relationship between the primary job and the secondary job is determined at the optimum by two elements: the disutility of work and the wage rate in the second job. The reasoning of the healthcare professional will lead him or her to take on a second job if and only if the hourly wage (w_2)offered there exceeds his or her reservation wage rate, i.e. his or her marginal rate of substitution (MRS) between consumption and leisure when the number of hours in the second job is zero. Hence,

$$\begin{cases} h_2 > 0 & si\ et\ seulement\ si\ w_2 > TMS \\ & et \\ h_2 = 0 & si\ et\ seulement\ si\ w_2 \leq TMS \end{cases} \quad (1)$$

Where h_2 indicates the number of work hours in the second job. This equation implies that the engagement of the healthcare professional in a second job not only depends on the hourly wage offered in the secondary job, but also on the marginal rate of substitution (MRS) between labour and leisure. The latter is a function of the socio-demographic variables, the characteristics of the household, and the conditions under which the primary job is performed.

Thus, in addition to the hourly wage of the second job, participation in a second job generally depends on six groups of variables: (i) labour market variables, including the hourly wage of the primary job, the number of work hours in the primary job, wage arrears in the primary job, working conditions, and the degree of security of the primary job; (ii) occupational variables, notably qualifications and experience in the profession; (iii) characteristics of the primary job, which include sector of employment, city of activity, healthcare facility category, monitoring of healthcare professionals on their job and the working environment in the health facilities; (iv) the socio-demographic variables of the healthcare professional, including age, sex, marital status and education; (v) the characteristics of the healthcare professional's household, including the number of dependent children and the employment status of the spouse; and (vi) finally, an unobservable component μ added to these groups of variables.

Assuming that Y_i^*, is the unobserved variable of recourse to a second job, equation (2) can be formulated as follows:

$$Y_i^* = \alpha' M_i + \mu_i \quad (2)$$

Where M_i is the vector of labour market variables, occupational variables, job characteristics, socio-demographic characteristics, and household variables of the

healthcare professional; α indicates the vector of the associated coefficients. It is assumed that μ_i has a zero mean and follows a normal distribution of variance of unity. The density function of μ_i thus describes a *Probit* model, which has been widely used in the analysis of multiple jobs (Foley, 1997). The latent variable Y_i^* is not observed. Only *Y* is observed, so that:

$$Y = \begin{cases} 1 & si \quad Y_i^* > 0 \\ 0 & si \quad Y_i^* \leq 0 \end{cases} \tag{3}$$

The healthcare professional *i* therefore takes on a second job if *Y* has the value 1.[11] However, the problem with the analysis of multiple job holding is that the wage income generated by the second job is observed only for multiple job holding workers. To solve this problem, the hourly wages of second jobs, estimated from the two-stage Heckman method (1979), will be attributed to all workers in the sample (Foley, 1997, Heineck and Schwarze, 2004 Guariglia and Kim, 2006). Heckman's method will be used here, ensuring that the conditions of identification are met through exclusion restrictions. It is a question of introducing into the equation of participation in a second job the variables that do not affect the determination of income from the second job. These variables include marital status, number of dependent children, spousal employment status, job security, working environment in the healthcare facility, wage arrears, satisfaction with working conditions, and the perception of control within the healthcare establishment. The correction of selection bias is made because multiple-job holding healthcare professionals may have self-selected in this sub-sample because of their unique characteristics that distinguish them from single job holding healthcare professionals.

— The extent of multiple job holding of healthcare professionals and other variables

A critical observation on the analytical treatment of multiple employment in the healthcare sector and its regulation in developing countries is that it places more emphasis on the activity of public sector healthcare professionals in the private healthcare sector (Berman and Culzon, 2004). With Ferrinho *et al.* (2004), the concept of the multiple job holding healthcare professionals in developing countries has evolved to a certain degree since the secondary practices go beyond the medical field and take into account those carried out in the agricultural and commercial sectors as well as other non-medical

[11] Multiple employment could also be defined in three categories as follows: 1 = secondary employment in the healthcare sector, 2 = secondary employment outside the healthcare sector 0 = single activity. In addition, in this framework, the model used is the multinomial Logit rather than the binomial Probit model.

activities. For example, a healthcare professional in this study will be said to be multi-job holding if, in addition to his or her primary job, he/she performs additional activity within and /or outside the healthcare sector (see Table 1).

Table 1: Forms of multiple employment performed by healthcare professionals

		Secondary employment			
		(1) In the healthcare sector			(2) Outside the healthcare sector
		Public	**Private, for-profit**	**Private, not-for-profit**	**Agriculture, non-medical commercial activities, etc.**
Primary employment	**Public**	Yes	Yes	Yes	Yes
	Private, for-profit	No	Yes	Yes	Yes
	Private, not-for profit	No	Yes	Yes	Yes

Source**:** Adapted from Ferrinho *et al*. (2004:4).

The definitions of other variables used in the equations of selection, determination of secondary income, and multiple employment holding are provided in the Annex, in Table 6.

4. Data

The data used in this study came from a field survey carried out in the cities of Yaoundé and Douala between October and November 2013 as part of the survey "Working conditions of urban healthcare professionals in Cameroon". This latter survey, conducted in collaboration with the International Development Research Center (IDRC) and the African Population and Health Research Center (APHRC), provides information on 830 healthcare professionals from the public, private and secular sectors. It provides information on the primary and secondary activities as well as the socio-demographic characteristics of the healthcare professional, income, and the working conditions of the primary job. The number of healthcare professionals selected for the survey in each type of healthcare facility, each institutional sector, each qualification and each city was determined using the quota method. Two observations were excluded from the analyses due to the missing values for the dependent variable. Another observation was excluded from the analyses because of inconsistencies in the wages from the primary job. After data

processing, 827 healthcare professionals were selected for this study. Among them, nurses, health technicians and physicians account for 67 per cent, 22 per cent and 11 per cent of the sample, respectively. It was on the basis of these observations that the estimates were made.

5. Empirical results

The econometric results that are analysed in this subsection are preceded by analyses of the relevant variables of the model.

5.1. Descriptive statistics

The results in Table 2 indicate that, overall, 26 per cent of healthcare professionals have more than one job, compared to 74 per cent who have only one. This multiple job holding rate of healthcare professionals in is higher than that obtained by Zehnati and Peyron (2013) on physicians in two large cities of Algeria (21.6 per cent), but lower than that indicated by Baah-Boateng (2013) in the Ghanaian urban labour market (30.45 to 33.44 per cent). The rate obtained of multiple job holding of healthcare professionals is equivalent to that of the Cameroon's labour market (26.1 per cent),[12] but it is almost double that observed at the urban level (14 per cent, of which 11 per cent are in Yaoundé and 10.1 per cent in Douala) (EESI, 2011). In addition, multiple job holding healthcare professionals reported a statistically lower number of weekly work hours in the primary job compared to those with only one job (38.04 vs. 40.42, respectively). They therefore work 2.37 hours per week (5.8 per cent) less than those with a single job. This result corresponds to the concept that opting for a second job is associated with the time constraints in the primary job.

Concerning the characteristics of healthcare professionals, Table 2 indicates that multiple job holding healthcare professionals are relatively young and mostly women. Multiple job holding is also more pronounced among healthcare professionals living without partners. In regards to the professional category, physicians seem to be the most inclined to multiple job holding. Compared to the place of professional training, professionals trained in Cameroon are less inclined to practice multiple job holding than those trained abroad. Furthermore, multidisciplinary healthcare professionals are more include to hold less secure jobs and have relatively less experience in the profession.

[12] All workers and not only those from the healthcare sector are taken into account in the EESI survey (2011).

Table 2: Descriptive statistics of individual and professional characteristics (%)

Variables	Multiple job holding	Single job holding	Total
Number of personnel (%)	215 (26)	612 (74)	827 (100)
Age (in years)	35.18 (7.3)	35.91 (9.156)	35.72 (8.713)
Sex			
Man	27.44 (0.030)	30.72 (0.018)	29.86 (0.015)
Woman	72.56 (0.030)	69.28 (0.018)	70.14 (0.015)
Matrimonial status			
In partnership	64.65 (0.032)	71.24 (0.018)	69.53 (0.016)
Single	35.35 (0.032)	28.76 (0.018)	30.47 (0.016)
Professional category			
Physician	20.00 (0.027)	08.00 (0.010)	11.12 (0.010)
Nurse	63.25 (0.032)	68.79 (0.018)	67.35 (0.016)
Health technician	16.75 (0.025)	23.21 (0.017)	21.53 (0.014)
Place of training			
Cameroon	85.11 (0.024)	92.97 (0.010)	90.93 (0.009)
Abroad	14.89 (0.024)	7.03 (0.010)	9.07 (0.009)
Job security			
Permanent	40.46 (0.033)	52.61 (0.020)	49.45 (0.017)
Precarious	59.54 (0.033)	47.39 (0.020)	50.54 (0.017)
Work hours (job 1)	38.04 (11.302)	40.42 (13.062)	39.80 (12.665)
Experience (average number of years)	7.67 (6.871)	8.22 (8.300)	8.08 (7.953)
Seniority in the facility (in months)	51.91 (57.643)	58.91 (71.765)	57.09 (68.410)
Satisfaction with working conditions (out of 10)	6.07 (1.803)	6.55 (1.865)	6.43 (1.860)
Wage arrears			
No	83.25 (0.025)	88.89 (0.012)	87.42 (0.011)
Yes	16.75 (0.025)	11.11 (0.012)	12.58 (0.011)
Perception of control			
Weak	29.76 (0.031)	21.89 (0.016)	23.94 (0.014)
High	70.24 (0.031)	78.11 (0.016)	76.06 (0.014)
Education			

1st cycle of secondary school or more	20.00 (0.027)	18.46 (0.015)	18.86 (0.013)
2nd cycle of secondary school	36.27 (0.032)	48.52 (0.020)	45.35 (0.017)
Higher education	43.73 (0.033)	33.02 (0.019)	35.79 (0.016)
Management position			
Director, General Supervisor or Medical Officer	17.68 (0.026)	17.34 (0.015)	17.41 (0.013)
Other position	21.86 (0.028)	24.50 (0.017)	23.82 (0.014)
No position	60.46 (0.033)	58.16 (0.019)	58.77 (0.017)
Working environment			
Poor	35.81 (0.032)	45.04 (0.020)	42.56 (0.017)
Good	64.19 (0.032)	54.96 (0.020)	57.44 (0.017)
Sector of primary job			
Public	46.05 (0.034)	48.69 (0.020)	48.00 (0.017)
Private secular	43.26 (0.033)	35.79 (0.019)	37.73 (0.168)
Private, faith-based	10.69 (0.021)	15.52 (0.014)	14.27 (0.012)
Type of facility			
Hospital	39.06 (0.033)	34.97 (0.019)	36.03 (0.016)
Medical centre	27.92 (0.030)	38.07 (0.019)	35.42 (0.016)
Other health centres	33.02 (0.032)	26.96(0.017)	20.55 (0.015)
City of practice			
Yaoundé	35.34 (0.032)	52.77 (0.020)	48.25 (0.017)
Douala	64.66 (0.032)	47.23 (0.020)	51.75 (0.017)

Table based on survey data. The values in parentheses represent the z-values

*** p<0.01, ** p<0.05, * p<0.1

In addition, multiple job holding is observed among the oldest healthcare professionals in their healthcare facility. Similarly, negative financial shocks and the perception of weak control in the healthcare facility seem to be associated with the multiple job holding of healthcare professionals. Moreover, a better working environment seems to favour the multiple job holding behaviour of healthcare professionals, probably because it allows them to better cover their activities when the parallel activity is performed during working hours. In addition, multidisciplinary healthcare professionals are represented more in faith-based public and private health establishments as well as in hospitals and integrated health centres. Finally, the multiple job holding is observed to a greater extent in Douala, the economic and commercial capital of Cameroon, than in Yaoundé, a more administrative town.

- **Multiple employment and a comparison between primary job wages**

Table 3 indicates that the primary job provides multiple job holding healthcare professionals with an hourly wage that is on average CFAF426 more than those with only one job. This result is the opposite of the concept that multiple job holding in Cameroon is due to financial concerns with respect to the primary job (INS, 2011). It suggests that wage income from the primary job would not be the major factor that would lead healthcare professionals to seek a second job. The reason is that this result conceals the disparities that exist in the distribution of average hourly wages within the different health professions. Indeed, out of all healthcare professionals, physicians are those who seem most inclined to perform a second job even though the income from their primary job is already relatively high. Multiple job holding doctors earned an hourly wage of CFAF4,042 in their primary job, whereas those with only one job had an hourly wage of CFAF2,216, a difference of CFAF1,825 (82.35 per cent).

Table 3: Gaps in hourly wages in the primary job: professional qualifications and multiple job holding

Variables	No. of personnel	Average (standard deviation)	Difference
Multiple jobs			
One job only	612	1 690.51 (219.64)	-
More than one job	215	1 264.56 (48.49)	425. 94 (153.65) ***
		1 375.30 (67.66)	

	Hourly wages						
Variables	**Est. multiple jobs (N1 = 215)**		**One job only (N2 = 612)**		**Total (N = 827)**		**Difference**
Professional category	Obs.	Average	Obs.	Average	Obs.	Average	
Physicians	43	4 042 (984.98)	49	2 216 (185.19)	92	3 069 (477.54)	**1 825 (942.98)***
Nurses	136	1 083 (83.59)	421	1 174 (59.49)	557	1 152 (49.37)	Not significant
Health technicians	36	1 177(182.08)	142	1 204 (78.91)	178	1 199 (72.69)	Not significant
				N = 827			

Note: Table based on survey data. The values in parentheses represent the standard deviations

*** p<0.01, ** p<0.05, * p<0.1

Due to the high expertise associated with medicine, multidisciplinary physicians appear to be those whose reputation in the primary job has already been proven, which is reflected by higher income and greater demand for them in the labour market. In the other categories of healthcare professionals, especially nurses and health technicians, there is no significant difference in hourly wages between multiple job holding and the single job holding. It appears that physicians' income is raising the average hourly wages of multiple job-holding healthcare professionals compared to single job holders in the sample.[13]

5.2. Econometric results and analysis

The econometric results recorded in Table 4 allow to analyse the effects of labour income and other control variables on the decision to opt for a second job. At 1 per cent (Prob chi2 = 0.000),[14] all the equations for the selection, secondary income and recourse to a second job equations are generally significant. The control of the selection bias in estimating secondary income was a wise decision because the variable indicating the inverse of Mills' ratio (IMR) is very significant. Analysis of the effect of labour income on opting for second jobs requires that income from the primary job be distinguished from that derived from the second job. In terms of primary job income, it appears that its effect on the likelihood of opting for a second jobs is small and insignificant. This result does not confirm the theoretical approach of the financial rationale for multiple job holding nor much of the empirical work (Baah-Boateng, 2013, Jan *et al*., 2008, Schwarze, 2004). However, a number of theoretical and empirical approaches help

The first explanation is linked to the reasoning of job heterogeneity (Renna and Oaxaca, 2006; Averett, 2001). This approach assumes that even when workers may have the opportunity to earn high income in their primary job, they may decide to pursue another job that is not perfectly replaceable even if it is paid at a lower rate than the primary job. Similarly, Averett (2001) finds that, in areas of expertise, individuals could take on a second job to carry out activities of particular interest to them. Thus, a physician could, in addition to his or her primary job, use his or her expertise to carry out external consultations even if he or she is already well paid in his or her primary job. The second explanation for the non-significance of labour income in the primary job may also come from the Gonzalez model (2004). This model assumes, as part of a dual public-private model, that multiple job holding physicians agree to perform a job in the public sector for strategic reasons.

[13] The average is the major area of focus, because it easily adapts to algebraic calculations; its particular feature is that it is highly sensitive to the extreme values of the distribution (Bouget and Vienot, 1995).
[14] The results of the estimate of equations on selection and secondary income are shown in the Annex (Table 7).

Table 4: Results of the estimates of the Probit model on opting for multiple jobs by healthcare professionals

	All		Nurses and technicians	
VARIABLES	**Coefficients**	**Marginal effects**	**Coefficients**	**Marginal effects**
Age	0.0173	0.005	0.00414	0.001
	(0.0150)	(0.004)	(0.0115)	(0.003)
Single	0.124	0.038	0.107	0.030
	(0.189)	(0.059)	(0.202)	(0.058)
Man	-1.269**	-0.307**	-0.733***	-0.175***
	(0.502)	(0.092)	(0.265)	(0.051)
Dependent children	-0.0341	-0.010	-0.0345	-0.009
	(0.0253)	(0.007)	(0.0268)	(0.007)
Spousal employment	0.00546	0.001	-0.139	-0.039
	(0.175)	(0.053)	(0.190)	(0.054)
Number of hours (job 1)	-0.0121**	-0.003**	-0.0136**	-0.003**
	(0.00582)	(0.001)	(0.00623)	(0.001)
Income from Job 1	0.0334	0.010	-0.0530	-0.014
	(0.111)	(0.033)	(0.119)	(0.033)
Income from Job 2 (imputé)	5.344**	1.621**	1.293**	0.364**
	(2.356)	(0.711)	(0.540)	(0.149)
Experience	0.0274**	0.008**	0.0245*	0.006*
	(0.0127)	(0.003)	(0.0135)	(0.003)
Permanent	-0.506***	-0.162***	-0.436***	-0.129***
	(0.114)	(0.038)	(0.122)	(0.038)
First cycle of secondary education or more	-1.912**	-0.341**	-0.464*	-0.115*
	(0.875)	(0.082)	(0.253)	(0.054)
Higher education	-0.504*	-0.134*	0.0508	0.014
	(0.294)	(0.066)	(0.156)	(0.045)
Physician	-5.453**	-0.446**		
	(2.705)	(0.118)		
Technician	-2.314**	-0.399**	-0.527**	-0.131**
	(0.991)	(0.094)	(0.233)	(0.049)
Cameroon	0.923*	0.198	-0.545*	-0.181*
	(0.513)	(0.068)	(0.330)	(0.123)

Director, General Supervisor or Medical Officer	0.0464	0.014	0.105	0.030
	(0.149)	(0.046)	(0.164)	(0.048)
Other position	-0.140	-0.041	-0.0480	-0.013
	(0.129)	(0.037)	(0.143)	(0.039)
Wage arrears	0.272*	0.088*	0.333*	0.103*
	(0.162)	(0.055)	(0.179)	(0.060)
Working environment	0.213*	0.063	0.257**	0.071**
	(0.110)	(0.032)	(0.118)	(0.032)
Control	-0.367***	-0.118***	-0.354**	-0.107**
	(0.130)	(0.044)	(0.141)	(0.045)
Working conditions	-0.100***	-0.030***	-0.0929***	-0.026***
	(0.0300)	(0.009)	(0.0325)	(0.000)
Hospital	-0.125	-0.037	-0.0558	-0.015
	(0.141)	(0.041)	(0.152)	(0.042)
Medical centre	-0.390***	-0.113***	-0.323**	-0.087**
	(0.143)	(0.039)	(0.155)	(0.040)
Private secular	-1.574**	-0.399**	-0.471**	-0.124**
	(0.665)	(0.135)	(0.215)	(0.052)
Private, faith-based	-1.867**	-0.308**	-0.534**	-0.126**
	(0.782)	(0.057)	(0.219)	(0.421)
Yaoundé	-0.394***	-0.118***	-0.481***	-0.134***
	(0.116)	(0.034)	(0.125)	(0.034)
Constant	-35.12**		-6.435*	
	(16.14)		(3.625)	
Observations	827		735	
Probability		0.229		0.201
Prob>chi2	0.000		0.000	

The table is based on survey data. The values in parentheses represent the z-values. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Results of the estimates of the multinomial Logit model on opting for multiple jobs by healthcare professionals

	All healthcare professionals				Nurses and health technicians			
	(1)		(2)		(3)		(4)	
Variables	**Healthcare sector**	**Marginal effects**	**Outside of the healthcare sector**	**Marginal effects**	**Healthcare sector**	**Marginal effects**	**Outside of the healthcare centre**	**Marginal effects**
Age	0.0373	0.004	0.0443	0.002	0.030	0.003	-0.0143	-0.001
	(0.0306)	(0.003)	(0.0529)	(0.002)	(0.025)	(0.002)	(0.0303)	(0.001)
Single	0.0994	0.007	0.507	0.030	0.0158	-0.002	0.557	0.036
	(0.385)	(0.046)	(0.552)	(0.037)	(0.418)	(0.041)	(0.563)	(0.039)
Man	-2.365**	-0.199**	-2.685	-0.100	-1.440***	-0.111***	-0.921	-0.039
	(0.989)	(0.073)	(1.945)	(-0.069)	(0.552)	(0.035)	(0.730)	(0.030)
Dependent children	-0.128**	-0.015**	0.0276	0.002	-0.161**	-0.016**	0.0275	0.002
	(0.0641)	(0.007)	(0.0558)	(0.003)	(0.0778)	(0.007)	(0.0555)	(0.003)
Spousal employment	-0.0995	-0.015	0.367	-0.021	-0.417	-0.045	0.242	0.017
	(0.359)	(0.043)	(0.521)	(0.027)	(0.396)	(0.042)	(0.535)	(0.030)
1st cycle of secondary education or more	-3.622**	-0.218**	-4.218	-0.108	-1.056**	-0.085**	-0.275	-0.009
	(1.729)	(0.070)	(3.392)	(0.067)	(0.524)	(0.033)	(0.686)	(0.036)
2nd cycle of secondary education	-0.815	-0.074	-1.427	-0.054	0.215	0.024	-0.163	-0.010

or more								
	(0.575)	(0.048)	(1.104)	(0.031)	(0.313)	(0.035)	(0.449)	(0.023)
Physician	-9.673*	-0.266	-14.42	-0.199				
	(5.358)	(0.092)	(10.56)	(0.181)				
Technician	-4.471**	0.122**	-4.878	-0.128	-1.292***	-0.103***	-0.223	-0.005
	(1.964)	(0.042)	(3.852)	(0.095)	(0.496)	(0.031)	(0.628)	(0.034)
Cameroon	1.722*	0.122*	1.962	0.057	-1.299**	-0.201	-0.0323	0.012
	(0.999)	(0.042)	(1.889)	(0.030)	(0.624)	(0.128)	(1.158)	(0.055)
Director, General Supervisor or Medical Officer	-0.00887	-0.002	0.181	-0.010	0.00184	-0.003	0.425	0.028
	(0.308)	(0.036)	(0.400)	(0.025)	(0.350)	(0.034)	(0.425)	(0.031)
Other position	-0.281	-0.029	-0.381	-0.018	-0.248	-0.024	0.0163	0.002
	(0.262)	(0.028)	(0.381)	(0.018)	(0.301)	(0.027)	(0.389)	(0.023)
Number of work hours (Job1)	-0.0191	-0.002	-0.0160	-0.000	-0.0226*	-0.002	-0.0204	-0.001
	(0.0119)	(0.001)	(0.0159)	(0.000)	(0.0131)	(0.001)	(0.0166)	(0.000)
Income job 1	-0.0349	-0.002	0.281	-0.016	-0.106	-0.010	-0.00451	0.000
	(0.223)	(0.001)	(0.304)	(0.017)	(0.242)	(0.024)	(0.323)	(0.018)
Income job 2 (imputé)	9.642**	1.046**	12.67	0.641	2.381**	0228**	1.910	0.095
	(4.655)	(0.549)	(9.181)	(0.503)	(1.130)	(0.111)	(1.482)	(0.085)
Experience	0.0635**	0.007**	0.0201	0.000	0.0496*	0.004*	0.0253	0.001
	(0.0259)	(0.003)	(0.0354)	(0.003)	(0.0284)	(0.002)	(0.0369)	(0.002)

Wage arrears	0.378	0.040	0.703*	0.045*	0.440	0.042	0.735	0.049
	(0.312)	(0.043)	(0.412)	(0.034)	(0.352)	(0.043)	(0.452)	(0.040)
Permanent	-0.938***	-0.117**	-0.740**	-0.035**	-0.859***	-0.093***	-0.558*	-0.027
	(0.224)	(0.032)	(0.317)	(0.021)	(0.246)	(0.031)	(0.333)	(0.022)
Working environment	0.461**	0.053**	0.0569	-0.000	0.443*	0.041*	0.375	0.018
	(0.224)	(0.025)	(0.301)	(0.016)	(0.247)	(0.024)	(0.323)	(0.018)
Control	-0.642**	-0.080**	-0.488	-0.023	-0.568*	-0.057	-0.650*	-0.038
	(0.257)	(0.037)	(0.351)	(0.023)	(0.291)	(0.035)	(0.367)	(0.027)
Working conditions	-0.230***	-0.026**	-0.0709	-0.002	-0.192***	-0.018***	-0.0939	-0.004
	(0.0609)	(0.007)	(0.0797)	(0.004)	(0.0676)	(0.006)	(0.0833)	(0.004)
Hospital	-0.126	-0.011	-0.429	-0.022	-0.0354	-0.001	-0.234	-0.013
	(0.277)	(0.032)	(0.392)	(0.020)	(0.305)	(0.030)	(0.411)	(0.022)
Medical centre	-0.547*	-0.055*	-0.954**	-0.045**	-0.409	-0.034	-0.875**	-0.044**
	(0.292)	(0.031)	(0.394)	(0.018)	(0.318)	(0.029)	(0.433)	(0.021)
Private secular	-3.092**	-0.284**	-3.143	-0.127	-1.053**	-0.094**	-0.383	-0.015
	(1.312)	(0.126)	(2.607)	(0.129)	(0.444)	(0.036)	(0.610)	(0.033)
Private faith-based	-3.327**	-0.186	-4.456	-0.099	-0.956**	-0.073**	-0.847	-0.035
	(1.553)	(0.048)	(3.065)	(0.042)	(0.458)	(0.028)	(0.655)	(0.024)
Yaoundé	-1.134***	-0.137***	0.280	-0.025	-1.306***	-0.136***	0.0525	0.012
	(0.245)	(0.028)	(0.332)	(0.018)	(0.273)	(0.028)	(0.343)	(0.019)
Constant	-62.71**		-88.41		-11.90		-12.75	
	(31.93)		(62.75)		(7.575)		(9.909)	
Observations	827		827		735		735	

Probability		0.138		0.060		0.115		0.063
Prob>chi2	0.000		0.000		0.000		0.000	

Table based on survey data. Values in parentheses represent z-values.
*** p<0.01, ** p<0.05, * p<0.1

NOTE: The main reason for the lack of the equation for physicians opting for multiple jobs is fundamentally technical and is due to the overall non-significance of the equation of the physician's secondary income. An explanation for this result may be due to the small sample size of the sub-population under consideration. This explains why the coefficients of the income equation in secondary jobs were not extracted to predict secondary income variables across the sample.

The primary job in a public hospital makes it possible to have a fixed salary and to gain a reputation and prestige among the patients, with the aim of obtaining income in the private sector, which depends directly on the demand for healthcare. Hence, the reputation and prestige gained in public hospitals give "good doctors" the opportunity to benefit from a high income in private clinics. Income from the primary job would therefore not be at the heart of the decision to pursue a second job. According to this reasoning, a physician could engage in multiple job holding even though his or her primary income is high.

The third explanatory hypothesis of the effect of labour income is related to the shortage of healthcare professionals in health systems. In fact, physicians account for 5.23 per cent of the health workforce in Cameroon, while nurses and health technicians account for almost 65 per cent (see Figure 3.2). In large metropolitan areas such as Yaoundé and Douala, general practitioners and specialists are once again divided between referral hospitals and those belonging to the margins of the health system, thus aggravating the shortage of physicians in urban areas. Under these conditions, physicians become a scarce resource in the face of the growing private healthcare sector and a sick population. This context encourages the physician to opt for more than one job in the medical sector even though he or she may have a high income from her or his primary job.

The last explanation comes from De Sardan's (2001) analysis of local professional cultures and privatized bureaucratic cultures of midwives in West Africa. The author concludes that for these healthcare professionals, a position would be less valued according to its official profile or salary than what it could provide in terms of extra job opportunities it offers, notably the opportunity to enter private practice. From this point of view, the multiple job holding behaviour of nurses and health technicians would be less sensitive to the level of their official income in the primary job, provided that they, by virtue of their status in the primary job, will benefit from financial opportunities, even illegal ones. The degree of importance given to labour income according to the above-mentioned the explanations how difficult it is to determine the recourse to multiple job holding of healthcare professionals by means of a waged-based policy.

In addition, income from secondary jobs has a positive and significant effect on the opting for secondary jobs (Table 4), notably on the resource of alternative employment in the medical sector (and not in the non-medical sector) (Table 5). The fact that healthcare professionals are more likely to take on alternative employment in the medical sector (and not in the non-medical sector) as a result of increased secondary income may be associated with the entry cost (learning, adaptation, physical investment, etc.) in a new field of activity; this cost could be higher than in the medical field. Similarly, income

insecurity in the primary job significantly increases the multiple job holding of healthcare professionals. The accumulation of wage arrears in the primary job increases the likelihood that healthcare professionals (nurses and health technicians) will take on additional employment by 10.7 per cent. When considering the overall sample, this significant effect of wage arrears is strong due to the probability that he or she will pursue another job outside the healthcare sector rather than remain as single job holder. Negative financial shocks and income uncertainties created as a result of wage arrears cause healthcare professionals to financially protect themselves by resorting to additional jobs. This result corresponds to that obtained by Boheim and Taylor (2004) in England. The behaviour of healthcare professionals is thus like an insurance that allows them to smooth their consumption.

Moreover, the number of work hours negatively and significantly influences the opting of healthcare professionals for multiple employment as well as for nurses and health technicians to seek secondary employment in the healthcare sector. Although the effect is weak, the negative coefficient of hours worked in the primary job confirms the concept that healthcare professionals who work more in their primary job are less likely to take on a second job. This result is consistent with the theory and especially with the work of Shishko and Rostker (1976) and recently with Baah-Boteng (2013) in Ghana. Finally, the precariousness of employment leads healthcare professionals to secure or smooth their incomes by taking a job in addition to the primary one. This result, which is strong among nurses, only in the secondary activities of the medical sector, are in line with concrete data obtained by Boheim and Taylor (2004) in the United Kingdom, which show that a permanent contract reduces the chances of opting for a second job.

6. Conclusion

This study aimed to assess the effect of the labour income of healthcare professionals on opting for secondary employment in the urban areas of Cameroon. It was carried out using by primary data collected in Yaoundé and Douala from healthcare professionals employed in district hospitals, *arrondissement* medical centres, integrated health centres, and in facilities that are respectively assimilated in the private sector. Two steps guided the methodology for the analysis. The first was based on statistical analyses to describe the profile of healthcare professionals according to whether they a multiple job holding behaviour or not. The second step allowed to make econometric estimates of the multiple job holding behaviour of healthcare professionals using Probit binary and multinomial logit models.

The potential selection bias associated with the non-observability of secondary income of single job holding healthcare professionals led to the use of the two-step Heckman method for estimating the logarithm equation of the secondary income. At the end of the study, the following results were obtained: at the statistical analysis level, multiple job holding healthcare professionals earned a higher hourly wage in the primary job than those with a single job. This result is due to the fact that of all the categories of healthcare sector, physicians are those who mostly seem to take on a second job even though their main incomes are already relatively high. According to econometric analysis, this study finds that labour income from the primary job has a non-significant effect on the probability of taking on alternative employment, while the secondary income has a positive and significant effect on the probability of taking on an alternative job in the health field rather than remaining with a single job.

This is strong result regardless of the estimate considered. Also, uncertainty about earnings derived from employment increases the likelihood of opting for a second job. A policy based on high wages with respect to one aimed at a regular income would therefore be ineffective in controlling the multiple job holding behaviour of healthcare professionals working in cities in Cameroon.

Annexes

Table 6: Definition of variables to be used in equations on selection, secondary incomes and recourse to multiple jobs

Variables	Definition of variables
Dependent variable	
Multiple employment	1 if the healthcare professional has one job (one activity) in addition to his / her primary job and 0 if not.
Demographic variables	
Age	Age of healthcare professional
Single	1 if the healthcare professional is single, widowed or separated, and 0 if not
Man	1 if healthcare professional is male and 0 if not.
Children	Number of dependent children of healthcare professional
Education	
1st cycle of secondary education or more	1 if the healthcare professional has at least completed the first cycle of secondary education and 0 if not
Higher education	1 if the healthcare professional has completed a higher educational level and 0 if not
Professional characteristics	
Seniority	The number of months of seniority in the healthcare facility
Experience	The number of years of experience as a healthcare professional
Physician	1 if the healthcare professional is a nurse and 0 if not
Health technician	1 if the healthcare professional is a health technician and 0 if not
Permanent	1 if the healthcare professional works in his or her primary job as a permanent employee and 0 if not
Director/General Supervisor/Medical Officer	1 if the healthcare professional has a position as head of the healthcare facility, general

Other position	supervisor or medical officer and 0 if not
Cameroon	1 if the health worker has a less important position and 0 if not
	1 if the healthcare professional was trained in Cameroon and 0 if not
Internal factors of the primary job	
Number of work hours (job 1)	Weekly hours of contract work in the primary job
Income job 1	Logarithm of hourly wage of the healthcare professional in the primary job
Control	1 if the healthcare professionals consider the level of control to be high in the healthcare facility
Environment	and 0 if not
Satisfaction with the working	1 if the working environment within the healthcare facility is considered "good" and 0 if not
conditions	The level of satisfaction with working conditions, continuous variable ranging from 1 to 10
Wage arrears	1 if the healthcare professional experiences wage arrears problems in his/her primary job and 0 if not
Secondary job(s)	
Income job 2	Logarithm of hourly wage of healthcare professional in secondary job(s)
Characteristics of primary job	1 if the healthcare professional works in a healthcare facility classified as a hospital (4th category)
Hospital	and 0 if not
Medical centre	1 if the health worker works in a healthcare facility of the *arrondissement* medical centre (5th
Private, secular	category) and 0 if not
Private, faith-based	1 if the healthcare professional works in a private, secular healthcare facility and 0 if not
Yaoundé	1 if the healthcare professional works in a private, faith-based healthcare facility and 0 if not
	1 if Yaoundé is the city where the healthcare professional practises and 0 if not

Source: Author

Table 7:

Results of secondary income estimates using the two-step Heckman method

	(1)	(2)	(4)	(5)
	All healthcare professionals		Nurses and health technicians	
VARIABLES	**Income job 2**	**Selection equation**	**Income job 2**	**Selection equations**
Age	-0.00465	-0.00933	-0.00305	-0.000806
	(0.0126)	(0.0102)	(0.0135)	(0.0113)
Man	0.209	-0.210*	0.419**	-0.249*
	(0.155)	(0.126)	(0.181)	(0.139)
Single		0.0955		0.1000
		(0.187)		(0.199)
Dependent children		-0.0337		-0.0397
		(0.0251)		(0.0271)
Spousal employment		0.0309		-0.0971
		(0.172)		(0.186)
Experience	0.00468	0.00578	0.0300	0.00292
	(0.0266)	(0.0113)	(0.0346)	(0.0128)
Experience squared	-0.000290		-0.00182	
	(0.000893)		(0.00146)	
Seniority		0.000642		0.000258
		(0.00105)		(0.00123)
Permanent		-0.484***		-0.425***
		(0.110)		(0.118)
1st cycle of secondary education or more	0.367**	0.0376	0.395**	0.0332
	(0.165)	(0.136)	(0.165)	(0.138)
Higher education	0.113	0.0858	-0.0468	-0.0249
	(0.159)	(0.134)	(0.187)	(0.153)
Physician	1.146***	0.707***		
	(0.234)	(0.195)		
Technician	0.418**	-0.0644	0.351**	-0.0626
	(0.174)	(0.135)	(0.174)	(0.137)
Cameroon	-0.195	-0.183	0.328	-0.134
	(0.225)	(0.200)	(0.333)	(0.283)

/General Supervisor/Medical Officer		0.0465		0.0852
		(0.147)		(0.161)
Aposte		-0.152		-0.0666
		(0.129)		(0.142)
Arrears		0.252		0.299*
		(0.158)		(0.175)
Working environment		0.197*		0.259**
		(0.108)		(0.117)
Control		-0.338***		-0.338**
		(0.128)		(0.139)
Working conditions		-0.0974***		-0.0888***
		(0.0297)		(0.0322)
Hospital		-0.107		-0.0529
		(0.139)		(0.150)
Medical centre		-0.365***		-0.304**
		(0.140)		(0.152)
Private, secular	0.281**	-0.0989	0.301**	-0.101
	(0.136)	(0.141)	(0.148)	(0.151)
Private, faith-based	0.328	-0.208	0.170	-0.370*
	(0.219)	(0.187)	(0.245)	(0.201)
Yaoundé		-0.351***		-0.437***
		(0.115)		(0.123)
Lambda	0.533***		0.532***	
	(0.188)		(0.194)	
Constant	6.804***	1.223**	6.212***	0.901
	(0.511)	(0.489)	(0.579)	(0.554)
Observations	827	827	735	735

Table based on survey data. Values in parentheses represent z-values.

*** p<0.01, ** p<0.05, * p<0.

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Household Income Inequality in Ghana: A Decomposition Analysis

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Abstract

The study sought to decompose income inequality across various household income components and to estimate the marginal effects of changes in income components on overall income inequality in Ghana. A Gini decomposition procedure was applied to the fifth and sixth rounds of the Ghana Living Standards Surveys. The results suggest that, in general, income inequality has increased marginally over the years (Gini coefficient of 0.66 in 2013 and 0.62 in 2006).

Inequality was however higher in urban areas than in rural areas in 2013 with the reverse observed in 2006. The income component analysis suggests that wage employment income dominated household income in both rural and urban areas, even though the magnitude was higher in urban areas. Farm income was only dominant in rural communities in 2006. Self-employment and remittance income had consistent equalizing effects on total household income distribution. The findings suggest that directing poverty reduction strategies towards specific income components will be crucial for improving income inequality.

Key words: Household income, Inequality, Gini decomposition, Ghana

JEL: D630, I32, I38

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[2] Welfare levels for 2005/06 were revised based on new poverty lines from 2012/13.

1. Introduction

Reducing poverty and inequality has been a principal concern among many developing country governments over several decades. This is evident in the targets set under the Millennium Development Goals to halve poverty by the year 2015 (United Nations, 2010). The threat posed by poverty to human development in the areas of education and health makes the fight against poverty crucial. Like many other developing countries Ghana has engaged in various poverty reduction programmes, including a number of structural adjustment programmes. These programmes seem to have yielded positive dividends with a decline in poverty rates over the past years. Poverty fell from 51.7 per cent in 1991/92 to 31.9 per cent in 2005/06[2] and further to 24.2 per cent in 2012/13. This suggests that Ghana is in good position to achieve the MDG 1 target of halving poverty between 1990 and 2015 (Ghana Statistical Service, 2014a).

Further, Ghana's new lower middle-income status coupled with the discovery of crude oil has raised the country's economic prospects and its expectations of accelerated economic growth. Understanding the nature and trend in household income inequality is therefore crucial to identify whether this economic growth has been beneficial. Indeed, studies have consistently showed the existence of a link between inequality, poverty and economic growth and that reducing inequality is central to sustained economic growth (Fosu, 2009, Ravallion, 2001, Bourguignon, 2004). This study is motivated by the important role of income inequality in the growth and national development process.

Reduced income inequality is considered to be an important component of a country's growth and development agenda. This is because uncontrolled income inequality in a country could erode gains made from economic growth. Available evidence suggests that in Ghana about 2.5 percentage points of poverty reduction was lost as a result of the increase in income inequality between 1992 and 2006 (Cooke et al. 2016). This implies that policies directed towards growth and poverty reduction targets may be hindered by income inequality.

A body of literature on income inequality and its decomposition analysis has emerged over the years with different studies in different countries. For instance, applying an extended Gini decomposition procedure to United States income data, Lerman and Yitzhaki (1985) found

[2] Welfare levels for 2005/06 were revised based on new poverty lines from 2012/13.

that property income had a lower marginal impact on overall income inequality, and relative head of household and spousal earnings. Brewer and Lewis (2012) found that while general income inequality in Great Britain increased steadily since 1978, inequality in investment and pension income had fallen between 1991 and 2009. To understand the nature of income inequality in Greece, Papatheodorou (2000) showed that overall income inequality was significantly different among population subgroups. The decomposition analysis revealed that between group inequality accounted for very small part of overall inequality. The author, therefore, concluded that "reducing inequality between the household groups would have limited effect on reducing overall inequality". Using a regression-based approach to decomposing household income by source, Kimhi (2007) provided evidence from various decomposition methods to show that "non-farm income is an equalizing source of income among farm households in Georgia". Household land holdings was found to have significant influence on income inequality. Schooling, land holdings and farm assets had decreasing effects on inequality while family size had increasing effects. Some studies have also showed rural-urban differences in income inequality with Xin, Feng and Zongyi (2011) providing a good summary using data from China. The authors conclude that rural-urban differences are a dominant cause of inequality and the gaps in education and employment created by this difference impose long term effects on income inequality.

In Ghana, limited studies exist on the decomposition of household income inequality and the marginal impact of income component on inequality. Senadza (2011) provided a more recent evidence from the 2006 Ghana Living Standards Survey (GLSS) to show that aggregate non-farm income had an increasing effect on total income inequality. Further decomposition suggests that non-farm self-employment income and non-farm wage employment income had decreased and increased effect on overall inequality, respectively. Education was identified as crucial to the nature of inequality in non-farm income. This study differs from Senadza (2011) in various ways; first, we examined whether the various income sources have equalizing or unequalizing effect on overall inequality by estimating the marginal effects of income source on overall inequality. Secondly, we employ both the 2005/06 and 2012/13 GLSS data in a trend analysis to ascertain changes over time. Finally, while Senadza (2011) only focused on non-farm income in rural Ghana, we analysed inequality decomposition for all household income components and further disaggregated the analysis for both rural and urban households.

The remainder of the paper is structured as follows. Section 2 discusses the methodology and data used in the analysis while section 3 presents empirical findings. Sections 4 and 5 provide a discussion of results and conclusions with appropriate policy recommendations, respectively.

2. Methodology

2.1 Framework

The current study adopts a methodology developed by Lerman and Yitzhaki (1985) which is an extension of earlier income decomposition theories developed by Kakwani (1977) and Shorrocks (1982).

We begin with a supposed household's income, *y*, with its lowest level, *a*, highest level, *b*, and the cumulative distribution of income, *F*, then half of the mean Gini difference (*A*) can be written as follows:

$$A = \int_a^b F(y)[1 - F(y)]dy \tag{1}$$

using integration by parts, with $u = F(y)[1 - F(y)]$ and $v = y$, we obtain:

$$A = \int_a^b y[F(y) - 1/2]f(y)dy \tag{2}$$

Defining *y(F)* as the inverse function of *F(y)*, Equation (2) can further be transformed as:

$$A = 2\int_0^1 y(F)(F - 1/2]dF \tag{3}$$

Noting that *F* is uniformly distributed between [0,1] so that its mean is 1/2 Equation (3) can be re-written as follows:

$$A = 2\,\mathrm{cov}[y, F(y)] \tag{4}$$

The conventional Gini coefficient can then be derived by dividing equation (4) by the mean income (*m*).

2.2 Decomposition of income inequality

To decompose household income inequality, we assume that household income has *k* components such that $y = y_1,...,y_k$. Then Equation (4) can be re-written as follows using the properties of the covariance and $y = \sum_{k=1}^{K} y_k$

$$A = 2\sum_{k=1}^{K} \operatorname{cov}(y_k, F) \tag{5}$$

where $cov(y_k, F)$ is the covariance of income component *k* with cumulative distribution of income. The relative Gini can therefore be obtained by dividing Equation (5) by *m* while multiplying and dividing each component *k* by $cov(y_k, F_k)$ and by m_k yields the decomposition by source as follows

$$G = \sum_{k=1}^{K} \left[\operatorname{cov}(y_k, F)/\operatorname{cov}(y_k, F_k)\right] \times \left[2\operatorname{cov}(y_k, F_k)/m_k\right]\left[m_k/m\right] \tag{6}$$

$$G = \sum_{k=1}^{K} R_k G_k S_k \tag{7}$$

where S_k represents the share of source *k* in total income, G_k is the source Gini corresponding to the distribution of income from source *k*, R_k represents the Gini correlation of income from source *k* with the distribution of total income.[3]

As noted by Stark, Taylor and Yitzhaki (1986) an intuitive interpretation of these parameters can be identified. For instance, the influence of an income component on total inequality depends on: (1) the importance of a particular income source with respect to total income, S_k; (2) how equally or unequally distributed this income source is, G_k; and (3) the correlation between this income source and total income, R_k.

Lopez-Feldman (2006) observed that an income component with a large share of total income is likely to have a large impact on inequality. However, an equally distributed income source ($G_k = 0$) cannot influence overall inequality. On the contrary, a large and unequally

[3] $R_k = Cov\{y_k, F(y)\} / Cov\{y_k, F(y_k)\}$ where $F(y)$ and $F(y_k)$ are the cumulative distribution of total income and of income source k.

distributed income source (S_k and G_k are large) can either have an increasing or decreasing effect on total inequality. An increasing or unequalizing effect may occur if the source of inequality favours the rich (R_k is positive and large) while a decreasing or equalizing effect may occur if inequality favours the poor.

2.3 Marginal impact

Understanding the impact of small changes of a particular income source on overall income inequality is critical to any decomposition analysis. Suppose a small change in income from source k equal to ey_k, where e is close to unity and y_k is income from source k. The partial derivative of the Gini coefficient with respect to a percentage change in income source k can be obtained as

$$\partial G / \partial e_k = S_k (R_k G_k - G) \tag{8}$$

where G is the Gini coefficient of total income inequality prior to the income change. It can further be shown that, the percent change in inequality resulting from a small percentage change in income from source k equals the original contribution of source k to income inequality minus source k's share of total income:

$$\frac{\partial G / \partial e_k}{G} = \frac{S_k G_k R_k}{G} - S_k \tag{9}$$

2.4 Data

The study was based on cross section data from the fifth and sixth round of the GLSS conducted by the Ghana Statistical Service. The GLSS is a data series comprised of various socio-economic indicators. The first five surveys were conducted in 1997, 1988, 1991/92, 1998/99 and 2005/06. The sixth and most recent was conducted between October 2012 and October 2013.[4] The data is nationally and regionally representative with comprehensive information on household income and expenditure. A total sample of 16,772 households were interviewed with 7,445 (44.4 per cent) urban and 9,327 (55.6 per cent) rural households (Ghana Statistical Service, 2014b).

[4] See sixth GLSS report for further details about sampling procedure.

To perform the income source decomposition analysis, household income was disaggregated into the following components;

i. Farm income (farm): this comprised all income from engagements in agricultural activities including wages, sale of farm products etc.
ii. Non-farm employment wage income (wage employment): this was made up of income from all non-farm formal and informal engagements
iii. Non-farm self-employment wage income (self-employment): this included income from both formal and informal self-employment activities
iv. Rental income (rent): this included returns from all forms of capital and land
v. Remittance income (remittances): this was made up of both domestic and international transfers from family and friends to the household
vi. Miscellaneous income (Miscellaneous): These were all other sources of income in the household apart from the above mentioned components

3. Results

Table 1 shows decomposition results of household income components at the national level. The results show that wage employment income accounts for about 70 per cent and contributed the largest share to non-farm income as well as to total household income in Ghana in 2013. This indicates a significant rise from about 33 per cent in 2006. Self-employment income contributed the lowest to household income with an income source share of approximately 0.1 per cent in 2013, while miscellaneous income contributed the lowest (about 1.2 per cent) to total income in 2006. It is worth noting that farm income contributed about 19 per cent to total income in 2013, a reduction from about 30 per cent in 2006.

In general, household income inequality has marginally increased between 2006 and 2013. A Gini coefficient of about 0.66 was estimated in 2013 relative to 0.62 in 2006. The decomposition analysis suggests that in 2013, with the exception of income from miscellaneous sources, income from self-employment with a source Gini coefficient of about 0.93 and remittances with a source Gini coefficient of about 0.92 were the most unequally distributed. In 2006, wage employment income sources (source Gini of about 0.89) and remittance income (source Gini of about 0.88) were the most unequally distributed.

A further examination of the share of total inequality (share) suggests that wage employment income contributes the highest to total income inequality in both 2013 (about 78 per cent) and 2006 (about 38 per cent). The Gini coefficient correlation with distribution of total income (R_k) also shows that wage employment income favours the rich more than any other income source with relatively high values of about 0.94 in 2013 and 0.82 in 2006. On the other hand, income from remittances, even though highly unequal, favours the poor and has a slightly equalizing effect on the distribution of total income. This is shown by the relatively small (about 3.0 per cent in 2013 and 10.8 per cent in 2006) share of remittances in total income inequality and the relatively low (about 0.49 in 2013 and 0.64 in 2006) Gini coefficient correlation between remittance income and total income.

Table 1 also show that in 2013, self-employment income favoured the poor more than any other income source with a Gini correlation coefficient of approximately 0.48 despite being the most unequal. On the other hand, rent income favoured the poor more than any other income source in 2006. This implies that self-employment wage income and rent income had the most equalizing effect on the distribution of income in 2013 and 2006, respectively. Farm income was unequally distributed in 2013 and 2006 with a Gini coefficient of 0.81 and 0.87, respectively. The Gini correlation between farm income and total income was around 0.62 and 0.66 in 2013 and 2006, respectively. Farm income also contributed around 15 per cent and 27 per cent of total income inequality in 2013 and 2006, respectively.

Table 1: ***Trend in national income inequality by source***

	2013				2006			
Income source	S_k	G_k	R_k	Share	S_k	G_k	R_k	Share
Farm	0.19255	0.81427	0.62505	0.14875	0.29511	0.86706	0.66421	0.27376
Wage employment	0.69880	0.77820	0.94020	0.77601	0.32533	0.88716	0.82422	0.38319
Self-employment	0.00115	0.92521	0.48314	0.00078	0.23081	0.84549	0.67822	0.21319
Rent	0.04645	0.70668	0.50940	0.02538	0.01796	0.80923	0.29485	0.00690
Remittances	0.04473	0.91662	0.48794	0.03037	0.11925	0.87989	0.64154	0.10843
Miscellaneous	0.01631	0.99131	0.76272	0.01871	0.01154	0.99462	0.78512	0.01452
Total income		0.65886				0.62080		

Source: Authors' computation

Note: S_k=Income share; G_k= Gini source; R_k= Correlation with rank of total income; Share= Share of income inequality

Similar analysis was conducted for rural households in Ghana. The results in table 2 show that, in general, inequality in rural household income increased marginally from a Gini coefficient of 0.61 in 2006 to 0.64 in 2013. While farm income contributed about 52 per cent of household income in 2006, this share fell significantly in 2013 to 36 per cent of total household income. Farm income also contributed about 31 per cent of total income inequality in 2013, a reduction from 51 per cent in 2006. This income source was also unequally distributed with a relatively high source Gini in both 2013 (0.72) and 2006 (0.74). The relatively high Gini correlation with rank of total income in 2013 (0.78) and 2006 (0.81) imply that farm income favoured the wealthy. The trend however shows a slight decline in the period 2006-2013. It is also worth mentioning that while farm income was the highest contributor to total rural household income in 2006, this changed in 2013 with wage employment income becoming the highest contributor to income.

Similar to the earlier results, with the exception of miscellaneous income, self-employment (0.93) and remittance (0.90) income were the most unequal in 2013 while the most unequal income sources in 2006 were wage employment (0.94) and remittances (0.88). Despite their unequal nature, self-employment and remittance income favoured the poor with a relatively low Gini correlation with total income of 0.45 and 0.40, respectively. On the contrary, the most unequal income sources in 2006 also recorded a relatively high Gini correlation with total income of 0.81 and 0.61, respectively. This implies that wage employment and remittance income had a relatively dis-equalizing effect on the distribution of total income in 2006.

Table 2: *Trend in rural income inequality by source*

Income source	2013				2006			
	S_k	G_k	R_k	Share	S_k	G_k	R_k	Share
Farm	0.35989	0.72071	0.77916	0.31482	0.52261	0.73804	0.80730	0.50869
Wage employment	0.54267	0.80427	0.91466	0.62187	0.17651	0.93873	0.80779	0.21866
Self-employment	0.00062	0.92568	0.46024	0.00041	0.18128	0.86470	0.67389	0.17257
Rent	0.05100	0.63348	0.54900	0.02763	0.02150	0.70549	0.35356	0.00876
Remittances	0.03257	0.90335	0.40465	0.01855	0.08781	0.88214	0.60682	0.07679
Miscellaneous	0.01325	0.99469	0.81448	0.01672	0.01028	0.99751	0.86676	0.01452
Total income		0.64194				0.61212		

Source: Authors' computation
Note: S_k=Income share; G_k= Gini source; R_k= Correlation with rank of total income; Share= Share of income inequality

The inequality analysis for urban household income components is detailed in table 3 below. The results indicate that income inequality in urban areas increased over the years with a Gini coefficient of approximately 0.60 in 2006, compared to 0.66 in 2013. The income source decomposition analysis show that wage employment income was consistently the highest contributor to total urban income over the period and accounted for 82 per cent of total income in 2013 compared to 44 per cent in 2006. Moreover, wage employment income also contributed the highest to overall income inequality in 2013 (87 per cent) and 2006 (47 per cent). As expected, in 2013, the share of farm income as percentage of total income was low in urban areas at 5.9 per cent, and its contribution to total inequality was also low (4.6 per cent). The share of farm income in total urban income was relatively higher (12.5 per cent) in 2006 and contributed 16.4 per cent to overall inequality.

The Gini coefficients suggest that, apart from miscellaneous income, farm income and remittance income were the most unequal in 2013. In 2006 farm income and rent income were the most unequal. However, the Gini correlation with total income suggests that farm income favoured the rich more in 2006 than in 2013. On the other hand, remittance and rent income favoured the poor in 2013 and 2006, respectively.

Table 3: ***Trend in urban income inequality by source***

Income source	2013				2006			
	S_k	G_k	R_k	Share	S_k	G_k	R_k	Share
Farm	0.05926	0.9305	0.54744	0.04574	0.1251	1.05526	0.74021	0.16362
Wage Employ	0.82317	0.72832	0.96191	0.87383	0.43654	0.81111	0.80002	0.47433
Self-employ	0.00158	0.90701	0.43964	0.00095	0.26782	0.80037	0.61901	0.22218
Rent	0.04283	0.75991	0.4803	0.02369	0.01532	0.87942	0.22441	0.00506
Remittances	0.05442	0.91329	0.48132	0.03625	0.14274	0.85051	0.59395	0.12074
Miscellaneous	0.01874	0.98699	0.69725	0.01954	0.01248	0.99006	0.6799	0.01407
Total income		0.65996				0.59721		

Source: Authors' computation
Note: S_k=Income share; G_k= Gini source; R_k= Correlation with rank of total income; Share= Share of income inequality.

In comparing the decomposition analysis for rural and urban areas, it can be observed that, overall income inequality was higher in urban areas than rural areas in 2013. The reverse was observed in 2006 where overall income inequality was higher in rural areas than in urban areas. Also the share of farm income in total income was significantly higher in rural areas than in urban areas. Indeed, farm income contributed the most to overall rural income in 2006, even though wage employment income contributed slightly more than farm income in 2013. On the contrary, wage employment income consistently dominated overall urban income in 2006 and 2013. Remittance income was more important in urban areas than rural areas, contributing more to overall urban income and inequality than rural.

3.1 Marginal effects of income source on overall inequality

To further understand the extent to which the various income sources have equalizing or unequalizing effect on total income inequality, the marginal effects were computed and reported in table 4. Podder (1993) noted that, in examining whether an income source has equalizing or unequalizing effect, the marginal effects are more informative than the proportional contributions to inequality. Paul (2004) and Kimhi (2007) established that the marginal effects are more consistent in such analysis. The marginal effects also show the impact of a 1 per cent change in a particular income source on overall income inequality. A negative (positive) marginal effect shows that a percentage increase in a particular income source reduces (increases) overall income inequality and hence has an equalizing (dis-equalizing/unequalizing) effect.

Table 4 shows that, all other things being equal, a 1 per cent increase in farm income decreases the Gini coefficient of total income by 0.044 per cent in the national sample, 0.045 per cent in the rural sample and 0.014 per cent in the urban sample. In 2006, a 1 per cent increase in farm income, all things equal, decreases overall inequality by 0.021 per cent and 0.014 per cent in the national and rural samples, respectively, but increased inequality in the urban sample by 0.039 per cent. This implies that, with the exception of results on the urban sample in 2006, farm income largely had an inequality decreasing effect and hence equalizing effect on overall income distribution.

Similarly, household remittance income showed consistently negative estimates, implying that a marginal change in this income source decreases overall income inequality. This suggests that remittance income was an equalizing income source for both rural and urban households and over time. For instance, in 2013, the marginal effect show that a 1 per cent increase in remittance income, all things equal, decreases the Gini coefficient for overall income by 0.014 per cent, 0.014 per cent and 0.018 per cent in the national, rural and urban samples, respectively. Similarly, self-employment and rent income were also found to be equalizing income sources, irrespective of the survey year and place of residence.

Conversely, wage employment income consistently showed an increasing impact on overall inequality with positive marginal effects. The results show that, in 2013, a 1 per cent increase in wage employment income, all things being equal, increases overall inequality by 0.077 per cent, 0.079 per cent and 0.051 per cent in national rural and urban samples, respectively. Similarly, a 1 per cent increase in this income source, increased total inequality by 0.058 per cent, 0.042 per cent and 0.038 per cent for national, rural and urban samples in 2006, respectively.

Table 4: ***Marginal impact of change in income source on total income inequality***

	2013			2006		
Income source	National	Rural	Urban	National	Rural	Urban
Farm	-0.04381	-0.04507	-0.01352	-0.02134	-0.01392	0.03852
	(-0.050, -0.038)	(-0.060, -0.032)	(-0.017, -0.010)	(-0.345, -0.0004)	(-0.028, -0.001)	(0.021, -0.062)
Wage employment	0.07721	0.0792	0.05066	0.05786	0.04215	0.03779
	(0.070, 0.083)	(0.063, 0.092)	(0.045, 0.057)	(0.040, 0.070)	(0.034, 0.053)	(0.010, 0.053)
Self-employment	-0.00037	-0.00021	-0.00063	-0.01762	-0.00871	-0.04564
	(-0.004, -0.003)	(-0.003, -0.002)	(-0.008, -0.005)	(-0.024, -0.090)	(-0.017, -0.003)	(-0.054, -0.036)
Rent	-0.02107	-0.02337	-0.01914	-0.01106	-0.01274	-0.01026
	(-0.023, -0.018)	(-0.025, -0.021)	(-0.022, -0.014)	(-0.013, -0.009)	(-0.014, -0.011)	(-0.012, -0.008)
Remittances	-0.01437	-0.01402	-0.01817	-0.01082	-0.01102	-0.022
	(-0.015, -0.013)	(-0.015, -0.013)	(-0.022-0.015)	(-0.018, -0.006)	(-0.018, -0.003)	(-0.033, -0.010)
Miscellaneous	0.00241	0.00347	0.0008	0.00298	0.00424	0.00159
	(0.001, 0.005)	(-0.008, -0.009)	(-0.001, -0.006)	(-0.004, -0.009)	(-0.003, -0.016)	(-0.002, -0.006)

Source: Authors' computation

Note: Bias corrected 95 per cent confidence intervals obtained from bootstrap procedure are reported in parenthesis

4. Discussion

The findings of the study suggest that, in general, household income inequality slightly increased over the period 2006-2013. This is in spite of the significant economic growth recorded in Ghana over the period. Available statistics suggest that between 2006 and 2013, Ghana's GDP growth rate averaged 8.1 per cent (World Bank, 2013). This rate is economically significant considering the global economic crises recorded within the same period. However, the findings of the study point to the fact that this growth has not reduced inequality. A similar trend in inequality was found for both rural and urban areas. It is also interesting to note that, contrary to what prevailed in 2006, urban communities were more unequal that rural communities in 2013. This, however, echoes similar findings by other researchers such as Mussa (2014) who found higher urban inequality in Malawi.

Disaggregating household income showed that non-farm wage income (from wage employment or self-employment) was the dominant contributor to household income in both rural and urban areas. Farm income was only dominant in rural areas in 2006. This finding suggests that, over the years, there has been a shift from agricultural activities to non-agricultural waged activities. However, non-farm wage employment, self-employment and remittance sources of income were the most unequally distributed, irrespective of the year, even though the inequality in self-employment and remittance income favoured the poor more than wage employment. This finding suggest that an unequally distributed income source does not necessarily mean it is pro-rich. That is, an income source may be highly unequal (high Gini coefficient) but also be pro-poor (Taylor *et al.*, 2005, Lopez-Feldman, 2006).

The marginal effects, which are considered to be the more effective way of establishing whether changes in an income component increases or decreases overall inequality, suggest that farm income, remittances, self-employment and rent income had the most important reducing effect on total income inequality in Ghana. This finding was consistent, irrespective of the year and place of residence, even though farm income had a more equalizing effect on income distribution in rural areas than urban areas. This findings echo those of Senadza (2011) who found that non-farm self-employment income was more equalizing than non-farm wage employment. Senadza (2011) argues that this is due to barriers to entry that exist in non-farm wage employment activities. These barriers (such as skill and education levels) act as significant limitations on poor households or individuals who are largely unable to acquire

the requisite skills. On the other hand, self-employment on any scale, even though it may require specific skills, is easier for the poor to engage in. In terms of the equalizing effect of remittances, Taylor and Wyatt (1996) came to the similar conclusion that remittances reduce inequality because they factor into a greater share of poor households' income. The authors argued that remittances can increase the access of poor household to credit by facilitating the accumulation of productive assets which in turn can lead to increased future income.

The findings serve as important tools in refocusing policies directed towards poverty and inequality reduction. Blanket poverty reduction policies that seek to increase income may not achieve their objective and may rather lead to increased inequality which only favours the rich. While household income levels may generally increase, the poorest households may be disadvantaged under such an income distribution. Effective poverty reduction policies that also target inequality reduction should focus on the poorest households. For instance, policies that encourage small scale self-employment activities will be crucial for reducing income inequality. Such policies may include access to credit and provision of basic infrastructure for individuals in self-employment activities.

5. Conclusion

The paper set out to investigate inequality in household income components. The marginal effects of the impact of changes in inequality in income components on overall income inequality were also estimated. Using data from the fifth and sixth GLSS, the trend in inequality between 2006 and 2013 was explored. The results suggest that, in general, income inequality has increased marginally over this period. Inequality was however higher in urban areas than in rural areas in 2013 with the reverse being observed in 2006. The income component analysis suggests that wage employment income dominated household income in both rural and urban areas, even though the magnitude was higher in urban areas. Farm income was only dominant in rural communities in 2006. It can also be concluded from the decomposition analysis that self-employment and remittance income were the two most consistent income sources that had equalizing effects on total household income distribution, even though their Gini coefficients suggest they were highly unequal.

The findings provide important policy implications for Ghana. In recent times, several poverty reduction strategies have been adopted in Ghana. These include the Savannah Accelerated Development Authority (SADA) and social cash transfer programmes such as the Livelihood

Empowerment against Poverty (LEAP). While these programmes are important for poverty reduction, directing them towards specific income components will be crucial to improving income distribution.

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The Poverty and Inequality Nexus in Ghana: a Decomposition Analysis of Household Expenditure Components

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Abstract

The study examined the linkages between inequality in household expenditure components and total inequality and poverty in Ghana. Using microdata from the sixth round of the Ghana Living Standards Survey (GLSS 6) conducted in 2012/2013, marginal effects and elasticities were computed for both within- and between-component analysis. The results suggest that, in general, reducing within-component inequality significantly reduces overall poverty and inequality in Ghana, compared with between-component inequality. Specifically, inequality in education and health expenditure components were the largest contributors to overall poverty and inequality. The findings imply that policies directed towards reducing within-component inequality will be more effective than those directed towards between-component inequality. Specifically, the findings of the study corroborate with tax policies (such as Value Added Tax and the National Health Insurance Levy in the case of Ghana) that provide exemptions for educational, health and agricultural inputs. This will lead to reduction in overall poverty and inequality by reducing inequality within these expenditure components. The results were robust irrespective of the poverty line used and consistent for both rural and urban locations.

Keywords: Household expenditure, inequality, poverty,
Ghana JEL: D630, I32, I38

1. Introduction

The devastating impact of poverty has caused policymakers to propose various policies directed towards its reduction. The situation is most severe in developing regions, where a significant proportion of the population still lives below the poverty line. The urgency in reducing poverty is evident in the Millennium Development Goals (MDGs), which have strong targets focused directly or indirectly on poverty reduction. While poverty reduction in itself is crucial, the concept is complex and requires a holistic approach. For instance, while economic growth is generally expected to translate into improved welfare and poverty reduction, this is not always the case. As noted by Araar and Duclos (2010), the impact of growth on poverty largely depends on whether the growth is pro-poor or a reduction in inequality that favours the rich. This implies that an effective assessment of the impact of growth on poverty requires an assessment of the link between growth and inequality and how this inequality consequently feeds into poverty.

In recent times, Ghana's economic prospects have experienced a major boost, with the country moving from low-income to lower-middle income status. The country has also discovered and started extracting crude oil in commercial quantities. Available statistics suggest that Ghana's gross domestic product (GDP) grew by an average of 8.1 percent annually between 2006 and 2013 (World Bank, 2013). However, as already mentioned, the extent to which this growth impacts on poverty significantly depends on how the wealth is distributed across the population. The aim is to find out whether the poorest households in the population also benefit from this growth (Ghana Statistical Service, 2014a).

There has been growing literature examining whether or not economic growth and development is pro-poor, with some authors suggesting that economic growth alone is not enough to reduce poverty unless it also reduces inequality (Ravallion, 2001; Fosu, 2009; Odedokun and Round, 2004). For instance, Dollar and Kraay (2002) provided evidence from 92 countries, spanning four decades, to show that growth does not necessarily reduce inequality. The results of the study show that the determinants of growth have little systematic effect on the income of households in the bottom quintile and that the poorest fifth of society benefits from these factors along with everyone else. In a similar study, Bourguignon (2004) found that there exists a negative relationship between inequality and economic growth. However, the author argued that this relationship applies to

redistribution of wealth rather than mere redistribution of income and is likely to favourably affect economic efficiency and growth. Such wealth redistribution can be achieved through correcting credit market imperfections that would otherwise limit productive investments, by lowering taxes or freeing other distortionary income redistribution mechanisms. Other empirical works on the inequality-growth nexus include Bruno et al. (1996) and Eastwood and Lipton (2001).

The literature on poverty and inequality decomposition has mostly focused on household income components. For instance, Araar and Duclos (2010) provided evidence from Nigeria to show that changes in within-component inequality generally had a higher impact on poverty compared with between-component inequality. Based on this finding, they concluded that policies directed towards reducing within-component inequality may be more effective at reducing poverty than policies directed towards reducing between-component inequality. Essama-Nssah and Lambert (2009), using data for the period 1993-2002 from Indonesia, showed that the amount of poverty reduction achieved over the period was much lower than what distributionally neutral growth would have produced. The decomposition for household expenditure components suggested that expenditure on food (particularly rice) was the main contributor to this pattern of poverty and inequality. It should be mentioned that these findings were derived from an elasticity-based methodology developed by the same authors. Applying the methodology proposed by Araar and Duclos (2010) to household expenditure components, Mussa (2014) found that increase in both within-component and between-component inequality raised overall poverty in Malawi. Specifically, inequality in food and health had relatively higher poverty-reducing effects.

The current study examined the link between poverty and inequality in Ghana. An inequality analysis of within- and between-household expenditure components was performed using data from the sixth Ghana Living Standards Survey. Specifically, the paper explores the impact of marginal changes in inequality in the various expenditure components on total inequality and poverty. The analysis was also conducted along rural and urban lines to further examine the direction and magnitude of impact.

The rest of the paper proceeds as follows: section two presents the methods and data used in the analysis, while section three presents the results. In section four, the results and their various policy implications are discussed. The summary and conclusions are presented in section five.

1.1 Brief country profile

Economic growth and poverty reduction strategies in Ghana date back to 1957, when the country gained independence. However, the most notable strategies were pursued after the country returned to constitutional rule. Ghana: Vision 2020 was the first coordinated programme of economic and social development to be pursued by the then Government in 1995. An offshoot of this programme was the first Medium-Term Development Plan introduced between 1997 and 2000. This programme's priority areas included economic growth and human development, as well as rural, urban and infrastructural development. Following the implementation of the Vision 2020 programme, the Ghana Poverty Reduction Strategy Paper I (GPRS I) was formulated and implemented over the period 2003-2005. Key objectives of the strategy included stabilizing the macroeconomy, achieving sustained economic growth and reducing the high incidence of poverty in the country, while its successes included creating the necessary fiscal space to increase expenditure in agriculture, health and education. To address challenges remaining after the GPRS I, the GPRS II was launched and implemented between 2006 and 2009. This time, the focus was on accelerating economic growth and poverty reduction by supporting the private sector to create wealth. More recently, the Ghana Shared Growth and Development Agenda (GSGDA) was implemented over the period 2010-2013.

In spite of the progress made by the various strategies in terms of economic growth and poverty reduction, there remain structural challenges that limit the capacity of the economy to achieve sustainable improvement in the population's livelihood. These include the inability of the increased growth rate to be accompanied by a reduction in inequality.

For instance, Table 1 shows a brief trend in economic growth, poverty and inequality in Ghana between 1991 and 2013. The table shows that the rate of economic growth steadily increased throughout the period, from 4 percent in 1991/92 to 8.5 percent in 2012/13. Similarly, poverty reduced from 51.7 percent in 1991/92 to 24.2 percent in 2012/13. On the contrary, the Gini coefficients show that inequality increased from 0.37 to 0.42 over the same period. This suggests that while economic growth and poverty have improved over the period, the same observation cannot be made for inequality, raising the question as to whether the achievements in economic growth have been pro-poor.

Table 1: ***Trends in inequality, poverty and economic growth in Ghana***

Year	Inequality (Gini)	Poverty (%)	Economic growth rate (%)
1991/92	0.37	51.7	4
1998/99	0.39	39.5	4.5
2005/06	0.42	28.5	6
2012/13	0.42	24.2	8.5

Source: GSS (2014a, 2007), Osei-Assibey (2014) and the World Bank (2013)

2. Methodology

To estimate the marginal impact of changes in the inequality of household expenditure components on overall inequality and poverty, the current study borrows from the methodology developed by Araar and Duclos (2010) and also used in Mussa (2014).[2] The starting point is to consider total expenditure with *K* components where the expected amount of expenditure component *k* at the *pth* percentile can be denoted by *s(p; k)*. The overall mean of expenditure component *k* is given as $m(k) = \int_0 s(p;k)dp$. It is worth noting that *s(p; k)* can be increasing o r decreasing in *p* or even negative.

2.1 Within-component inequality

Increasing the bipolarization of expenditure component *k* is equal to an increase in the distance between the total mean component and the individual value of all expenditure components. This can be derived by adding (η(k)-1)(μ(k)-s(p; k)) to *s(p; k)* (Arrar and Duclos, 2010).

The overall single-parameter Gini coefficient (S-Gini) after bipolarization, with parameter *η(k)*, reduces to the ordinary Gini coefficient if the parameter of inequality aversion, ρ, is set to 2 (i.e. ρ =2). This implies that the impact of a change in *η(k)* on inequality can be derived as

$$\frac{\partial I\left(\rho;\eta\left(k\right)\right)}{\partial \eta\left(k\right)}\Big|_{\eta(k)=1} = \frac{\mu\left(k\right)}{\mu} IC\left(\rho;k\right) \tag{1}$$

Where $\frac{\mu(k)}{\mu}$ represents the share of expenditure component k in total expenditure and IC(p;k) is the coefficient of concentration of component *k*. Thus, the impact on total inequality of an increase in inequality within a particular component (component inequality) depends both

on the expenditure share and on the concentration index of that component. The impact of component inequality on overall inequality is presented in equation (1). In order to capture the joint impact of inequality in all the components on total inequality, we simply apply the same *η(k)* to all components.

Given a poverty line (*z*) and poverty aversion parameter (α), the Foster-Greer-Thorbecke (FGT) (Foster et al., 1984) class of poverty indices, after applying the bipolarization factor, *η(k),* can be used to estimate the marginal impact of within-component inequality on total poverty as follows

$$\frac{\partial p\left(z;\alpha;\eta\left(k\right)\right)}{\partial \eta\left(k\right)} = \begin{cases} \alpha z^{-1}\mu(k)\left[p(z;\alpha-1)-\overline{CD}(z;\alpha;k)\right] if\ \alpha>0 \\ -f(z)(s(F(z);k)-\mu(k)) if\ \alpha=0 \end{cases} \tag{2}$$

f(z) and *F(z)* represent the probability and cumulative density functions, respectively, at *z (*Arrar and Duclos, 2010). *CD*(*z*;*a*; *k*) is a normalized consumption dominance curve for component *k* as developed by Makdissi and Wodon (2002).

The sign of the marginal impact of within-component inequality on poverty (Equation 2) depends on *z*, *α*, *μ(k)* and the distribution of *s(p; k)*. For instance, the sign of the poverty headcount (α = 0) depends on the difference between the expected level of expenditure component *k* at the poverty line and the overall mean value of the component. If *s[F(z); k]* exceeds *μ(k)*, the headcount will fall following an increase in the inequality of component *k*. Equation (2) measures the individual impact of inequality in each component on overall poverty. The joint impact of inequality in all the components on overall poverty is measured by applying the same *η(k)* to all components.

To measure the elasticity of total poverty with respect to within-component inequality, we combine the impact of within-component inequality on total inequality (equation 1) and on total poverty (equation 2) as follows

$$\varepsilon_{\eta(k)}\left(z;\alpha;\rho\right) = \frac{\partial P\left(z;\alpha;\eta\left(k\right)\right)/\partial\eta\left(k\right)}{\partial I\left(\rho;\eta\left(k\right)\right)/\partial\eta\left(k\right)} \frac{I\left(\rho;\eta\left(k\right)\right)}{\partial P\left(z;\alpha;\eta\left(k\right)\right)}\Big|_{\eta(k)=1} \tag{3}$$

Equation (3) captures individual expenditure component elasticities. A joint impact of within-component inequality on total poverty can be measured by applying *η(k)* to all components (Arrar and Duclos, 2010).

2.2 Between-component inequality

The basic idea here is to measure how changes in the bipolarization of average expenditure components impact on overall poverty and inequality without changing within-component inequality. Mussa (2014) provides a typical example of such a relationship, whereby an increase in food prices benefits producers of food items by raising their expenditure on other goods while buyers of food items redirect their spending to food items. The impact of such between-component inequality on overall inequality and poverty can be measured by defining a component-specific factor of change *τ(k)* in the average of component *k* while holding within-component as well as overall mean expenditure constant.

The marginal impact of a change in *τ* on the S-Gini coefficient is then given by

$$\frac{\partial I(\rho;\tau)}{\partial \tau}\Big|_{\tau=1} = \left[I - \sum_{k=1}^{K} \frac{IC(\rho;k)}{K} \right] \tag{4}$$

Equation (4) shows the impact of between-component inequality on overall inequality. On the other hand, the marginal impact of between-component inequality on overall poverty can be written as follows

$$\frac{\partial P(z;\alpha;\tau)}{\partial \tau}\Big|_{\tau=1} = \begin{cases} \alpha\left[P(z;\alpha) - P(z;\alpha-1) + \frac{\mu}{z}\sum_{k=1}^{K} \frac{\overline{CD}(z;\alpha;k)}{K} \right] if\, \alpha > 0 \\ -f(z)\sum_{k=1}^{K} s(F(z);k)\left(1 - \frac{\mu/K}{\mu(k)}\right) if\, \alpha = 0 \end{cases} \tag{5}$$

The elasticity of total poverty with respect to between-component inequality can be derived by putting equations (4) and (5) together as follows (Arrar and Duclos, 2010)

$$\varepsilon_{\tau}(z;\alpha;\rho) = \frac{\partial P(z;\alpha;\tau)/\partial \tau}{\partial I(\rho;\tau)/\partial \tau} \frac{I(\rho;\tau)}{P(z;\alpha;\tau)}\Big|_{\tau=1} \tag{6}$$

The direction of the poverty impact of between-component inequality is not pre-determined as the sign depends on $\frac{\mu/K}{\mu(k)}$ and *p(z; α-1)*.

2.3 Data and variable definition

The study was based on cross-section data from the sixth round of the Ghana Living Standards Survey (GLSS) conducted by the Ghana Statistical Service. The GLSS is a series of data collected on various socio-economic indicators. The first five surveys were conducted in 1997, 1988, 1991/92, 1998/99 and 2005/06. The sixth and most recent round (GLSS 6) was conducted between October 2012 and October 2013.[3] The data are nationally and regionally representative, with comprehensive information on household income and expenditure. In total 16,772 households were interviewed, with 7,445 (44.4 percent) urban and 9,327 (55.6 percent) rural households (Ghana Statistical Service, 2014b). Following Mussa (2014), household expenditure was disaggregated into four mutually exclusive and exhaustive components as follows: (1) food: this includes expenditure on all food items as well as beverages; (2) non-food non-human capital: this comprises all spending on non-food items apart from spending on human capital development such as education and health; (3) health: this include expenditure on health care such as consultation, medication and hospitalization; (4) education: this expenditure component covers school fees, books, uniforms and other education-related spending.

3. Estimation results

Table 2 shows some descriptive statistics on the share and mean of expenditure components included in the analysis. The statistics are presented at the national level and further disaggregated across rural and urban households. At the national level, the statistics suggest an average household expenditure of GH¢2722.95. However, average urban household expenditure (GH¢3746.54) was higher than average rural household expenditure (GH¢1905.91). Statistics on the expenditure components show that, at the national level, expenditure on food items made the highest contribution (48 percent) to total expenditure.

While a similar situation prevailed at the rural level, with food expenditure making up about 56 percent of total expenditure, non-human capital household spending was highest in urban areas, at about 46 percent of total expenditure. A comparison of spending on human capital shows that, at all levels, education expenditure was significantly higher than health expenditure. It is also worth mentioning that in all the expenditure components, average spending was higher in urban areas than in rural areas.

[3] See GLSS 6 report for further details on the sampling procedure

Table 2: *Descriptive statistics*

	National		Rural		Urban	
Source	Mean	Share	Mean	Share	Mean	Share
Food	1340.0	0.48	1083.85	0.56	1660.99	0.43
Non-human	1188.2	0.42	709.66	0.36	1787.89	0.46
Health	25.07	0.01	20.97	0.01	30.22	0.01
Education	169.56	0.09	91.43	0.07	267.44	0.10
Total	2722.9	1.00	1905.91	1.00	3746.54	1.00

Source: Authors' computation

Note: All amounts are presented in per capita Ghana Cedis (GH¢) and annualized. Expenditure component shares are computed by dividing mean of component by mean of total expenditure [μ(k)/μ].

Table 3 shows the incidence of poverty and inequality in Ghana at the national as well as the rural and urban levels. The poverty analysis was based on the FGT poverty analysis with three different indices, namely: poverty headcount ($\alpha = 0$); poverty gap ($\alpha = 1$) and poverty severity ($\alpha = 2$). As mentioned earlier, the inequality measure was based on the ordinary Gini coefficient (which is the S-Gini coefficient with $\rho = 2$). A critical part of the analysis was to select an acceptable poverty line (*z*). In this regard two different values of z, computed by the Ghana Statistical Service based on GLSS 6, were employed in the analysis. These are the upper poverty line (z = GHC1314.00) and the lower or food poverty line (z = GHC792.05).

The results show that, for headcount poverty at the national level, about 36 percent of households were living below the upper poverty line, while 14.9 percent were living below the lower poverty line. Significantly higher proportions of the poor were also based in rural areas, irrespective of the poverty line used. For the upper poverty line, 53 percent of the rural population were poor, compared with 19 percent of the urban population. On the other hand, for the lower poverty line, rural poverty was estimated to be 25 percent, compared with 5 percent in urban areas. A similar pattern prevailed in the poverty gap index and poverty severity index. The Gini coefficient (which is independent of poverty line) suggests an inequality level of 0.42. Again the Gini coefficient is slightly higher for rural areas than urban areas, suggesting that rural areas are more unequal than urban areas in Ghana.

Table 3: *Poverty and inequality incidence in Ghana*

	Poverty line= GHC 1314.00			Poverty line= GHC 792.05		
FGT index/Gini coefficient	Nationa	Rural	Urban	Nationa	Rural	Urban
Poverty headcount (α= 0)	36.3	53.4	19.2	14.9	25.1	4.7
Poverty gap (α= 1)	0.128	0.20	0.051	0.04	0.075	0.009
Poverty severity (α= 2)	0.061	0.10	0.019	0.02	0.032	0.003
Gini coefficient	0.422	0.39	0.387	0.422	0.394	0.387

Source: Authors' computation

Note: Poverty health count has been multiplied by 100

Table 4 presents the impact and elasticities of changing within-component and between-component inequality across household expenditure components and poverty indices (α) at the national level. In general the results show that broad changes in within-component inequality have a higher impact on poverty than broad changes in between-component inequality. This pattern is reflected in the elasticities, except for the case of poverty headcount (α = 0) where the magnitude of the elasticity of poverty is greater for between-component inequality.

It can also be observed that, irrespective of the poverty index used, the signs of the marginal impact and elasticity of within-component inequality on total poverty were all positive. On the contrary, the signs of the marginal impact and elasticities of between-component inequality on overall poverty were only positive for poverty headcount. This suggests that both within- and between-component inequality impact overall poverty headcount in the same direction. However, in the case of poverty gap and poverty severity, within- and between-component inequality impact poverty in opposite ways. This implies that an increase in within- and between-component inequality will decrease headcount poverty, while only an increase in within-component inequality will decrease poverty severity and poverty gap. Coupled with the relatively higher magnitude of impact, the findings suggest that policies directed towards reducing within-component inequality will be more effective at reducing overall poverty than policies intended to reduce between-component inequality.

Consequently, the results further show that a decrease in inequality in any of the expenditure components will lead to a reduction in poverty headcount, poverty gap and poverty severity. Specifically, education expenditure recorded the largest elasticity, irrespective of the poverty index used. A 1 percent reduction in inequality in education expenditure, all things being equal, will lead to a 1.14 percent, 3.46 percent and 2.82 percent reduction in overall poverty

headcount, poverty gap and poverty severity respectively. Reduction in inequality in health produced the second most important reduction in the overall poverty gap (3.38 percent) and poverty severity (2.83 percent), while non-food non-human expenditure had the second highest impact on overall poverty headcount (1.12 percent).

Table 4: ***Elasticity of poverty with respect to within- and between-component inequality (ρ = 2), national***

			α = 0		α = 1		α =	
Source	Share	MII	MIP	Elasticity	MIP	Elasticity	MIP	Elasticity
Food	0.48	0.00170	0.001559	1.066107	0.001736	3.372722	0.000697	2.82063
Non-human	0.42	0.00209	0.002012	1.118052	0.001953	3.083788	0.000747	2.45872
Health	0.01	0.00003	0.000029	0.985102	0.000036	3.382998	0.000014	2.83329
Education	0.09	0.00039	0.000383	1.142501	0.000408	3.462728	0.00016	2.81852
Within		0.00422	0.00395	1.088998	0.004133	3.237746	0.003236	5.28190
Between		0.00006	0.000116	2.115344	-0.000032	-1.65018	-	-4.46068

Source: Authors' computation

Note: MII is the marginal impact on inequality; MIP is the marginal impact on poverty; Elasticity is elasticity of poverty with respect to inequality. An upper poverty line of GH¢1314.00 was used.

A further decomposition analysis was performed across rural and urban areas. Table 5 shows results on the marginal impact of inequality in within- and between- household expenditure components on inequality and poverty, as well as the elasticities of the impact on overall poverty at the rural level. In general, the results show that the marginal impact of within-component inequality on poverty is higher than that of between-component inequality. However, the corresponding elasticities are higher for between-component than within-component inequality. The signs of the elasticities of changes in component inequality with respect to poverty vary across poverty indices: the elasticities for within- and between-component inequality were both positive for poverty severity and poverty gap, whereas only within-component elasticity was positive for headcount poverty. Also while the marginal impacts on overall poverty of a change in within-component inequality were all positive, the marginal impact for between-component was only positive for headcount poverty. It is worth noting that the marginal impact of a change in within-component inequality on overall inequality was positive while that of between-component was negative. The results suggest that, in rural Ghana, reductions in within-component inequality are more effective in reducing overall poverty and inequality, irrespective of poverty index used. However, with regards to the elasticity of impact, a reduction in between-component inequality is only effective in reducing poverty gap and poverty severity. Specifically, a 1 percent reduction in within-component inequality leads to a 0.26 percent, 1.63 percent and 2.96 percent reduction in poverty headcount, poverty gap and poverty severity respectively. On the other hand, a 1 percent reduction in between-component inequality, all things being equal, leads to a 4.29 percent and 11.29 percent reduction in poverty gap and poverty severity respectively.

A look at the various expenditure components shows that the marginal impacts with respect to poverty and inequality were all positive, irrespective of poverty index. Similarly the elasticities of impact were all also positive for all expenditure components and indices. Contrary to the findings at the national level, changes in inequality in food and non-food non-human expenditure impacted highest on overall poverty headcount. On the other hand, inequality in education and health were the highest contributors to poverty gap and poverty severity. For instance, in terms of poverty gap and severity, a 1 percent reduction in inequality in education and health led to a 1.69 and 1.67 percent reduction in poverty gap respectively, while poverty severity reduced by 1.58 percent and 1.54 percent respectively.

Table 5: ***Elasticity of poverty with respect to within- and between-component inequality (ρ = 2), rural***

			α = 0		α = 1		α =	
Source	Share	MI	MIP	Elasticity	MIP	Elasticity	MIP	Elasticity
Food	0.56	0.002032	0.000663	0.240782	0.001743	1.650722	0.000813	1.525851
Non-human	0.36	0.00161	0.00071	0.32519	0.00134	1.602247	0.000595	1.409104
Health	0.01	0.000043	0.000012	0.214624	0.000037	1.667642	0.000017	1.54366
Education	0.07	0.000254	0.000067	0.193696	0.000224	1.693923	0.000105	1.575925
Within		0.003938	0.00141	0.264184	0.003344	1.63388	0.003061	2.963117
Between		-0.000027	0.000126	-	-0.000059	4.29142	-	11.28622

Source: Authors' computation

Note: MII is the marginal impact on inequality; MIP is the marginal impact on poverty; Elasticity is elasticity of poverty with respect to inequality. An upper poverty line of GH¢1314.00 was used.

Table 6 shows the marginal impact of inequality in within- and between-expenditure components on poverty and inequality for urban areas. The table also shows the elasticities of impact on overall poverty. The results show that the magnitude of impact was higher for within-component inequality than for between-component inequality. The direction of impact was also the same for both within- and between-component inequality, irrespective of poverty index used. The elasticities of poverty with respect to within- and between-component inequality were all positive across the three poverty indices. This implies that a reduction in both within- and between-component inequality leads to a reduction in overall poverty. The signs of the marginal impact on inequality with regard to within- and between-component inequality were all positive, but were relatively higher for within-component inequality.

Specifically, the results suggest that a 1 percent reduction in within-component inequality leads to a 2.81 percent, 6.02 percent and 8.98 percent reduction in poverty headcount, poverty gap and poverty severity respectively. On the other hand, a 1 percent reduction in between-component inequality leads to a 2.16 percent, 0.69 percent and 0.60 percent reduction in poverty headcount, poverty gap and poverty severity respectively. It is worth mentioning that the magnitude and direction of marginal impact and elasticities are more consistent at the urban level than at the rural level. Furthermore, the magnitude of elasticities of poverty with regards to within-component inequality was greater in urban areas than in rural areas. The reverse was true for between-component inequality.

The individual component analysis shows that, irrespective of the poverty index, the marginal impact on poverty and inequality as well as elasticities were all positive. This implies that, all things being equal, a reduction in inequality in any one of the expenditure components will lead to a reduction in overall poverty and inequality. Education had the highest reducing effect on poverty and inequality, followed by food. For instance, a 1 percent reduction in education inequality or food inequality leads to 3.05 percent or 2.89 percent reduction in headcount poverty respectively. This was slightly different from rural areas, where inequality in education and health were the leading contributors to total inequality and poverty.

Table 6: ***Elasticity of poverty with respect to within- and between-component inequality (ρ = 2), urban***

			α = 0		α = 1		α =	
Source	Share	MII	MIP	Elasticity	MIP	Elasticity	MIP	Elasticity
Food	0.43	0.001449	0.00208	2.890367	0.001212	6.353346	0.00034	4.791254
Non-human	0.46	0.002045	0.002688	2.647174	0.00151	5.609726	0.00042	4.144609
Health	0.01	0.00003	0.00004	2.677472	0.000025	6.262691	0.00000	4.692585
Education	0.10	0.000349	0.000529	3.05467	0.00032	6.981007	0.00009	5.230152
Within		0.003872	0.005404	2.810124	0.003066	6.016532	0.00174	8.977162
Between		0.000162	0.000174	2.157658	0.000015	0.690399	0.00000	0.597107

Source: Authors' computation

Note: MII is the marginal impact on inequality; MIP is the marginal impact on poverty; Elasticity is elasticity of poverty with respect to inequality. An upper poverty line of GH¢1314.00 was used

4. Discussions

The findings of the study suggest that food expenditure was the highest contributor to total household expenditure at the national and rural levels. This is not surprising, as food consumption usually takes a significant part of household expenditure in developing areas, particularly in rural communities. On the contrary, non-food non-human capital expenditure contributed the most to total household expenditure at the urban level. Health expenditure made the lowest contribution to household expenditure, with similar findings at the national level as well as in rural and urban areas. This may partially be explained by the fact that Ghana operates a National Health Insurance Scheme (NHIS) that covers about 35 percent of the population (NHIA, 2012), whereby individuals are expected to pay an annual premium to enable them to receive health care for selected services at no cost. Under this scheme, the older population aged over 70 years, children under 18 years and pregnant women are exempt from paying the premium (Gajate-Garrido and Owusua, 2013).

The findings consistently show that a reduction in within-component inequality leads to a reduction in overall poverty and inequality. The relationship was consistent at the national level as well as in rural and urban areas. Changes in the poverty line did not also change the relationship.[4] However, the relationship for between-component inequality and poverty was not consistent. The findings generally have significant implications for government fiscal policies in the form of taxes/subsidies and expenditure. For instance, Mussa (2014) noted that when the marginal impact of inequality in a particular commodity on overall poverty is positive, a tax increase (decrease) on the commodity is likely to increase (decrease) inequality which in turn, increases (reduces) total poverty. In this regard, an effective poverty reduction strategy would be to decrease tax on the commodity or exempt it completely from tax.

With regards to the current findings, the signs of the marginal impact of within-component inequality on inequality and poverty were all positive, suggesting that a tax cut or exemption would likely reduce poverty by reducing inequality. Considering the magnitude of the elasticities of poverty with respect to within-component inequality, education had the highest effect on poverty. This implies that a reduction in taxes or an increase in government subsidies on educational commodities will significantly reduce inequality in educational expenditure, hence reducing overall poverty. In addition, a tax cut, exemptions or increased subsidies in health and food items will lead to poverty reduction in rural and urban areas respectively.

A good example of the implications of the findings for tax policy is the sales tax in Ghana. The

sales tax encompasses Value Added Tax (VAT) and the National Health Insurance Levy (NHIL).[5] These taxes are charged on goods and services sold in the country, with certain exemptions including health and educational items as well as agricultural and fishing inputs. Our findings corroborate these exemptions as they are likely to reduce inequality in these essential items and hence reduce overall inequality and poverty in Ghana. This is because, as discussed earlier, educational, health and food expenditure inequalities are the largest contributors to overall inequality and poverty. It is therefore important to ensure that more items are made exempt and that these exemptions are sustained to achieve general reduction in inequality and poverty in Ghana.

The findings of the study are also relevant for policy in terms of increasing government expenditure on within-component focused poverty reduction strategies. These include specific policies directed towards reducing inequality in sensitive household expenditure components. The signs and elasticities of poverty suggest that poverty reduction policies directed towards reducing inequality in human capital development, such as the education and health sectors, will be critical in Ghana. It is worth mentioning that the country has already made significant efforts in terms of such policies. With regards to education, relevant policies include the school feeding programme, which was intended to increase primary school enrolment and attendance among the poor. In recent times, the Government has proposed a new policy to make secondary education free. If these policies are implemented effectively, they are likely to reduce inequality in education and hence reduce overall poverty in Ghana.

Inequality in health was the other component of human capital development found by this study to have an important role in poverty reduction in Ghana. As reported earlier, reducing inequality in this component of household expenditure will reduce overall poverty. The Government made a critical policy effort in this regard in its introduction of the NHIS and its exemption of poor and vulnerable groups from paying premiums. The policy's primary aim is to make health care accessible to all Ghanaians and to reduce inequality in health care access. This implies that implementing this policy effectively will have poverty-reducing effects through reduced inequality. In addition, the findings also suggest that reducing tax or increasing subsidies on food items will also have significant poverty-reducing effects.

5. Conclusion

This paper sought to investigate the link between inequality in household expenditure components and overall inequality and poverty in Ghana. The analysis focused on within- and between-component inequalities using data from GLSS 6 conducted between October 2012 and October 2013. Household expenditure was disaggregated into four components: food; non-food, non-human capital; health; and education expenditure. The results showed that, in general, the largest part of Ghanaian household expenditure is on food and the smallest part on health items. The results also showed that an increase in within-component inequality increases overall poverty levels. It was also observed that the marginal impact of within-component inequality on poverty was higher than that of between-component inequality. A similar pattern was also observed for elasticity of poverty with respect to changes in within- and between-component inequality. The elasticity of poverty with respect to inequality in all the expenditure components was positive, irrespective of poverty index used. However, the elasticity of poverty with respect to changes in inequality in education expenditure was relatively higher at the national level as well as in rural and urban areas.

The findings suggest that appropriate government fiscal policies could be effective in reducing poverty. Specifically, reducing taxes and increasing government subsidies in human capital development will be critical in reducing inequality and poverty. Similarly, increased government commitments to pro-poor policies directed towards reducing inequality in education and health will be a step in the right direction.

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Appendix: Estimation results using the lower poverty line (GH¢792.05)

Table 1: ***Elasticity of poverty with respect to within- and between-component inequality (ρ = 2), national***

		α = 0			α = 1		α =	
Source	Share	MII	MIP	Elasticity	MIP	Elasticity	MIP	Elasticity
Food	0.47624	0.00170	0.002507	4.18609	0.001455	8.676893	0.000439	6.258797
Non-human	0.42395	0.00209	0.002806	3.80616	0.001522	7.377051	0.000445	5.153704
Health	0.00913	0.00003	0.00005	4.09523	0.00003	8.778557	0.000009	6.431319
Education	0.09067	0.00039	0.000586	4.26737	0.000329	8.550129	0.000098	6.06462
Within		0.00422	0.006037	4.06386	0.003336	8.021007	0.001983	11.38781
Between		0.00006	-1.1E-05	-0.51117	-0.000056	-8.99195	-	-18.1513

Source: Authors' computation

Note: MII is the marginal impact on inequality; MIP is the marginal impact on poverty; Elasticity is elasticity of poverty with respect to inequality. An upper poverty line of GH¢792.05 was used.

Table 2: ***Elasticity of poverty with respect to within- and between-component inequality (ρ = 2), rural***

		α = 0			α = 1		α =	
Source	Share	MII	MIP	Elasticity	MIP	Elasticity	MIP	Elasticity
Food	0.56270	0.002032	0.00261	2.022404	0.001821	4.73209	0.000601	3.61526
Non-human	0.36034	0.00161	0.00198	1.938139	0.001316	4.31734	0.000422	3.20266
Health	0.01088	0.000043	0.00005	1.901408	0.000039	4.83239	0.000013	3.73699
Education	0.06606	0.000254	0.00032	2.016929	0.000235	4.87806	0.000079	3.77925
Within		0.003938	0.00500	1.995569	0.003411	4.57308	0.002229	6.91706
Between		-	0.00001	-	-0.0001	19.82080	-	39.7989

Source: Authors' computation

Note: MII is the marginal impact on inequality; MIP is the marginal impact on poverty; Elasticity is elasticity of poverty with respect to inequality. An upper poverty line of GH¢792.05 was used.

Table 3: ***Elasticity of poverty with respect to within- and between-component inequality (ρ = 2), urban***

		α = 0			α = 1		α =	
Source	Share	MII	MIP	Elasticity	MIP	Elasticity	MIP	Elasticity
Food	0.43031	0.00144	0.00164	9.427244	0.000578	17.67595	0.000113	11.3344
Non-human	0.45774	0.00204	0.00204	8.286491	0.000682	14.78877	0.000132	9.338386
Health	0.00820	0.00003	0.00003	9.130382	0.000012	17.2742	0.000002	11.44064
Education	0.10373	0.00034	0.00043	10.30021	0.000152	19.35293	0.00003	12.29236
Within		0.00387	0.00438	9.398059	0.001424	16.2994	0.000554	20.73513
Between		0.00016	0.00003	1.869361	-0.000006	-1.73733	-	-7.12318

Source: Authors' computation

Note: MII is the marginal impact on inequality; MIP is the marginal impact on poverty; Elasticity is elasticity of poverty with respect to inequality. An upper poverty line of GH¢792.05 was used.

Food and Non-Food Expenditure Differential across Poor and Non-Poor Households in South-East Nigeria

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Abstract

This paper examines the expenditure differential patterns of food and non-food items in rural and urban south-east Nigeria, focusing on poor and non-poor households using the subdivision of the Nigeria National Bureau of Statistics Household Expenditure Survey data of 2009/2010(NBS_HhExp_2009/2010). Descriptive statistics and econometric models were used to profile the pattern of household expenditure on food and non-food items, as well as expenditure patterns for food and non-food items across poverty status, and to estimate the effects of household characteristics on food and non-food expenditure. Household characteristics included in the survey were: age, sex, sector (rural/urban) and the presence of a living spouse. Mean per capita expenditure of the non-poor in urban south-east Nigeria was found to be greater than that of the non-poor in the rural area, and mean per capital expenditure of the non-poor was greater or non-food items than food items. The mean per capita food and non-food expenditure in the urban area was found to be ₦77,181.27 while the mean per capita expenditure of households in the rural area was ₦67,621.61. Disaggregating the data into core/moderately/non-poor, the mean per capita food and non-food expenditure was ₦21,866.55k, ₦38,949.09k and ₦1, 100, 88.00k respectively. Thus the research was able to deduce that there ought to be a balance between the amount spent on both food and non-food items, scaling of the living standards of the rural poor and enhancement of the productive capacities of able-bodied groups to reduce the disparity observed in relation to food and non-food expenditure among the poor and non-poor households of south-eastern Nigeria.

Key words: food and non-food items, poor and non-poor households, Ordered Probit, expenditure differential pattern, rural and urban, south-east Nigeria.

1. Introduction

Food production, distribution and consumption is currently an issue of serious scientific, social and economic concern, with various studies and diverse researchers looking for answers to align food availability, sustainability and security with production, distribution and consumption (Nigerian Bureau of Statistics(NBS), 2012). A number of studies carried out on food have shed more light on food intake, availability, non-availability, expenditure, consumption, production and other related aspects (Obayelu *et al*., 2009; Pasquale De Muro and Mazziotta,2010/2011). These efforts have included international, national and non-governmental bodies in a bid to achieve better, more robust nutritional and food policies for

the teeming population (NBS, 2012). The issue of food consumption and expenditure is of utmost importance in developing countries, since food and non-food expenditure accounts for a larger share of household outgoings on a regular basis (Obayelu *et al.*, 2009). It is generally accepted that even if a particular household does not have adequate access to other essential commodities, their access to food must not be affected or tampered with (Dawoud, 2013). Access to food and non-food commodities is an important issue, directly linked to poverty and insecurity, and directly related to living standards and household resource accumulation or depletion in both the short- and long term (Chambers, 1995, 2011). The demand for food and non-food items depends on the population, the dietary habits of the populace, taste/preference and the per capita income of the people under consideration (Babalola and Isitor, 2014). Those living in the rural areas and villages of Asia and Africa are characterized as poor by the majority of indices (FAO, 2013). These people are overwhelmingly dependent on agriculture for their sustenance, food and non-food consumption expenditure and they have fewer alternative sources of income and/or employment, thus predisposing them to vulnerable conditions and crises (FAO, 2013). A large number of these people migrate to cities in search of employment, leading to overpopulation of towns and larger cities in developing countries (FAO, 2013). The International Food Policy Research Institute (IFPRI) estimates that about half of the world's hungry people are smallholder farming communities, surviving on their marginal lands which are prone to natural disasters including drought and flood, and often lacking modern agricultural inputs.

As the world's total urban population is increasing rapidly, so too is the number of people who are poor and hungry (UNICEF, 2013). Food and non-food consumption expenditure are pre-requisites to measuring poverty, determining the diverse consumption patterns, and calculating the consumer aggregate price index and both the long- and short-term availability of food and non-food items to households (HNLSS, 2012). Income and consumption expenditure are the most popular approaches to determining household living standards. Income essentially refers to the earnings from productive economic activities and current transfers made by the populace (Dawoud, 2013). As income tends to vary widely from week to week or month to month, information on consumption is much easier to obtain than that on income, particularly in agricultural communities and among those who are self-employed (Per Pinstrup-Andersen, 2009). Expenditure is usually measured over a week or month to then provide an indication of a household's consumption habits and expenditure patterns over a year. Hence, measures using consumption and expenditure produce a better

indicator of living standards (NBS, 2012). It is worth noting that food expenditure involves spending/expenses on food items (consumables) e.g. pulses, bread and cereals (Obayelu *et al*., 2009), while non-food expenditure is spending/expenses on non-edible items such as payment for electricity bills, housing rent and communication (Dawoud, 2013).

The poor, as defined by the Multidimensional Poverty Index (MPI, 2010, 2013), are those who are unable to obtain adequate income, find a stable job, own a property or maintain healthy living conditions; they also lack an adequate level of education and cannot satisfy their basic needs. People are also considered poor when their measured standard of living in terms of income or consumption is below the poverty line, a measure that separates the poor from the non-poor (Foster, Greer and Thorbecke, 1984; Okunmadewa *et al*., 2005). The poverty line is not the same everywhere; rather, it is relative to the norm in a particular country (MPI, 2010, 2013). Poverty could also refer to general scarcity, or the state of people who lack a certain amount of material possessions or money (IFPRI, 2013).

According to Olayemi (1995),the poor have no access to the basic necessities of life such as food, clothing and decent shelter; are unable to meet social and economic obligations; lack skills and gainful employment; have few, if any, economic assets; and sometimes lack self-esteem. Poverty can also be defined as the inability to attain a minimum standard of living (World Development Report (WDR), 1990). Poverty is multifaceted and characterized by a lack of purchasing power, exposure to risk, insufficient access to social and economic services and limited opportunities for income generation (WDR, 2009). The multidimensionality of the subject not only considers the absolute but also the relative positions as it relates to people's level of poverty, so the concept of defining who is poor by standard tools used to measure poverty in both its absolute and relative terms needs to be addressed concisely and precisely(WDR,2013). However, for the purpose of this study, the poverty decomposition indices of the Harmonized Nigeria Living Standards Survey (HNLSS) 2009/2010were used, whereby poverty was subdivided into core-poor, moderately poor and non-poor (based on two-thirds of per capita expenditure), with household expenditure delineated into food and non-food expenditure. Hence, this research carried out an analysis of expenditure differences among rural and urban dwellers in south-east Nigeria, considering the core poor, moderately poor and the non-poor.

2. Objectives of the study

The main objective of this study is to determine the food and non-food expenditure differential pattern across poor and non-poor households in south-eastern Nigeria, while the specific objectives are to:

1) Profile the pattern of expenditure on food and non-food items in south-east Nigeria.
2) Profile the pattern of expenditure on food and non-food items across poverty status of households in south-east Nigeria.
3) Estimate the effects of household characteristics on food and non-food expenditure in south-east Nigeria.

3. Justification for the study

This study focuses on Nigeria—the most populous country in Africa and the ninth most populous country in the world, with particular emphasis on the south-eastern part of the country. South-east Nigeria is one of six geopolitical zones in Nigeria, where agriculture, tourism and natural resource exploitation are the main employment sectors (Pius, 2014). The zone consists of five states: Abia, Anambra, Ebonyi, Enugu and Imo. This research also used the HNLSS, 2009/2010 conducted by the Nigerian National Bureau of Statistics. The HNLSS is a combination of the Nigeria Living Standards Survey (NLSS) and the World Bank's Core Welfare Indicators Questionnaire (CWIQ) (NBS, 2012). Hence the data used for this study can also be called the NBS_HhExp_2009/2010 (National Bureau of Statistics' Household Expenditure Survey Data 2009/2010). The total population size for NBS_HhExp_2009/2010 was 33,012; however, this study focuses more on the south-eastern part of Nigeria due to its agrarian lifestyle and the high disparity between the rural and urban, poor and non-poor populations (Pius, 2014).

This study used the Ordered Probit model—a regression model that generalizes probit regression, allowing the use of more than two discrete variables/outcomes that are ordered as the econometric tool for delineating food and non-food expenditure among poor, core-poor, moderately poor and non-poor in south-east Nigeria. The model is used to ascertain the relationships between a polytonous response variable which has an ordered structure and a set of regression variables. Besides the Ordered Probit, tools such as descriptive analysis and cross-tabulation were also used in this study.

Researchers from other poverty and food studies have examined other parts of Nigeria using various tools and analyses. In 2010, Obayelu and Awoyemi looked at the poverty profiles across all six geopolitical zones in Nigeria using the National Living Standards Survey data of 2003/2004 and employing the Foster-Greer-Thorbecke (FGT) poverty decomposition method. Omonona (2001) examined poverty correlations among rural farming households in Kogi State, Nigeria, using well-structured questionnaires, the descriptive analysis and FGT indexes.

Obayelu *et al*. (2009) examined the difference in food consumption patterns between rural and urban households in the north-central geopolitical zone of Nigeria using food consumption data obtained from households. The study was based on seven days' memory recall, descriptive analysis and the double-hurdle model, which was used due to the presence of a number of zero consumption responses in relation to fruit and vegetables. Meanwhile, in 2013 Dawoud carried out an econometric analysis of the changes in food consumption expenditure patterns. The study analysed the changes in food expenditure patterns over time in Egypt, placing particular emphasis on the differences between the urban and rural sectors. The double-log function type was used to estimate Engel curves, while weighted least squares were used in estimating the regression equations. The study used the household income, expenditure and consumption survey conducted by the Central Agency for Public Mobilization and Statistics of Egypt over two five-year survey periods from 1990/1991 to 2009/2010.

Thus, this study draws its strength from the fact that it was able to carry out a differential analysis of food and non-food expenditure among poor and non-poor households in the south-eastern region of Nigeria. It was also able to estimate the contributions of the different age groups, sex of households, household structures, sectoral analysis of the regions (rural and urban), purchases, and per-capita income of households to both food and non-food expenditure.

4. Methodology

The HNLSS is a combination of the Nigeria Living Standards Survey (NLSS) and the World Bank's Core Welfare Indicators Questionnaire (CWIQ) (NBS, 2012). Hence the data used for this study can also be called the NBS_HhExp_2009/2010 (National Bureau of Statistics' Household Expenditure Survey Data 2009/2010). The total population size for NBS_HhExp_2009/2010 was 33,012; however, this study focused more on the south-eastern part of Nigeria due to its

agrarian lifestyle and the high disparity between the rural and urban, poor and non-poor populations (Pius, 2014), the data was sorted and the other five geopolitical zones were dropped. Using STATA12 statistical/econometric software, this left a population size of 4,405 corresponding to the south-eastern part of the country. HNLSS data were used to categorize respondents as either poor or non-poor or into an in-depth division of core poor, moderate poor and non-poor households based on a 3,000 calories index division (NBS, 2012).This also forms the premise upon which this study bases its poverty line.

For the purpose of this study, the food and non-food items were categorized as obtained from the HNLSS data. Seventeen food groups were used: rice, maize, other cereals, bread, tubers and plantain, poultry, meat, fish and seafood, milk(cheese, eggs), oils and fats, fruits, vegetables, beans and pulses, sugar(jam, honey), non-alcoholic, alcoholic, and food items not mentioned (miscellaneous category)(Obayelu *et al*., 2009), while the non-food items used in this study were categorized into education(tuition), health, transportation, fuel, water, rent, and electricity (Dawoud, 2013).

The effects of household food and non-food expenditure were analysed using the functional form exponential regression equation, while the Ordered Probit regression model (Robinson, 1998) was used to determine the effect of poverty status on household characteristics and expenditure on food and non-food items. This model was chosen based on theoretical and statistical criteria. Total per capita food and non-food expenditure was the dependent variable for the exponential regression equation, while the poverty level based on the 3,000 calories index was the dependent variable for the Ordered Probit regression model. The following explanatory variables were used in the equations: sector (rural or urban), household size, sex of household head, household structure, presence of a living spouse (is spouse alive?), and age of household head. Household marital status was removed due to the effect of multi-collinearity with other variables in the exponential regression model, while it was included as part of the explanatory variables in the Ordered Probit model. The result of the analysis is presented in Tables 7 and 8.

5. Expenditure differential across households in south-east Nigeria

Expenditure was used as a proxy for income in this research in favour of the "permanent income hypothesis" by Friedman (1957), which argues that "household expenditures are more stable across time than current incomes which may fluctuate for groups within the self-

employed range, employees as well as due to uncertainties in life, events and other circumstances like savings, debt and running up and down".

Model specification: The exponential regression model and the Ordered Probit regression models were used, enabling this research to see/identify the level of interaction of the dependent variables (total per capita expenditure) and poverty status with the various independent variables i.e. the X(s) which are household size, sex of household head, sector (rural/urban), household structure, and presence of a living spouse (is spouse alive?). The exponential model was used because it gave an output of a robust coefficient of determination that supported expenditure based on economic theory and statistical significance.

The exponential regression model specification is expressed as:

$$\text{Ln } Y = f(X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + U \quad (1)$$

Where, Ln Y = Total per capita household expenditure (Naira),

X_1 = Household size

X_2 = Household marital status (1= married, 0= otherwise

X_3 = Sex of household head (1= male, 0= otherwise)

X_4= Household structure

X_5 = Presence of a living spouse in the household (Is spouse alive?)

X_6 = Sector (rural or urban) (1=rural, 0= otherwise)

X_7 = Occupation of household head

U = Error term and is assumed to be normally distributed, having a mean of zero and constant variance. This error term represents variations that are due to variables not specified in the model.

The Ordered Probit Model can be expressed as:

$$Y^* = \beta' X + U \quad (2)$$

Y is the dependent variable and Y* is the subdivision of the poverty status of the households,

i.e. $Y^* = 1$ (core poor) if $Y^* < U_1$ (3)

$Y^* = 2$ (moderately poor) if $U_1 < Y^* < U_2$ (4)

$Y^* = 3$ (non-poor) if $Y^* > U_1 / U_2$ (5)

β′ is the vector of estimated parameters, X(s) are the explanatory variables, U is the error term.

U_1 and U_2 are threshold variables of the Ordered Probit regression model. The threshold variables are unknown and they indicate the discrete category of the latent variables i.e. depict which categories they will fall into. They were determined in the maximum likelihood estimation procedure for the Ordered Probit as:

$$Y = [\Phi(0-X_1\beta)]^{Z_{11}}[\Phi(U_1-X_1\beta) - \Phi(0-X_1\beta)]^{Z_{12}}[1-\Phi(X_1\beta-U_1)]^{Z_{13}} \quad (6)$$

$$Z_{(1-n)} = [\,1 \text{ if } y_{i=j,} \text{ otherwise } 0 \text{ for } j = 0,1,2,3] \quad (7)$$

Hence for the dependent variable represented by Y and each explanatory represented by X, Φ is the cumulative logistic distribution and β was determined using maximum likelihood estimation.

Y = subdivided into:

$Y^* = 1$ (core poor) if $Y^* < U_1$ (8)

$Y^* = 2$ (moderately poor) if $U_1 < Y^* < U_2$ (9)

$Y^* = 3$ (non-poor) if $Y^* > U_1 / U_2$

X_1 = Household size

X_2 = Household marital status (1= married, 0= otherwise)

X_3 = Sex of household head (1= female, 0= otherwise)

X_4= Household structure

X_5 = Presence of a living spouse in the household (Is spouse alive?)

X_6 = Sector (rural or urban) (1=rural, 0= otherwise)

X_7 = Occupation of household head

6. Results and discussion

An overview based on Table 1 gives an insight in to the mean amount spent by poor and non-poor households and the maximum per capita expenditure on major non-food items and commodities such as education, transportation, water, electricity, rent, communication, and clothing. This research calculates the mean amount spent by poor households on education to be ₦2,948.87k per month, with a maximum per-capita expenditure on education of

₦273,200.00k per annum. The mean amount spent by non-poor households on educationis₦5,748.55k per month, while their maximum per capita expenditure on education for the year is ₦440,990.00k.

The major food items purchased by households in south-east Nigeria are represented in Table 2, which shows that non-alcoholic beverages account for the smallest amount of household food expenditure in both poor and non-poor households.₦8,516.66k and ₦7,178.33k is spent on non-alcoholic beverages by the poor and non-poor respectively. The non-poor spend more on fruit, meat and sugar (jam, honey, chocolates and confectionaries),in consonance with the results of Obayelu *et al*. (2009) that those who can afford it prefer to indulge in food not prepared at home at times. The total amounts spent on these items by the non-poor are ₦51,343.33, ₦66,919.67, ₦74,946.75 respectively, while the poor spend₦35,648.33, ₦36,500.00 and ₦37,716.67 respectively. Also, it is clear from Table 2 that the poor spend more on rice, other cereals, bread, fish and seafood, which may signify the fact that the poor have no option but to cook their own food. These results also reflect the dietary habits of people in rural south-eastern Nigeria in that they prefer home-made food, including a lot of fish delicacies (Pius, 2014). The poor spend₦103,416.70k on rice, ₦19,466.67k on other cereals, ₦60,833.33k on bread and ₦33,458.33k on fish and seafood, while the non-poor spend₦94,291.67k, ₦29,200.00k, ₦33,215.00k, ₦20.683.33k respectively on these food items.

The aggregate for the poor and non-poor based on this study is shown in Table 3, with 2,175 poor respondents and 2,230non-poorrespondents based on the3, 000 calories index used as a poverty count by the HNLSS survey. In poor households, total per capita food expenditure was ₦48,006.19k while their total per capita non-food expenditure was ₦46,554.16. The total per capita food and non-food expenditure of non-poor households was ₦744,139.63k and ₦878,216.76k respectively. This shows a wide disparity between the expenditure of the non-poor and the poor.

It was also found that among the poor, 16.6per cent live in the urban area while 83.4per cent live in the rural area of south-eastern Nigeria, as shown in Tables 4 and 5. The mean per capita expenditure of those in the urban area is ₦77,181.27, compared with ₦67,621.61 in the rural area. When the data set is disaggregated into core/moderately/non-poor, the mean per capita food and non-food expenditure is ₦21,866.55k for the core poor; ₦38,949.09k for the moderately poor, and ₦1, 100, 88.00k for the non-poor. This division into core poor,

moderately poor and non-poor shows that there is a wide gap in south-east Nigeria among the so-called class system: the poor are highly disadvantaged while the non-poor (rich) have all the advantages, since this research found that the non-poor spend over a million naira on their food and non-food items, while the core poor and the moderately poor can barely exist on ₦21,866.55k and ₦38,949.09kwhen their family size and marital status are taken into account.

Table 5 elaborates on the impact of men on the upkeep of their home, as the results showed that 77per cent of male-headed households were poor compared with23per cent of female-headed households, based on the poor/non-poor 3,000 calorie index generated by the HNLSS data in accordance with the research of Oni and Yusuf (2007). This implies that the overall burden of taking care of the household falls more on males (i.e. the male-headed household) than on females (female-headed household). Likewise, this follows the findings by Dawoud (2013) from a household survey conducted in Egypt, and by Babalola and Isibor (2014) in Lagos Metropolis, south-west Nigeria.

The study used cross-tabulation to compare the age cohorts of the poor and non-poor households with the 3,000 calorie index. The age cohorts were delineated as follows:15-30 years, 31-46 years, 47-62 years and > 62 years against the poor/non-poor 3,000 calorie index, as shown in Table 6, which depicts that55 per cent of the47-62 years cohort are in the poor category because they spend approximately 42.1percent of their total per-capita expenditure on both food and non-food items. The 15-30 and 31-46 age ranges were not left out of these poverty incidences; they form the major productive group in the south-east economy and it is understandable that they fall further in to the poor category because they have to provide for themselves as well as those that depend on them. This result is in line with the study carried out by Adeoye (2015), which showed that females of working age have limited access to asset accumulation (non-food items). In their research, Olaniyan and Abiodun (2005) also attested to the presence of a serious burden on the working-age groups in Nigerian society in relation to human capital, capabilities and poverty. Thus it can be deduced that there is a high level of demand or financial burden on the working-age groups of south-eastern Nigeria in the provision of food and non-food items, causing expenditure differences between these groups and the older men and women of these societies.

Regression results: estimating the effect of household characteristics on food and non-food expenditure in south-east Nigeria

The results in Table 7 show that sector (rural/urban), household size, household structure, presence of a living spouse (is spouse alive?), and the age of the household head have a strong influence on total per capita expenditure among both poor and non-poor households. These variables are all significant at the 1percent level ($P \leq 0.01$), although some are negative, showing an inverse relationship when compared with the norm. Based on the results from this study, those in the urban areas of south-east Nigeria spend more on both food and non-food items than those in the rural areas. This finding is in line with a study carried out by Babalola and Isibor (2014) in Lagos State, an urban area in south-west Nigeria, since people in the rural areas produce some of their food and it is only the food commodities that they do not produce that they might buy. Also those in the rural areas are used to a lack of some basic non-food commodities and those on sale must be cheaper, as there will be low/no patronage if the asking/purchase price is too high. Although larger households are expected to spend more on food and non-food items, the results of the exponential regression show that the amount spent on food and non-food items has a negative sign, because many families in this region of Nigeria have other means of supporting the family/themselves, especially when there are many members of the household (Akerele *et al.*, 2012). The coefficient of determination (R^2) explains the ability of the independent variable to explain the variability in the dependent variable. It shows that 65per cent of all the variations in household total per-capita expenditure on food and non-food items are caused by these independent variables. The F- ratio is significant at 1 per cent, providing an overall test of significance and showing that the model was a good fit.

The results in Table 8 show that the sector (rural/urban), size of household, sex of household head, age(s) of individuals in the household, marital status of household head (single, married monogamous, married polygamous, divorced, widowed), and the status of spouse (living/dead) are household characteristics that have a very significant effect on total per capita expenditure on food and non-food items. The results are taken from the Ordered Probit regression after delineating the households into core-poor, moderately poor and non-poor based on the 3,000 calorie index used by the HNLSS survey data. (The negative sign for the sex of household head implies that the male-headed households are worse hit by poverty and have a higher per capita expenditure on food and non-food items than their female counterparts. However, this is contrary to the results from a study conducted in 2015 by

Adeoye, whose research deduced that women are affected by poverty, are more sensitive to the needs of their families and will put every effort into meeting the needs of their families, even if to their own detriment.)

7. Conclusion

The main objective of this study was to determine the food and non-food expenditure differential pattern across poor and non-poor households in south-eastern Nigeria. Based on the results obtained, it is clear that sector (rural/urban), sex of household head (with male-headed households having a higher per capita non-food expenditure than female-headed households, while female-headed households have an overall higher per-capita expenditure on both food and non-food items), household size, age of household head, household structure, and the presence of a living spouse have a significant positive or negative impact on total per capita household expenditure. It was deduced from the study that the 31-62 year age group forms the major productive sector of the sampled households. Members of this group are the most affected by poverty because they have to cater not only for themselves, but also for other members of their family, hence they spend more on both food and non-food items in the study area. It is also apparent that the poor spend less on non-food items/commodities such as education, water, rent, transportation, and communication because many of them, despite using these facilities, opt for cheaper ways of meeting these needs, while the non-poor try to improve their living at all costs. This explains the high per capita differential between the amounts spent by the poor and the non-poor on non-food items. Based on the sector analysis, there are more poor people living in the rural (3,583) of south-east Nigeria than in the urban area (822).The mean per capita expenditure of those in the urban area was ₦77,181.27, while the mean per capita expenditure for the rural area was ₦67,621.61. When the data was further disaggregated, the mean per capita food and non-food expenditure of the core poor is ₦21,866.55k, the mean per capita expenditure of the moderately poor ₦38,949.09k, while the mean per capita expenditure of the non-poor is ₦1, 100, 88.00k.

8. Recommendations

i) Particular attention should be placed on rural areas of south-east Nigeria in order to raise their living standards, as the results from this study show that poor households dominate this area.

ii) Household heads, particularly males and rural dwellers, need more help, information and support on the ways and importance of generating more income, in order to ensure balanced expenditure on both food and non-food items.

iii) There ought to be a concise and targeted focus on enhancing the productive capacities of the able-bodied in south-east Nigeria, because it is striking to note from this study that the productive age group (15-30, 31-46, and 47-62) is still very much in the poor standard of living category.

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Appendices

Table 1: ***Non-food expenditure for poor and non-poor households in south-east Nigeria***

Variable (non-food item)	Observations		Mean	
	Poor	Non-poor	Poor	Non-poor
			(₦)	(₦)
Education	2175	2230	2948.87	5748.55
Health	2175	2230	10601.94	46916.4
Water	2175	2230	631.01	1233.63
Electricity	2175	2230	1791.41	3188.67
Fuel(Kerosene)	2175	2230	2261.35	2483.09
Transport fares	2175	2230	5066.35	9239.21
Rent	2175	2230	1925.02	4031.22
Communication	2175	2230	3850.37	6434.89
Clothing	2175	2230	3109.75	5524.14

Source: Computed using data from the HNLSS (2009/2010)

Table 2: ***Food expenditure patterns across poor and non-poor households in south-east Nigeria***

	Number of Respondents	Maximum	Mean	Poor	Non-poor
				₦	₦
Rice purchased	4405	153300	6984.9448	103,416.70	94,291.67
Maize purchased	4405	48666.67	404.4581	19,466.67	29,200
Other cereals purchased	4405	246983.33	321.6115	19,466.67	18,250
Bread and similar products purchased	4405	166075	3992.7617	60,833.33	33,215
Tubers and plantains purchased	4405	210240	7946.317	40,150.00	79,083
Meat purchased	4405	208658.33	6339.6868	36,500.00	66,916.67
Poultry purchased	4405	120450	1073.1359	77,866.67	13,991.67
Fish and seafood purchased	4405	243333.33	10801.1836	33,458.33	20,683.33
Milk, cheese and eggs purchased	4405	238223.33	1640.1136	23,725	14,356.67
Oils, fats and oil-rich nuts purchased	4405	126533.33	2683.9805	26,158.33	104,633.30

Source: Computed using data from the HNLSS (2009/2010)

Table 3: ***Per capita food and non-food expenditure across poor and non-poor households in south-east Nigeria***

Poor/non-poor food (3,000cal)	₦	Minimum	Maximum	Mean
Poor	Per capita food	2175	464.03	48006.19
	Per capita non-food	2175	977.49	46554.16
	Per capita household expenditure	2175	4186.26	57388.52
Non-poor	Per capita food	2230	2871.5	744139.63
	Per capita non-food	2230	2705.72	878216.76
	Per capita household expenditure	2230	33604.12	1300692.08

Source: Computed using data from the HNLSS 2009/2010.

Table 4: ***Sectoranalysis across poor and non-poor households in south-east Nigeria***

Poor/non-poor food (3,000cal)	Frequency	Per cent	Poor/ non-poor	Core poor/moderately poor/non-poor
Poor			3583	143
				₦21,866.55k
Urban	360	16.6		
Rural	1815	83.4	₦67, 621.61.	742
				₦38. 949.09k
Total	2175	100		
Non-poor			822	₦1,100,88.00k
Urban	462	20.7	₦77,181.27	
Rural	1768	79.3		
Total	2230	100		

Source: Computed using data from the HNLSS 2009/2010

Table 5: ***Sex of household head * Poor/ non-poor food (3,000 calories) using cross-tabulation***

Sex of household head	Sex of household head	Poor	Non-poor	Total
		(Percent)	(Percent)	(Percent)
	Male	1675	1353	3028
	Percent within sex of household head	55.30	44.70	100.00
	Percent within poor /non-poor food (3,000cal)	77.00	60.70	68.70
	Female	500	877	1377
	Percent within sex of household head	36.30	63.70	100.00
	Percent within poor /non-poor food (3,000cal)	23.00	39.30	31.30
Total		2175	2230	4405
	Percent within sex of household head	49.40	50.60	100.00
	Percent within poor /non-poor food (3,000cal)	100.00	100.00	100.00

Source: Computed using data from the HNLSS 2009/2010

Table 6: ***Age cohorts * Poor/non-poor food (3,000 calories)***

Variable			Poor /non-poor food (3,000cal)		
			Poor	Non-poor	Total
			Percent	Percent	Percent
Age cohorts	>62	Count	554	825	1379
		Percent within age-cohorts	40.20	59.80	100.00
		Percent within poor /non-poor food (3,000cal)	25.50	37.00	31.30
	15-30	Count	120	201	321
		Percent within age-cohorts	37.40	62.60	100.00
		Percent within poor /non-poor food (3,000cal)	5.50	9.00	7.30
	31-46	Count	586	464	1050
		Percent within age-cohorts	55.80	44.20	100.00
		Percent within poor /non-poor food (3,000cal)	26.90	20.80	23.80
	47-62	Count	915	740	1655
		Percent within age-cohorts	55.30	44.70	100.00
		Percent within poor /non-poor food (3,000cal)	42.10	33.20	37.60
Total	Count		2175	2230	4405
	Percent within age-cohorts		49.40	50.60	100.00
	Percent within poor /non-poor food (3,000cal)		100.00	100.00	100.00

Source: Computed using data from the HNLSS 2009/2010 (Harmonized Nigeria Living Standards Survey2009/2010).

Table 7: ***Exponential regression results for total per capita (food and non-food) expenditure of households in south-east Nigeria***

Total per capita (food and non-food)expenditure (based on 3,000 calories index)	Coefficient	Standard error	T	P>[t]
Sector	11473.45	2633.95	(-4.36)***	0
Household size	-12699.24	513.2573	(-24.74)***	0
Sex of head of household	14063.16	9162.06	1.53	0.125
Household structure	-9983.85	2734.27	(-3.65)***	0
Is spouse alive?	28820.34	3642.53	(7.91)***	0
Age of household head	406.7528	71.51681	(5.69)***	0
Constant	81893.82	11663.18	6.99	0

Source: Computed using data from the HNLSS 2009/2010 ***Significance, 1% (P≤ 0.01).

Table 8: ***Ordered Probit Results: Poverty Status of household by food and non-food expenditure***

Poverty status (core poor, moderate poor and non-poor) based on 3,000 calories index	Coefficient	Standard error	Z	P>[Z]
Sector	0.32183	0.04908	-6.56	(0.000)***
Household size	-0.28128	0.00997	-28.2	(0.000)***
Sex of household head	-0.22572	0.33652	-0.67	(0.005)**
Age of household head	0.008311	0.00134	6.17	(0.000)***
Household marital status	-0.08524	0.0485	-1.76	(0.079)*
Household structure	0.11599	0.12877	0.9	0.368
Is spouse alive?	0.12295	0.0688	1.79	(0.074)*
Cut 1	1.92966	0.3417842		
Cut 2	1.3899	0.3413716		

Human Capital Contribution to Economic Growth in Sub-Saharan Africa Revisited: A Cross-Country Analysis

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Abstract

This paper revisits the relationship between human capital and economic growth in sub-Saharan Africa (SSA) and considers two alternative forms of human capital (i.e., health and education). The study employs dynamic model based on the system generalized method moment (GMM) and a balanced panel data covering 35 countries from 1980-2008. The empirical results show that the two measures of human capital (education and health) have positive effects on economic growth; contribution of health to economic growth is relatively larger than the impact of education. This finding emphasizes the importance of both measures of human capital and aligns with the argument in the literature that neither education nor health measures of human capital is a perfect substitute for each other.

Key Words: Human Capital, Education, Health, Economic Growth, SSA

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1. Introduction

In the economic literature, human capital is viewed as an important driver of economic growth (Romer 1986; Mankiw et al., 1992; Barro and Salai-i-Martin, 2004; Gyimah-Brempong and Wilson, 2004; Hanushek and Woessmann, 2008; Hartwig, 2010; Qadri and Waheed, 2014). The potential positive labour productivity effect of investment in human capital makes it an issue of high relevance for development policy in Africa. The concept of human capital is complex and multidimensional. Schultz (1961) and Becker (1964) define human capital as the sets of knowledge, skills, competencies, and abilities that are embodied in individuals and which individuals acquired over time, through training, education, work experience, medical care, and migration. Human capital can thus be divided into three key components: health, education and experience/training; and its stock could increase with better education, higher health status and new learning.

Possibly because new learning and training cannot be measured easily, health and education statuses have been the more commonly used human capital measures in previous empirical studies on the relationship between human capital and economic growth. Bloom et al. (2004) argue that adequate education and good health spur a more productive labor force that could consequently stimulate national economic growth. Ogundari and Abdulai (2014) show that a better educated and healthier workforce are more likely to create and adopt new technologies. Better health, according to Mayer-Foulkes (2001), increases workforce productivity and wages by reducing incapacity, debility, and the number of days lost to sickness. In contrast, poor health and corresponding loss in work-hours corresponds to a decline in workers' physical and mental capacities, productivity, and overall wages. According to Thomas and Frankenbery (2002), healthier individuals have higher life expectancy – which stimulates growth by accelerating demographic transition (Weil, 2001) – and thus have greater incentives to invest in training and in the acquisition of improved skills. Of the two commonly used measures of human capital, however, education has often been viewed as a more important source of human capital accumulation. This is because in a knowledge economy, education plays the crucial role of providing the highly skilled human capital needed for job creation, economic growth, and prosperity of the individual and the society (Pegkas and Tsamadias, 2014). As such, it has often been used in empirical research as a factor of production besides labour and capital

(Lucas, 1988). Thus, less emphasis has been devoted to the contribution of health status on economic growth.

Most of the existing empirical studies on the human capital-economic growth nexus have focused only on the one-to-one relationship between education and economic growth on the one hand, and health human capital and economic growth on the other (Aka and Dumont, 2008). Bloom et al. (2004) observe that most cross-country studies identify human capital mostly with education, arguing that ignoring health as a crucial aspect of human capital make policy discussion for economic growth less comprehensive. As such, a meta-analysis of the literature by Benos and Zotou (2014), for instance, reviewed up to 57 macro level studies that examined only the effect of education on economic growth for a cross-section of countries. Few of the studies in the literature have examined the joint growth effects of both health and education measures of human capital. Thus, many previous studies on this issue may suffer from omitted variable bias, as neither education nor health is a perfect substitute for the other as a measure of human capital. The joint inclusion of education and health measures of human capital would allow for more accurate estimates and inference on assessing the contribution of human capital to economic growth and help address omitted variable issues in previous studies (Glewwe et al., 2014; Aka and Dumont, 2008).

A careful review of the human capital-economic growth literature that focuses on the Sub-Saharan Africa (SSA) region shows that almost all the previous cross-country analyses only investigated the impact of education on economic growth. To our knowledge, only Gyimah-Brempong and Wilson, (2004) and Gyimah-Brempong et al., (2006) have attempted to investigate the contribution of both health and education measures of human capital on economic growth for a panel of SSA countries.

Glewwe et al., (2014) reviewed macro-level studies that estimate the impact of education on SSA economic growth and found that econometric problems may bias the estimates of the determinants of economic growth in the literature. Furthermore, they found the impact of education on economic growth in Sub-Saharan Africa is lower than in other countries, likely due to lower school quality. In addition, several studies investigated the effects of health on economic growth at individual countries

level (Ndiyo 2007; Odit et al. 2010; Isola and Alani, 2010; Bakare and Olubokun, 2011; Neeliah and Seetanah 2013; Onisanwa, 2014; and Babatunde, 2014). However, the estimated results from cross-country analysis are more useful sources of empirical evidence for making crucial policy decisions at the regional level (Ogundari et al., 2014). Unfortunately, only a limited number of cross-country studies have been conducted for SSA, hence limiting evidenced-based policy discussions and decisions on the role of human capital in the context of SSA (Glewwe et al., 2014).

The present study revisits the relationship between human capital and economic growth in the SSA region and contributes to the existing literature in the following ways: First, the study adds new cross-country evidence to the few existing studies that have so far investigated the link between human capital and economic growth in SSA countries. Second, this current analysis addresses the omitted variable bias in previous studies by simultaneously estimating the impact of both education and health measures of human capital. Third, the current study contributes to the literature in terms of the broadness of the time period covered. As earlier mentioned, Gyimah-Brempong et al., (2006) and Gyimah-Brempong and Wilson (2004) are the two known studies that have focused exclusively on a sample of countries from SSA region. While the former use data covering 1960-2000, the latter employ data covering 1975-1994. The present study, in comparison, covers 1980-2008. Fourth, the study provides empirical evidence for a wider range of SSA countries. In contrast to Gyimah-Brempong and Wilson (2004) that examined a sample of 21 countries, we utilize a larger sample of 35 SSA countries.

The main objective of the study is twofold. First, we reexamine the relationship between human capital and economic growth for a comprehensive panel of countries in SSA[2].Second, we accounted for some limitations in previous studies by jointly estimating the parameters for two common measures of human capital. Specifically, we investigate which of the two forms of human capital (i.e., health and education) contributes most to economic growth in the SSA region.

The preliminary results from our empirical analysis indicate that education and health

[2] This is necessary to ascertain whether the general concession in most of the literature that human capital contributes positively to economic growth exists in the region based on current extended data.

measures of human capital have positive and statistically significant effects on economic growth. We also found that the contribution of health to economic growth is relatively larger than the impact of education. This finding emphasizes the importance of both measures of human capital and aligns with the argument in the literature that neither education nor health measures of human capital is a perfect substitute for each other. Thus, joint inclusion of both variables in growth regression models should be preferred in order to address omitted variable issues.

The rest of the paper is organized as follows: Section 2 contains a brief over-view of human capital and economic development in the SSA region, while section 3 presents an overview of the theoretical framework and the empirical model. Section 4 describes the variable definition and data sources and section 5 contains a discussion of the empirical. Lastly, section 6 contains concluding remarks.

2. Human capital and economic development in SSA

Traditional economic theories emphasize sustained increase in Gross Domestic Product (GDP) as a key component of economic development. Although varying greatly among SSA countries, GDP per capita growth has been on the increase in the region since the late 1990s. King and Ranlogan-Dobson (2015) observe that a significant number of African economies have recorded strong GDP growth since 1998. According to the World Bank (2015), SSA economies have experienced an average GDP growth of about 4.5% in 2013 and 4.2% in 2014. Sala and Trivin (2014) observe that the region's cumulative growth of real GDP per capita has significantly risen from about 3.5% in the 1980s, to phenomenal level of 29% in the 2000s. In order to provide some context, we compare SSA's GDP per capita growth with those of other regions of the world. Over the period 1980 – 2000, the average growth rate of East Asia was 4.9%, Latin America 0.5%, Middle East 1.2%, and South Asia 3.6% (Glewwe et al., 2014; Sala and Trivin, 2014).

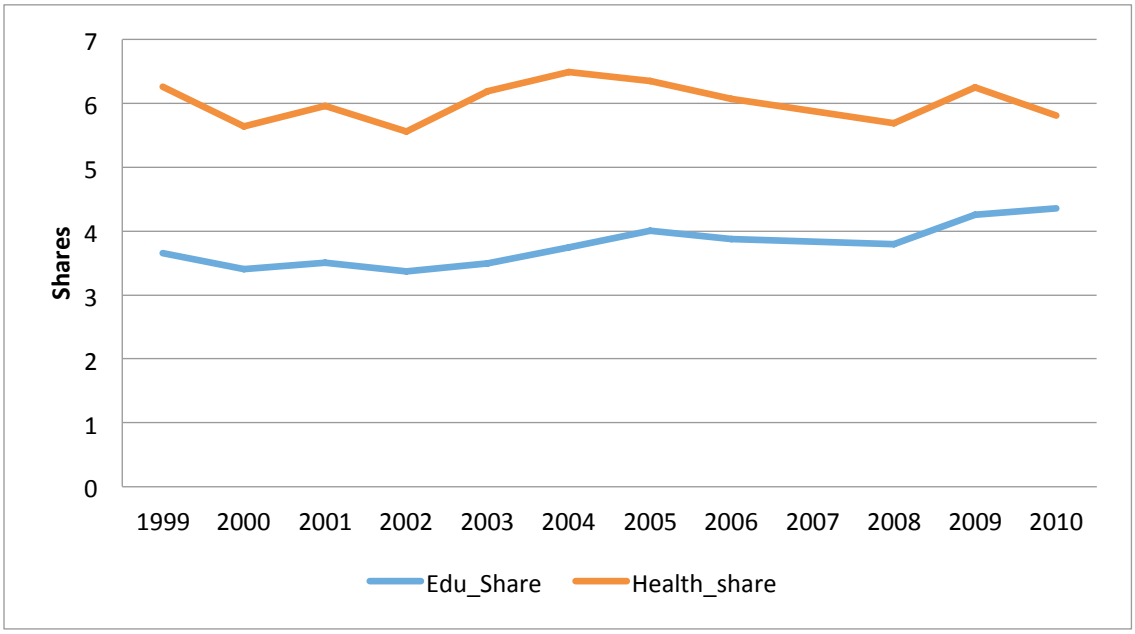
As some of the SSA countries are only recently emerging from civil wars that set back their respective developments, the implementation of structural reforms as well as greater priority for public spending on health, education and other social services stimulated the GDP per capita growth in recent decades (Calamitsis et al., 1999). UNESCO (2010) report that primary school enrollment ratio in SSA (an important index

of human capital) increased dramatically from an average of 56% to 73% in less than a decade, between the early 2000s and 2010.

Despite the upturn in economic growth rates, economic and social conditions in SSA countries remain poor and fragile. Based on the endogenous growth, investment in human capital should stimulate innovation and encourage the adoption of modern, output-increasing technologies that should consequently engender economic growth. Relative to the rest of the world, investment in education is low in the SSA region. For example, countries in Asia and Latin America have made much larger investment in primary school education when compared to SSA countries (Gyimah-Brempong et al., 2006). Over the period covering 1980-2000, primary gross enrollment rate in SSA declined from 80% to 77%, reflecting lower investment in education, (Glewwe et al., 2014). For East Asia, Latin America, Middle East and South Asia, however, this statistic increased or held steady at about 111%, 127%, 87% and 98% respectively (Glewwe and Kremen, 2006).

SSA countries' expenditures on their health sectors have, however, been higher than those spent on their education sectors. As reveal in Figure 1, which shows the SSA education and health expenditure shares of the GDP for the period 1999-2010, expenditure on health is about 60% higher than the level for education. This implies that the health sector in SSA countries perform poorly due to relatively low investment in this sector (Ogundari and Abdulai, 2014).

Figure 1: ***Education and Health Expenditure share of GDP in SSA (source, World Bank, 2015)***



3.0. Theoretical Framework and Empirical Model

3.1. Theoretical Framework

In a Solow (1956) neoclassical growth model, the output per worker depends on initial output per worker, initial level of technology, the rate of technological progress, the saving rate, the growth rate of the workforces, depreciation, share of capital in output and the rate of convergence to the steady state. Given that the model is widely known and has undergone series of modification, the present study, however, follows the augmented version of the endogenous growth model in Barro (1991), Mankiw et al., (1992) and Levine and Renelt (1992), where GDP per capita is defined implicitly as follows:[3]

$$\dot{y}_{it} = f\left(h_{it}, k_{it}, y_0, z_{it}\right) \qquad 1$$

where $\dot{y}_{it}$ denotes real per capita gross domestic product (GDP), h_{it} is a vector of education and health human capital defined as $h_{it} \approx Edu_{it}, Health_{it}$; k_{it} denotes physical capital; z_{it} is a vector of other potential macroeconomic variables such as

[3] Given that the model is widely known in the economic growth literature, for brevity, we did not re-produce the model in our paper, as detailed discussion of the model is available in Mankiw et al., (1992), Levine and Renelt 91992), and Glewwe et al., (2014).

population growth, trade openness, and democracy index; and y_0 represents initial per capita GDP.

3.2. Empirical Model Specification

The study follows a dynamic model to explicitly specify the implicit endogenous growth regression model of equation 1. We employ a dynamic specification to estimate the parameter of equation 1 based on the following reasons. **First,** recent evidence of persistency in growth of per capita GDP motivated the choice of dynamic specification by Belke and Wernet (2015). Evidence of persistence in economic growth is an indication that previous economic growth represented by $\dot{y}_{it-1}$ determines its current supply represented by $\dot{y}_{it}$. **Second**, we also believe use of dynamic model is justify, given that many of the previous studies also employ this methodology, which makes the results comparable.

To this end, the dynamic model for the study is specified as:

$$\dot{y}_{it} = \phi_i \dot{y}_{it-1} + \tau_i h_{it-1} + \beta_i k_{it-1} + \varphi_i y_0 + \delta_i z_{it-1} + \gamma_i + \eta_{it} \qquad 2$$

where $\dot{y}_{it}$ represents economic growth defined as growth in real per capita gross domestic product (GDP); lagged human capital, denoted by h_{it-1}, is represented by education and health; k_{it-1} is lagged physical capital is defined as investment share of PPP adjusted GDP per capita; y_0 is initial per capita GDP; γ_i denotes country specific effects; and η_{it} is the error term of the regression. To avoid the omitted variable bias problem highlighted by Glewwe et al. (2014), we control for structural differences across countries by including relevant macroeconomic drivers of $\dot{y}_{it}$ represented by z_{it-1}. These macroeconomic drivers include population growth, trade openness, and democracy index (a measure of civil liberties and political institutions).

Three alternative measures of education were used in the study. They are school enrollment ratio (i.e., enrollment for primary, secondary and tertiary levels), average years of schooling of adult population, and government expenditure on education. We use the three measures of education to test for the sensitivity of measures of education adopted in previous empirical studies.

For the indicator of health, we follow Bloom et al. (2004) and use life expectancy as a proxy for health. Though life expectancy measures tend to document mortality rates rather than morbidity, it is appropriate because higher life expectancy is generally associated with better health status and lower morbidity (Murray and Lopez 1997). Similarly, many previous empirical studies also used life expectancy as a proxy for health status (Bloom et al., 2004).

The inclusion of the trade openness variable is important because of the well-documented positive effect of trade expansion on economic growth. Import and export growth can stimulate GDP growth via its beneficial impact in encouraging efficient resource allocation, greater capacity utilization, exploitation of economies of scale and promotion of technological improvement due to foreign market competition (Helpman and Krugman, 1985; Awokuse, 2003, 2008). Following Bloom et al. (2004), we also include a democracy index to capture effect of the quality of political institutions on economic growth via the provision of social stability, public services and enforcement of private contracts. The population growth variable captures the contribution of the labor force and the effect of capital diffusion as the contribution of capital available to each worker shrinks as a country's population increases (Weil, 2013). Lastly, initial GDP per capita (y_0) is included to test the convergence hypothesis that over time countries with lower per capita income tend to have growth in GDP per capita at a more rapid rate relative to income growth per capita in richer countries.

Equation 2 is estimated using the system-generalized method of moments (GMM) estimator for dynamic panel data model proposed by Blundell and Bond (1998). As also noted by Hoeffer (2002) and Glewwe et al. (2014), cross-country growth regression is likely to suffer from endogeneity problem besides the dynamic specification. Based on this, the system dynamic GMM is an appropriated estimation approach that explicitly account for endogeneity issues and collinearity of regressors and it produces consistent estimates in the presence of endogenous regressors (Farhadi et al., 2015). Also, Hauk and Wacziarg (2009) noted that the use of system GMM estimator can account for the reverse causality by producing valid instruments under the assumption that current period shocks in the error term do not affect past values of the regressors and the past values of the regressors do not directly affect

current values of the dependent variables. In reference to the dynamic specification, Jaunky (2013) argue that the system GMM makes an exogeneity assumption where any correlation between endogenous variables and unobserved fixed effects are constant over time, allowing the inclusion of level equations in the system and the use of lagged differences as instruments for the levels. The system dynamic GMM is also able to overcome the econometric problems of cross-sectional dependence of countries and multi-correlation that are prevalent in macro panel models (Arrelano and Bond, 1991).

4. Data and sources

We employ a balanced panel data over 28 years (1980-2008) for 35 countries in Sub-Saharan Africa (SSA)[4]. Data was obtained from the Penn World Table (PWT) database (PWT 2013)[5] for real per capita Gross Domestic Product (adjusted by purchasing power parity (PPP)), investment share of real GDP per capita, trade openness, and population size (for the construction of population growth). Data on health measures as life expectancy at birth was taken from the World Development Indicator (World Bank, 2012). Enrollment ratios for primary, secondary, and tertiary levels, average years of schooling, government expenditure on education, and democracy index were obtained from the CANA database (Castellacci and Natera 2011). Table 1 presents summary statistics of the variables used in the study.

5. Results and discussion

5.1. Correlation matrix of the explanatory variables

Table 2 contains the estimated parameters for the model specification in equation 2 with three alternative variations on the choices of the human capital variables. First, we examine the pattern of the relationships between the growth regression model's explanatory variables. The results of the correlation matrix of the explanatory variables employed are presented in Tables A-C of the appendix, respectively. Correlation matrices provide intuitive information on the strength of the bivariate relationships between variables (Self and Grabowski, 2004). The results show that most of the

[4] The countries are Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Cote d 'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Swaziland, Tanzania, Togo, Ugandan, Zambia, and Zimbabwe.

[5] The PPP adjustment was based on 2005-dollar prices.

correlation coefficients amongst the explanatory variables are less than 0.50. These weak bivariate correlations suggest that multicollinearity should not be a serious problem for the estimated model.

5.2 Diagnostic test results

The consistency of the estimated parameters of the growth regression model is based on the diagnostic test results from the estimated dynamic GMM model, which have always been based on the presence of first-order auto correlation-AR [1] and the absence of second–order auto correlation-AR [2] in the residuals of the model. The GMM estimator is consistent only if there is no second-order-serial correlation (i.e., AR [2]) in the idiosyncratic error term of the system of equations as observed in the present study (Yu et al., 2011). Also, we ascertain with the Sargan-Hansen test the validity of the instruments, to ensure that the model is not misspecified. Given this, the study resent in the lower panel of Table 2 the reported AR [1], AR [2], and Hansen test from the estimated dynamic-system GMM model. Both the first-AR [1] and second-AR [2] order autocorrelation show that no serial correlation is in the disturbances, while the Sargan-Hansen test shows the validity of the instruments used in the GMM.

5.3. Education effect on economic growth

Table 2 also presents the results of human capital's contribution to economic growth in SSA where education and health proxies are jointly included. As earlier mentioned, three different alternative measures of education were considered in the study. The three alternative measures of education are: enrollment ratio included only in model 1, average years of school of an adult population included only in model 2, and government expenditure included only in model 3. And for each model, life expectancy is included as a proxy for health in the table.

The effects of enrollment ratio at the primary, secondary and tertiary levels on economic growth, as captured by model 1, show that education elasticity of growth is positive in the SSA region. Specifically, the results from model 1 suggest that a 10% increase in primary, secondary, and tertiary school enrollment would result in about 0.82%, 0.46%, and 0.01% increase in per capita GDP growth, respectively. However, only the elasticity of growth with respect to primary and secondary school enrollment are statistically significant.

The results also lend support to the work of Salai-i-Martin et al., (2004) and Artidi and Sala-i-Martin (2003) wherein they found primary school enrollment as the most robust variable with significant positive effect on economic growth. Also, the significance of primary enrollment may be reflecting the productivity-enhancing effect of the recent increase (since 2000) in primary enrollment ratio in the SSA region (World Bank 2012). The results be lends support to Petrakis and Stamatakis's (2002) argument that the growth effects of education depend on a country's level of development and that low-income developing countries benefit more from primary and secondary education while high income developed countries benefit more from tertiary education.

In model 2, the effects of average years of schooling of an adult population on economic growth are positive and significantly different from zero. While model 3's effects of government education expenditure on economic growth are also positive, they are statistically insignificant. The results in model 2 imply that 10% increase in a population's average years of schooling would result in about 0.17% increase in per capita GDP growth in SSA. Also model 3 shows that 10% increase in government expenditure on education would result in about 0.09% increase in GDP growth. We note that the positive and significant effect of average years of education on economic growth in the present study conforms to the findings of Gyimah-Brempong and Wilson (2004) from a dynamic GMM model using 1975 - 1994 data on 21 SSA countries.

5.4. Health effect on economic growth

As shown in Table 2, the contribution of health (measured as life expectancy) to economic growth shows that health's elasticity of growth is positive and significantly different from zero across models 1, 2, and 3. Specifically, the results show that a 10% increase in the population's life expectancy at birth would bring about an increase of 4.9%, 2.2%, 2.6% in per capita GDP growth for models 1, 2, and 3, respectively. Current results are consistent with Bloom et al. (2004) who also found evidence of positive and statistically significant effect of life expectancy on economic growth. However, the estimated coefficients of life expectancy from the 12 different studies they reviewed are substantially lower than those in the current study.

5.5.Comparing the effects of education and health on economic growth

It is useful to compare the relative strength of the contributions of education and health measures of human capital. First, a choice should be made on which of the three measures of education should be used in the comparisons. Gyimah-Brempong et al. (2006) note that although having the advantage of being comparable across countries, neither enrollment ratio nor government expenditure on education is a particularly appealing measure of education endowment. Despite possible cross-country data constraints, the average year of schooling is a more appropriate measure[6]. Reverse causation when using either enrollment ratio or education expenditure to proxy education is also another source of concern (Gyimah-Brempong et al., 2006). Hence, given these issues that are associated with the use of enrollment ratio and expenditure on education as proxies for education, the subsequent discussion focuses on model 2, which is based on average years schooling of adult population in the region.

To this end, a look at model 2 of Table 2 shows that the size of the effect of average years of schooling of an adult population taken as a proxy for education on economic growth is very small (0.0167)[7]. Contrary to the findings by Gyimah-Brempong and Wilson (2004), we found in this study that the health elasticity of growth estimate of 0.2151 is substantially larger than the education estimate, all things be equal. It should be noted that even in models 1 and 3, the contribution of health to economic growth is also substantially larger than that of education. First, similar to the observation in Glewwe et al. (2014), the relatively small size of the elasticity of growth with respect to the three education proxies in the study could be capturing the low quality of education coupled with the fact that healthcare expenditure share of GDP is far above that of education in many countries in the region. Second, the current results for the SSA region also supports Weil's (2007) argument that the positive effect of health on GDP growth is usually strongest among poor countries. The large and statistically significant estimates for health in this analysis is even more striking when

[6] It should be noted, however, an issue of concern, which was raised by van Leeuwen and Foldvari (2008) when investigating human capital contribution to economic growth is that years of schooling as proxy for education may fail to capture the differences in the quality of schooling. It should be noted further that government expenditure, which could potentially reflect the quality of schooling across countries, the issue of reverse causation aside, has statistically insignificant effects on real per capita GDP growth.

[7] This observation is robust to the other two measures of education considered in the analyses.

compared to existing studies with mostly mixed and ambiguous empirical evidence on whether or not health stimulates GDP growth in developed countries (Weil, 2007).

5.6. Contribution of the macroeconomic variables to economic growth

Although our focus is on the link between human capital and economic growth, we also examined the effects of various macroeconomic variables on economic growth. In contrast to findings in Gyimah-Brempong and Wilson (2004) and Gyimah-Brempong et al., (2006), we find that the investment share of GDP per capita contributes negatively to economic in SSA. This result is surprising. Nevertheless, we believe the outcome could be an indication that investment in physical capital formation may not be large enough to translate to increase growth over the period cover in the study. Also, the coefficient of the initial GDP per capita is consistently negative and significant across the models in Table 2 suggesting that the convergence hypothesis is supported at cross-country level in the study[8]. With the exception of model 1, the effect of population growth is negative and statistically significant, supporting the idea of capital dilution that occurs when population growth reduces the available capital per worker (Weil, 2013). The effect of trade openness is positive and statistically significant across the three model specifications, supporting the notion that market liberalization policies that encourages international trade tends to boost national economic growth. The importance and positive contribution of trade openness in this study further confirms similar findings in previous studies (Awokuse, 2008). The effect of democracy index on economic growth is positive and statistically significant in model 2 only.

6. Concluding remarks

In this study, we revisit the question of whether human capital stimulates economic growth in Sub-Saharan African (SSA) countries by jointly modeling the contributions of education and health measures of human capital in a growth regression model. First, we investigate whether the general concession that health and education contribute positively to economic growth exists in SSA based on current data from the region. Second, we compare the relative contributions of two alternative forms of human capital (i.e., health and education) to economic growth in the region. In a system dynamic GMM model based on a balanced panel data series from 1980-2008 for 35

[8] The convergence hypothesis states that countries with lower per capita income (GDP) tend to increase more rapidly relative to richer countries over time.

SSA countries, we employ three alternative measures of education (i.e., enrollment ratio for primary, secondary and tertiary levels; average years of schooling of an adult population; and government expenditure on education) and life expectancy at birth as a proxy for health.

The results show that the estimated coefficients for primary and secondary school enrollment and average years of schooling measures of education have a positive and statistically significant effect on economic growth in SSA. In contrast, the estimates for both tertiary school enrollment and government expenditure on education are not statistically significant. In addition, the estimated parameters for health have a positive and statistically significant effect on economic growth in SSA. In comparing, the estimated human capital elasticity of growth for the two forms of human capital, it appears that health measure of human capital makes a larger contribution to economic growth in SSA than the education measure of human capital.

From the policy standpoint, a possible explanation for the small size of elasticity of growth with respect to education proxies compared to that of health in the study could be linked to quality of education in SSA. This observation however, calls for improvement in quality of education in the region. The findings also show that joint inclusion of both measures of human capital in growth regression models should be preferred in order to minimize the omitted variable bias. This result aligns with the argument in the literature that neither education nor health measures of human capital is a perfect substitute for the other.

A possible limitation of this study is the inability to extend the dataset beyond 2008 due to lack of access to more recent data on the measures of education across a large panel of SSA countries. Future studies can address this issue as data becomes available and also consider other proxies for health and education.

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TABLES

Table 1: ***Descriptive statistics of the variables in empirical model***

Variables	Description	Mean	Std. Dev.
GDP	Real per capita Gross Domestic Product (GDP) adjusted by PPP at 2005 constant price.	1843.12	2346.84
GDP Growth	Per capita annual GDP growth, 1980-2008 in percentage	3.3857	7.2269
Primary level enrollment	Ratio of total enrollment, regardless of the age, to the population of age group that officially correspondents to the primary level.	83.67	28.84
Secondary level enrollment	Ratio of total enrollment, regardless of the age, to the population of age group that officially correspondents to the secondary level.	25.72	18.81
Tertiary level enrollment	Ratio of total enrollment, regardless of the age, to the population of age group that officially correspondents to the tertiary level.	4.48	4.30
Investment	Investment on physical capital as share of PPP adjusted GDP per capita in 2000 USD.	19.52	11.53
Average years of education	Average years of school completed in population over 14.	4.39	1.95
Expenditure on education	Current and capital public expenditure on education	3.84	1.89

Trade openness	Ratio of the sum of total imports and exports divided by GDP adjusted PPP in 2000 USD.	64.28	33.69
Life expectancy at birth	Average years a person may live	51.17	6.93
Democracy index	An index with political participation tends toward +10 and autocratic tends toward -10.	-1.27	6.03
Population growth	Population growth per annum, 1980-2008 in percentage	2.6737	1.1223

Table 2: ***Human capital contribution to economic growth with joint inclusion of education & health***

Variables	**Model 1**	**Model 2**	**Model 3**
	Coefficient [SE]	Coefficient [SE]	Coefficient [SE]
GDP per capita growth (lagged)	0.0534 [0.0523]	0.1557** [0.0795]	0.0443 [0.0362]
Primary enrollment	0.0821** [0.0420]		
Secondary enrollment	0.0460* [0.0251]		
Tertiary enrollment	0.0007 [0.0050]		
Total years of education		0.0167* [0.0098]	
Government Expenditure on education			0.0098 [0.0127]
Life expectancy at birth	0.4887*** [0.1525]	0.2151** [0.1064]	0.2632*** [0.1068]
Investment	-0.0072 [0.0151]	-0.0149* [0.0080]	-0.0119* [0.0068]
Initial GDP per capita	-0.2038*** [0.0589]	-0.0723* [0.0427]	-0.1119** [0.0538]
Trade openness	0.1406*** [0.0339]	0.0727***	0.1238***

		[0.0293]	[0.0334]
Population growth	-0.5314** [0.2437]	-0.2231 [0.2474]	-0.5063* [0.2852]
Democracy index	-0.0001 [0.0008]	0.0020*** [0.0007]	0.0003 [0.0007]
Constant	-1.2249*** [0.3187]	-0.5490* [0.3274]	-0.7028** [0.2184]
# Countries	35	35	35
# Periods	29	29	29
AR (1) p-value	0.025	0.011	0.001
AR (2) p-value	0.407	0.150	0.318
Hansen test p-value	0.983.000	0.928.000	0.971.000

*Values in parentheses are standard error of the estimates. *, ** and *** denote 10%, 5% and 1% significance levels, respectively.*

Model 1:Based on school enrollment ratio, Model 2: Based on total years of education; Model 3: Based on Government expenditure on education.

The following variables: primary, secondary, tertiary enrolments, average years of education, and government expenditure were define in logarithm for the analysis

Appendix

Table A: ***Correlation matrix for explanatory variables in GMM model***

	GDP_Growth_{t-1}	$Primary_{t-1}$	$Secondary_{t-1}$	$Tertiary_{t-1}$	Life $expt._{t-}$	$Investment_{t-1}$	GDP_{t-1}	$Openess_{t-1}$	Popu_ Growth	Democracy
GDP_Growth_{t-1}	1.000									
$Primary_{t-1}$	0.066	1.000								
$Secondary_1$	0.047	0.689	1.000							
$Tertiary_{t-1}$	-0.039	0.234	0.454	1.000						
Life $expt._{t-1}$	0.101	0.430	0.548	0.169	1.000					
$Investment_{t-1}$	0.058	-0.052	0.062	0.055	0.010	1.000				
GDP_{t-1}	0.114	0.447	0.623	0.325	0.558	0.244	1.000			
$Openess_{t-1}$	0.044	0.244	0.415	0.143	0.249	0.249	0.205	1.000		
Popu_Growth	0.228	-0.015	-0.056	-0.090	0.060	0.015	-0.002	-0.104	1.000	
Democracy	0.165	0.261	0.362	0.131	0.311	-0.0002	0.221	0.192	0.032	1.000

Table B*: Cross-tabulation of explanatory variables in model 2 of table 2*

	GDP_Growth_{t-1}	$Year\_Edu_{t-1}$	Life $expect._{t-1}$	$Investment_{t-1}$	GDP_{t-1}	$Openess_{t-1}$	$Popu\_Growth_{t-1}$	$Democracy_{t-1}$
GDP_Growth_{t-1}	1.000							
$Year\_Edu_{t-1}$	0.071	1.000						
Life $expect._{t-1}$	0.103	0.456	1.000					
$Investment_{t-1}$	0.062	-0.033	0.015	1.000				
GDP_{t-1}	0.117	0.473	0.560	0.249	1.000			
$Openess_{t-1}$	0.049	0.204	0.249	0.212	0.460	1.000		
$Popu\_Growth_{t-1}$	0.228	-0.039	0.073	0.021	0.010	-0.091	1.000	
$Democracy_{t-1}$	0.166	0.153	0.315	0.003	0.227	0.201	0.043	1.000

Table C: ***Cross-tabulation of explanatory variables in model 3 of table 2***

	GDP_Growth_{t-1}	Edu_exp_{t-1}	Life $expect._{t-1}$	$Investment_{t-1}$	GDP_{t-1}	$Openess_{t-1}$	$Popu\_Growth_{t-1}$	$Democracy_{t-1}$
GDP_Growth_{t-1}	1.000							
Edu_exp_{t-1}	0.014	1.000						
Life $expect._{t-1}$	0.103	0.345	1.000					
$Investment_{t-1}$	0.062	-0.015	0.015	1.000				
GDP_{t-1}	0.117	0.305	0.560	0.249	1.000			
$Openess_{t-1}$	0.049	0.343	0.249	0.212	0.460	1.000		
$Popu\_Growth_{t-1}$	0.228	0.013	0.073	0.021	0.010	-0.9010	1.000	
$Democracy_{t-1}$	0.166	0.279	0.315	0.227	0.201	0.2005	0.043	1.000

Social protection for food security in Cameroon

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Abstract

The present article deals with the relationship between social protection and food security in Cameroon. In a context of food insecurity and rise in poverty, the country's existing social protection programmes are falling short of maintaining food security, leaving the majority of the poor population, in particular those in the rural areas, children, older people and women, in a situation of food insecurity. Starting from the hypothesis that social protection may just as well be an end as a means of development, and basing our work on the example of poor countries that have succeeded in reforming their social protection systems, we intend to propose, for the near future, routes to reform of social protection in order to foster food security in Cameroon.

Keywords: social protection, food security, poverty, vulnerability, development, Cameroon.

JEL: I30; O11; Q18.

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1. Introduction

Hunger and food insecurity constitute the principal obstacles to poverty reduction in sub-Saharan Africa in general and in Cameroon in particular (World Bank, 2012). The rate of food insecurity is high in Cameroon. According to the results of the analysis of vulnerability undertaken using the World Food Programme (WFP) method on vulnerability as a function of diversity and frequency of food consumption, 27.6 per cent of households have poor food consumption, i.e. 3.38 million persons (2.84 million in the rural areas as against 0.54 million in the urban areas). Furthermore, only 37.1 per cent of households are in a situation of food security, with the food consumption of 35.7 per cent of the remaining households being below normal.

An analysis of the development and the scale of poverty indicates that it has remained stable during the period from 2001 (40.2 per cent) to 2007 (39.9 per cent). However, the actual number of poor people has increased because of the annual rate of demographic growth, which stands at 2.7 per cent. Out of the whole population, estimated at nearly 15.5 million people in 2001, 6.2 million were classified as poor. In 2007, according to the estimates of ECAM3[2], Cameroon had around 17.94 million inhabitants, of whom 7.1 million were considered poor[3]. It is also estimated that 26 per cent of the population is in a situation of chronic poverty. Poverty remains essentially a rural phenomenon, which is disproportionately prevalent in the country's regions of Nord and Extrême-Nord. While rates of poverty went down in the urban areas, in the rural areas they went up from 52.1 per cent in 2001 to 55 per cent in 2007. Out of the whole of the population classified as being in the poorest quintiles from the point of view of income distribution, 40 per cent and 17 per cent respectively are in Nord and Extrême-Nord. Looking at the movement of the poverty rate, these two regions recorded the greatest increases between 2001 and 2007: 13.6 per cent in Extrême-Nord and 9.6 per cent in Nord.

Cameroonian households are exposed to a great variety of environmental, economic and social risks. The risks related to environmental shocks have a direct impact on the livelihoods of the 45 per cent of the population engaged in subsistence agriculture. The environmental risks also have an indirect impact on the food security of the country's population, as a consequence of the drop in the worldwide food supply. In addition to the macroeconomic risks – inflation, exchange rate fluctuation, volatility of export prices, drop in export demand, drop in remittances of funds and in foreign direct investment, which have become significant in recent years – Cameroon is also vulnerable to the risks arising

[2] Cameroon Household Survey data set

[3] Gouvernement du Cameroun, 2009. Growth and Employment Strategy Paper (Document de stratégie pour la croissance et l'emploi) – Draft.

from the basic structure of the economy. This is the case in particular of the excessive trust placed in production of non-processed primary products, of the undiversified export base and the dependence on imports together with low agricultural productivity. Chronic poverty – which relates to those who cannot raise themselves above the poverty line within the near future and who are particularly vulnerable to the various shocks – affects 26 per cent of the population. Transient poverty, in other words the situation of those who are not actually poor but who remain at risk of becoming poorer owing to instability in levels of consumption, affects 9.9 per cent of the population. Furthermore, chronic poverty is also a rural phenomenon: 38 per cent of the inhabitants of the rural areas are in that situation and only 20 per cent of those living above the poverty line are considered as not at risk of falling lower. In terms of regional distribution, Cameroon's regions of Nord and Extrême-Nord show the highest levels of poverty and vulnerability. The persons in a situation of chronic poverty live in large households, including several children, and work in agricultural production. According to the results of ECAM3 (Cameroon Household Survey), the households in a situation of chronic poverty are headed by a person having a very low level of education (48.4 per cent), work in agricultural production (44.2 per cent) and have a large number of children aged between 4 and 15 years old.

The crisis in food product prices and fuel prices as well as the recent world financial crisis in 2008 have had a devastating effect on the welfare of households. Cameroon depends in part on imports to meet some of its food needs, and the recent rise in the price of imported cereals has inevitably damaged the welfare of the poor households. And, in the absence of social safety nets to cushion the shock, there are possibilities for persons in a situation of transient poverty to be plunged into deeper poverty. Likewise, the surge in fuel prices and the international financial crisis have a direct impact on the economy as a whole, and more specifically on the poor households. Given the high degree of vulnerability, the situation currently prevailing gives glimpses of even higher potential risks.

Examination of the existing programmes having to do with social safety nets[4] confirms that these programmes are not appropriate to tackle the problem of chronic poverty. Cameroon currently has a limited number of special programmes relating to social safety nets. Most of these programmes have a limited reach and coverage: each programme covers only, at the most, 1 per cent of the whole population, and only around two-thirds of individuals who have been identified as vulnerable within a target group. Furthermore,

[4] Social safety nets are programmes which protect a person or a household against two types of circumstances jeopardizing welfare, chronic incapacity to work and make a living (chronic poverty); and a reduction in this capacity owing to a marginal situation providing a minimal livelihood and a few reserves (transient poverty) (Subbarao et al., 1996).

these programmes are faced with challenges to their implementation, in particular the low level of effectiveness in defining their objectives. Analyses based on available sources reveal that expenditures relating to social protection initiatives are limited.

Based on the relationship between social protection and food security, this article has as its main objective the proposal of some policy guidelines for a social protection approach that will bring about food security in Cameroon. The article is arranged as follows: Section 2 reviews the literature on the relationship between social protection and food security. Section 3 covers food insecurity and poverty in Cameroon. Section 4 describes the existing social protection programmes for food security in Cameroon. Section 5 covers the institutional reforms of social protection for a situation of food security in Cameroon. Section 6 contains the conclusion and some policy recommendations.

2. Social protection and food security: a literature review

The *European Report on Development 2010* defines social protection as "A specific set of actions to address the vulnerability of people's life through *social insurance*, offering protection against risk and adversity throughout life; through *social assistance*, offering payments and in kind transfers to support and enable the poor; and through *inclusion efforts* that enhance the capability of the marginalized to access social insurance and assistance." (ERD, 2010). Other definitions include access to basic services, in particular health care, as well as means of support to the livelihood of the poor, such as subsidies for agricultural inputs (HLPE, 2012).

As for food security, according to FAO, "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." (FAO, 1996). The entitlement approach of Amartya Sen, originally thought of as a tool for analysis of famines, may be useful for classifying the sources of food insecurity. According to Sen (1981), nourishment comes from four sources: production (what one grows), labour (what one works for), trade (what one buys) and transfers (what one is given). One speaks of food insecurity "when the sum of all food derived from these four sources is inadequate to meet minimum consumption needs at the individual, household or national level" (HLPE, op. cit.). In other words, food insecurity describes the incapacity to have access to adequate food at the present time (chronic food insecurity) and the risk of not being able to achieve it in the immediate future (transient food insecurity) (HLPE, op. cit.).

Each source of 'food entitlement failure' can be counteracted with a social protection response (Devereux 2008). Food production can be boosted with input subsidies, while

harvest failure or livestock losses can be compensated with agricultural insurance. Unemployment or underemployment can be addressed, at least temporarily, by public works programmes. Problems of market access to food can be addressed on the demand side (food price stabilization, price subsidies) or the supply side (grain reserve management). Inadequate access to food can be addressed directly, through transfers of food (school feeding, supplementary feeding), or cash (with conditions or unconditional). While social protection is associated mainly with social transfers, this disaggregation shows that it offers a much larger menu of options. Thus, social protection for food security designates a set of proposals currently being discussed, seeking to "ways to lessen vulnerability through social and productive safety nets programmes and policies with respect to food and nutritional security" (HLPE, op. cit.).

At the changeover of the millennium, and in particular since the adoption of the Millennium Development Goals (MDGs) in 2000 and the Sustainable Development Goals (SDGs) in 2015, social protection seems to be getting a good press. Regarded as the flavor of the day, it is now closely linked with the problems of development, whereas the dominant view of the 1980s and 1990s was that it was part of the problem, not of the solution. Studies determine that social protection enables a growing number of persons (both poor and non-poor) to participate in economic growth, to contribute to it and to benefit from it (Devereux and Sabates-Wheeler, 2004; OECD, 2007; ERD, op. cit.; Merrien, 2013). Likewise, experiences of social protection programmes for food security in the countries of sub-Saharan Africa (see Table 1 below) have proved that strong capacity in the administration and political will can ultimately resolve a situation that in the beginning may have seemed insoluble.

Table 1: Model programmes of social protection for food security in some countries of sub-Saharan Africa

Country	Programme	Coverage	Impact
Malawi	Programme of subsidies for agricultural inputs	The programme enables small-scale agricultural operators to have access to two 50 kg sacks of fertilizer a year. Approximately 1.7 million small agricultural operators	The Farm Input Subsidy Programme (FISP) has strongly increased the proportion of households enjoying food security, which went up from 67 per

		are currently benefiting from this project.	cent in 2005 to 99 per cent in 2009. Overall, the incidence of poverty dropped from 52.4 per cent in 2005 to 39 per cent in 2009
Kenya	Programmes of school meals prepared locally.	This is a programme of monetary transfers with conditions attached, paid to educational establishments to purchase food for some 500 000 pupils in 29 arid and semi-arid districts and 2 slum districts in Nairobi.	This programme has stimulated local food production, increased children's daily food intake and their learning abilities and school attendance.
Ethiopia	The Productive Safety Net Programme (PSNP) has been designed as a complement to the Government's overall Food Security Programme (FSP).	In 2009, this programme covered 7.56 million people suffering from chronic food insecurity in 8 regions and 290 districts.	The programme brought about a drop of 30 per cent in the poverty level between 1998 and 2008. Food security also increased as a result, by 11 per cent, and ownership of breeding animals by 7 per cent.
South Africa	Child Support Grant CSG).	In October 2010, this system covered all poor children up to the age of 18 years, a total of 8 765 354 individuals.	Food grants for children have made it possible to diversify food intake and improve the nutritional status of

			the beneficiaries and their families, thereby reducing the cases of stunting which were common in the black population during apartheid
Namibia	Nutritional support to orphans and vulnerable children: in 2010, each orphan or vulnerable child received $N 30 per month.	160 000 orphans and vulnerable children in the rural environment.	Reduction in the rate of infant mortality and increase in school attendance and completion of primary education, with a concomitant reduction in the rate of youth mortality.

Source: ERD, 2010; HLPE, 2012.

3. Poverty and food insecurity in Cameroon

Poverty and food insecurity go hand-in-hand, since the regions of Cameroon with a high rate of chronic poverty or where the poverty levels have seen a rise also have high rates of food insecurity and malnutrition. Furthermore, the households in the regions generally perceived as having moderate levels of food insecurity could rapidly tumble into alarming levels of food insecurity, if there was to be a minor shock affecting consumption.

3.1. Poverty (chronic and transient)

Analysis of development of poverty shows that the poverty level held steady between 2001 (40.2 per cent) and 2007 (39.9 per cent). However, the actual number of poor people increased owing to an annual demographic growth rate of 2.7 per cent. Out of the whole population, estimated at 15.5 million in 2001, 6.2 million were classified as poor. The results of ECAM3 show that, out of a national population estimated at 17.94 million in 2007, 7.1 million live on less than 738 CFA francs ($US 1.64) a day – in other words 1.1 million more persons living below the monetary poverty line. The growth of the

poverty gap[5] at national level indicates that the reduction in poverty aimed for under Millennium Development Goal 1 may not be achieved. The poverty gap has gone down by only around seven percentage points between 1996 and 2007, the figures being 19.09 per cent in 1996; 12.27 per cent in 2001; and 12.31 per cent in 2007. The poverty gap of 12.31 per cent (corresponding to an incidence of poverty of 31 per cent) translates to an average cost of 83 500 CFA francs per poor person (prices applied in Yaoundé) to close the poverty gap, as against 73 950 CFA francs in 2001.

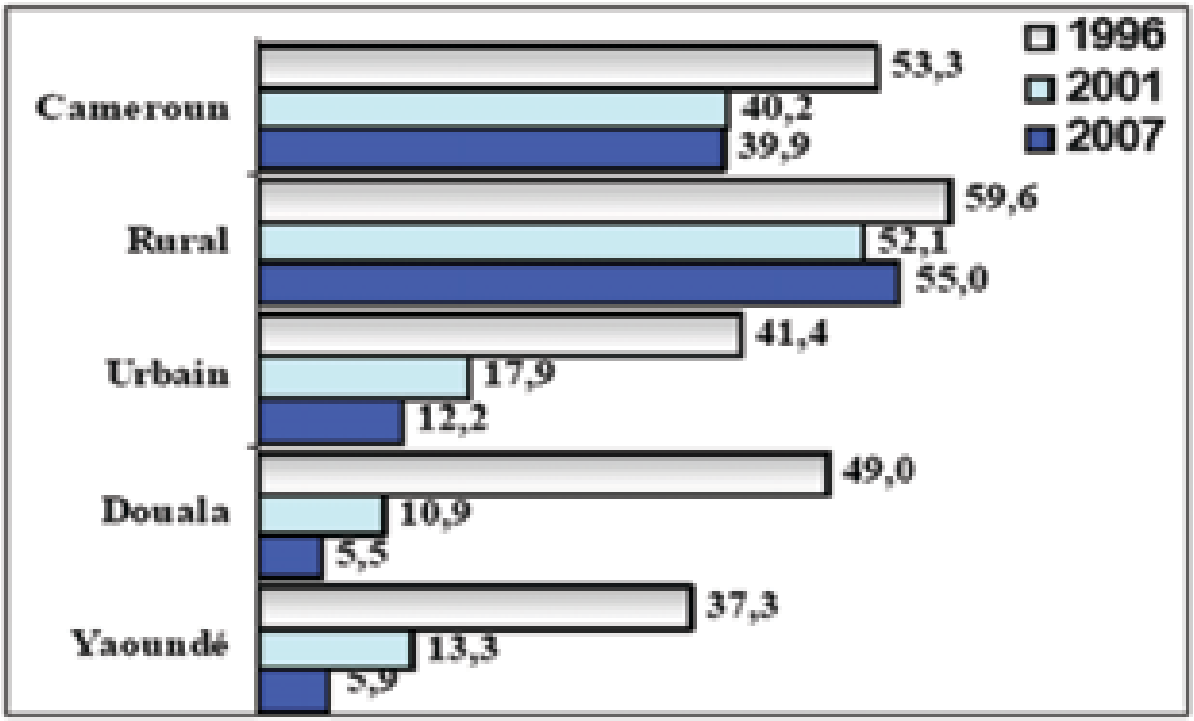
It is shown by the recent Household Survey that Cameroon might not reach the Millennium Development Goal relating to attendance in primary education. Cameroon is in the same situation with regard to most of the MDGs relating to health. Rates of infant and youth mortality have dropped down to the levels of the early 1990s, but they are still high, with an under-five mortality rate of 142 per 1 000 live births – much higher than the rate of 123 per 1 000 live births found in countries with an average medium income.
Although the poverty rate remains stable on the national scale, between 2001 and 2007 it increased significantly in four regions: Adamaoua, Est, Nord and Extrême-Nord. The Nord and Extrême-Nord regions recorded the largest increases in poverty levels, namely 13.6 per cent and 9.6 per cent respectively. In these two regions, the rate of extreme poverty is also high: 31 per cent in Nord and 41 per cent in Extrême-Nord. Furthermore, almost 40 per cent of the individuals classified in the poorest quintile live in Extrême-Nord and 17 per cent in Nord. Similarly, the poverty rates in Est and Adamaoua have increased by 6.4 per cent and 4.5 per cent respectively. Geographically, these regions in the northern part of Cameroon are located in the Sahel and Sudano-Sahel agro-ecological areas, which are subject to drought conditions, irregular precipitation and desertification[6]. By contrast, poverty rates have gone down significantly in the regions of Sud-Ouest, Ouest, Sud, Littoral and Centre. The largest drop was recorded in the Ouest region, with a reduction from 40.3 per cent in 2001 to 28.9 per cent in 2007.

The sharp distinction in poverty levels between the rural and the urban areas shows that the urban areas are doing better in poverty reduction. Whereas the rate of incidence of poverty in the urban environment went down, generally, from 17.9 per cent in 2001 to 12.2 per cent in 2007, in the rural environment it did in fact increase from 52.1 per cent to 55 per cent over the same period. The two main towns of Douala and Yaoundé recorded a significant drop in poverty rates over that period. The better status of the urban areas has

[5] The poverty gap is the mean shortfall of the total population from the poverty line (counting the nonpoor as having zero shortfall), expressed as a percentage of the poverty line. This measure reflects the depth of poverty as well as its incidence.
[6] Emergency Operations, WFP, 2001-2007.

become consistently more marked over time, through all the quintiles of income distribution. In 2007, more than half of poor people lived in the rural areas whereas only 12.2 per cent of the poor lived in the urban centres with at least 50 000 inhabitants. In Douala and Yaoundé, only one individual in twenty is poor whereas in other towns, the proportion increases to up to one individual in five. Almost 94 per cent of all individuals in the poorest quintile live in the rural areas, as against only 2 per cent in Yaoundé, 2 per cent in Douala and 6 per cent in the other towns.

Figure 1: Poverty rate of the individuals by poverty between urban and rural areas



Source: ECAM 1, ECAM 2, ECAM 3, INS.

The most important determinants or correlates of poverty in Cameroon are: (i) *the size of the household*: poor households have on average six persons as against three for non-poor households. The average fertility rate is around five children per woman. The households whose heads are polygamous are those most affected by poverty since polygamous marriages are correlated with a larger number of children. In fact, this is the only household category where the poverty rate has shown a significant increase, from 50 per cent (2001) to 60 per cent (2007); (ii) *the level of education*: poverty goes down progressively in parallel with the level of education of the head of household. Between 2001 and 2007, a major increase in poverty was observed only in the households of which the head had never been to school, whereas in the other households, poverty rates

dropped by at least 1 per cent. Generally speaking, a household headed by someone who has graduated from higher education is six times less likely to be poor than one headed by someone who has never been to school. [calculations based on the surveys of households] (Fambon et al., 2001). Finally, the data from ECAM3 show that the higher the level of education of the head of household, the less often the household has to deal with food insecurity; (iii) *the sex of the head of household:* female-headed households do not seem particularly affected by poverty, all other conditions being equal. It becomes evident that male-headed households register the highest poverty levels relative to those headed by women; (iv) *the features of the labour market*: the households where the head is principally engaged in informal agricultural activities encounter higher poverty levels. As shown in the table below, households belonging to all the vocational categories, except for informal agriculture, have registered a drop in their poverty level.

Table 2: Development of poverty as affected by the occupation of the head of household: 2001/2007 (Foster-Greer-Thorbeke indices)

	2001			2007		
	Rate	Gap	Severity	Rate	Gap	Severity
National	40.2	12.8	5.6	39.9	12.3	5.0
Occupation of head of household						
Public sector	16.7	4.8	2.1	10.0	2.5	0.9
Formal private sector	14.1	3.6	13	9.6	2.0	0.6
Informal agricultural sector	56.9	19.0	8.5	59.6	19.4	8.1
Rural informal non-agricultural sector	31.7	8.9	3.4	23.0	5.7	2.1
Unemployed	25.0	6.1	2.4	11.9	2.5	0.9
Retired	18.4	4.2	1.5	13.5	2.7	0.8
Other unemployed	43.9	15.3	7.0	34.2	10.3	4.3

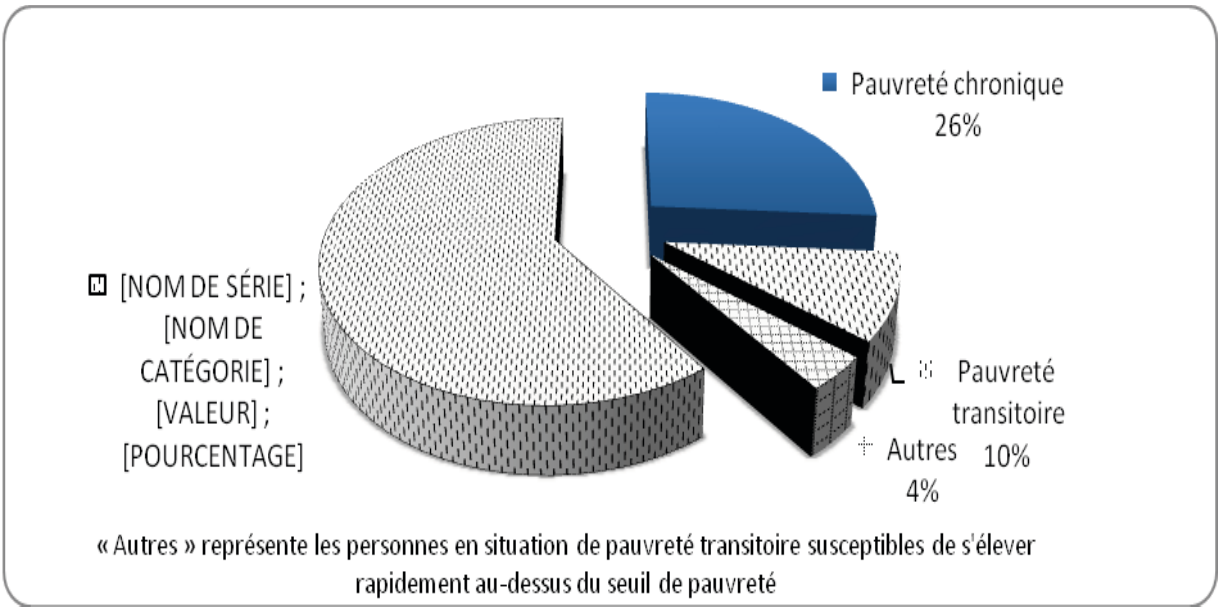
Source: Nguetse Tegoum (2010).

Cameroonian households are vulnerable to environmental, economic and social risks. The risks related to environmental shocks have a direct impact on the livelihoods of 45 per

cent of the population, those carrying out subsistence agriculture. Owing to the drop in world food supply, the environmental risks also have an indirect impact on the food security of the population. Over and above the macroeconomic risks – inflation, exchange rate fluctuation, volatility of export prices, drop in export demand, drop in remittances of funds and in foreign direct investment, which have become significant in recent years – Cameroon is also vulnerable to the risks arising from the basic structure of the economy, such as the excessive trust placed in production of non-processed primary products, the undiversified export base and the dependence on imports together with low agricultural productivity.

In addition to the high levels of chronic poverty, Cameroon also has a high level of transient poverty. Chronic poverty refers to the poor individuals who have a strong likelihood of remaining poor in the near future, and, furthermore, are extremely vulnerable to shocks related to consumption. On the other hand, transient poverty refers to individuals who are currently poor who may be able to raise themselves above the poverty line in the near future, but who remain vulnerable and, therefore, at risk of tumbling down to worse poverty levels owing to instability in levels of consumption. Consequently, the national average for chronic poverty is at 26 per cent as against 9.9 per cent for transient poverty.

Figure 2: Chronic poverty / transitory poverty



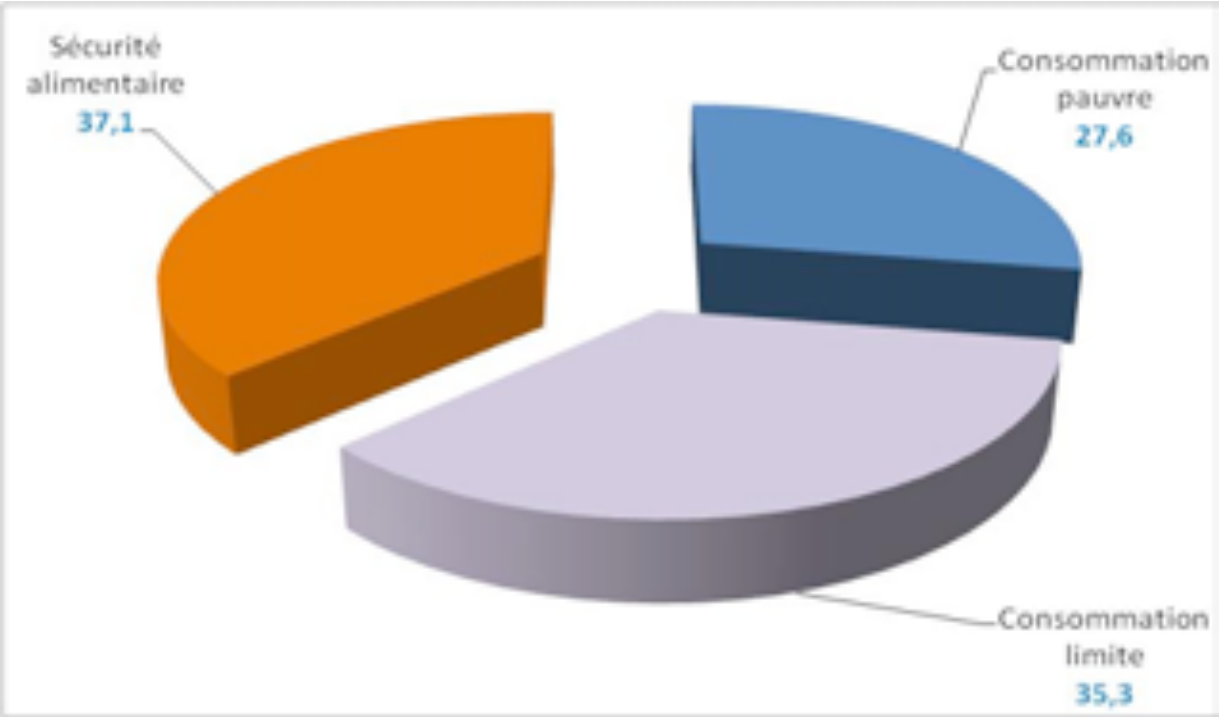
Source: Nguetse Tegoum (2010).

The regions demonstrating high rates of chronic poverty or that have registered a major increase in poverty levels also suffer high rates of food insecurity and malnutrition.

3.2. Food insecurity

The results of the analysis of vulnerability carried out on the basis of the vulnerability approach of the WFP using the diversity and frequency of food consumption, reveal that 27.6 per cent of households do not consume sufficient food, which equates to 3.38 million persons (2.84 million in the rural areas as against 0.54 million in the urban areas). Furthermore, only around 37.1 per cent of people enjoy food security, while 35.7 per cent of the remaining households live below the threshold limit for food security. This approach of vulnerability analysis is based on a level of food consumption used as an indicator of food insecurity. This approach stipulates that there are numerous theoretical foundations for assimilating a poor food consumption, as regards frequency and diversity, with the current level of food insecurity. In accordance with a comprehensive analysis of food security and vulnerability carried out by the WFP in 2007, the main causes of the serious vulnerability and the food insecurity in the northern part of Cameroon are attributable to low agricultural production, low levels of education and income and inadequate infrastructure.

Figure 3: Prevalence of food insecurity in Cameroon

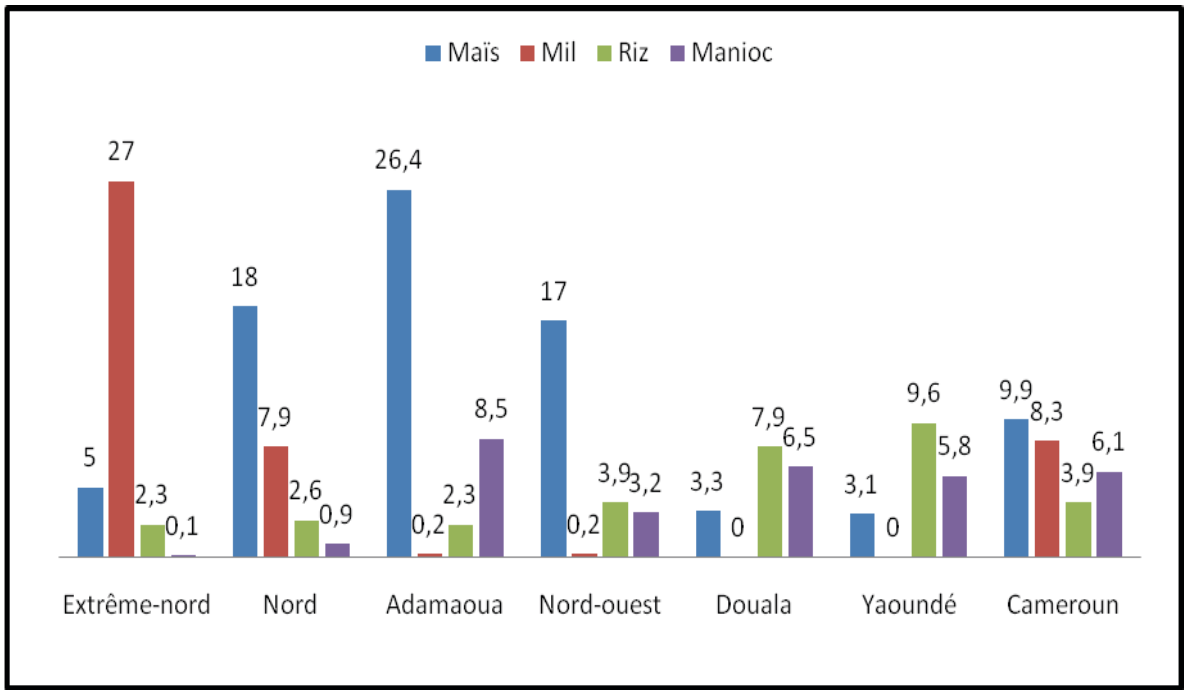


Source: Nguetse Tegoum (2010).

The patterns of consumption or of expenditures on food show the vulnerability of the poor households in the poorer regions to rises in prices of food products. As shown in the figure below, maize, millet and cassava represent a significant percentage of the

expenditures of poor households on food products. These regions are subject to high levels of chronic poverty and food insecurity. In the urban areas of Douala and Yaoundé, rice is a significant basic food for a number of poor households. As a result, any increase in the price of the various basic foodstuffs would have varying harmful consequences on the protection of households, in terms of location and mode of consumption.

Figure 4: Structure of basic food products by poor household (percentage of the budget allocated to food)



Source: Nguetse Tegoum (2010) based on ECAM3.

Despite significant regional variations, food insecurity is correlated with poverty levels. Overall, levels of food insecurity of the order of 27.6 per cent above the national average are observed in the regions of Sud-Ouest (44.1 per cent), Nord-Ouest (37.7 per cent), Nord (34.8 per cent), Adamaoua (32.9 per cent) and Extrême-Nord (32.4 per cent). According to the United Nations Organization for Food and Agriculture (FAO), the Cameroon regions of Nord and Extrême-Nord – where food coverage varies widely from 25 per cent to 80 per cent – suffer serious crises of food insecurity and chronic food shortfalls. For example, a mission for evaluating harvests and food availability (CFSAM) carried out by the Ministry of Agriculture and Rural Development (MINADER) estimated that the 2009 cereal harvest in the regions of Extrême-Nord and Nord was, on average, 11 per cent and 21 per cent respectively below their five-year average, and 9 per cent and 14 per cent respectively below the production levels of the preceding year. Whereas the net regional cereal shortfall for the years 2009-2010 was estimated by the World Food Programme (WFP) at 250 000 metric tonnes, 70 per cent of the total shortfall (176 000 metric tonnes) was

recorded in the region of Extrême-Nord. This drastic drop in food supply in the region is indisputably linked to the disadvantageous climate shocks, which impede poor populations' capacity for adaptation[7]. Furthermore, according to the same WFP assessment, flooded valleys, which serve as watering points for livestock, had dried up earlier than usual. This situation jeopardized livestock-raising, which is an important source of income for the population. In fact, as is stressed by the market assessment carried out jointly by the CILSS[8], EWS NET[9] and the WFP in the eastern basin of the Sahel, the regional livestock market was in crisis, reducing the livelihoods of the farmers and breeders of northern Cameroon. In February 2010, the prices of beef cattle, sheep and goats in the main regional livestock markets, such as in Maiduguri, Nigeria – that have an influence in northern Cameroon and in Chad – dropped by 25 per cent, 40 per cent and 33 per cent respectively relative to their level in February 2009. Furthermore, as a result of the 30 per cent rise in the price of wheat bran (the main animal feedstuff) over the same period, the sale of livestock as a means of adaptation became less viable than in the past.

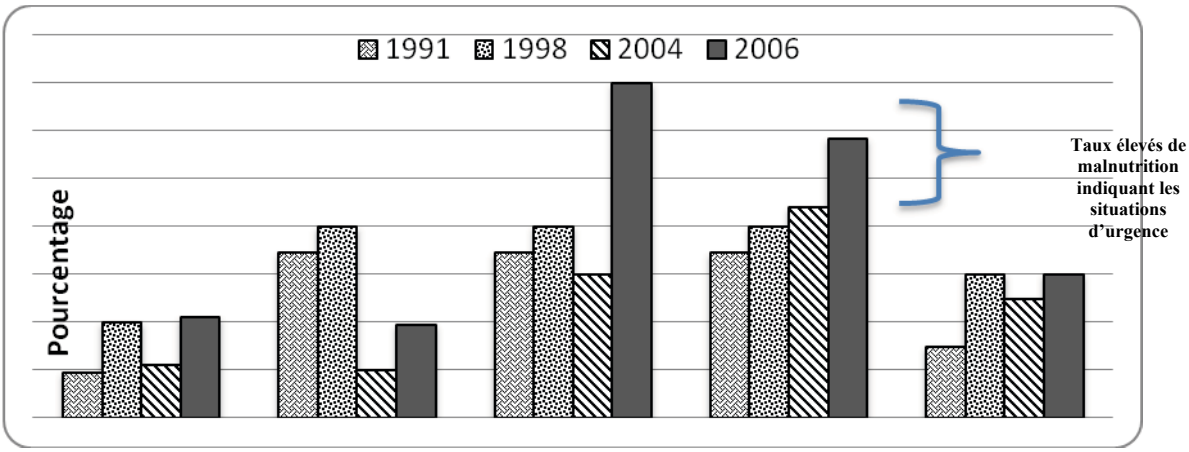
Furthermore, the households in the regions generally seen as having only moderate levels of food insecurity could rapidly drop into alarming levels of food insecurity, given just a small shock relating to consumption. This is the case for the regions of Est, Ouest and Centre. The general problem of food insecurity arises particularly acutely in the rural areas (33.3 per cent) relative to the urban areas (17.9 per cent), as well as in the poor households (33.8 per cent) relative to the non-poor households (25 per cent).
Malnutrition is acute, in particular in the Cameroonian regions of Nord and Extrême-Nord. At the national level, it is estimated that 19.3 per cent of children under five suffer hunger and food insecurity – a rate which would need to be brought down to 8 per cent between the present and 2015 in order to enable the country to achieve the first Millennium Development Goal, namely the reduction of extreme poverty and hunger. Malnutrition remains a serious challenge, given that a third of children are thought to suffer chronic malnutrition. According to certain estimates, up to 45 000 children die from malnutrition alone every year (UN IRIN, April 2009).

- *The rate of global acute malnutrition (GAM)* is highest among children under five years of age in the regions of Nord and Extrême-Nord, 14.1 per cent and 11.7 per cent respectively. These figures are higher than the critical thresholds indicating alarming levels of malnutrition. Furthermore, these two regions also have the highest levels of

[7] For example, the out-of-season production of local sorghum (or mouskwari) was probably diminished as a result of a lack of surface water.
[8] Permanent Interstates Committee for Drought Control in the Sahel.
[9] Famine Early Warning Systems Network.

severe acute malnutrition (SAM), 2.9 per cent and 2.8 per cent respectively (see box 2 of the 2012 report of the World Bank on social safety nets in Cameroon for more details on the method of calculating rates of global acute malnutrition (GAM) and severe acute malnutrition).

Figure 5: Prevalence rates of acute malnutrition in emergencies, 1991-2006



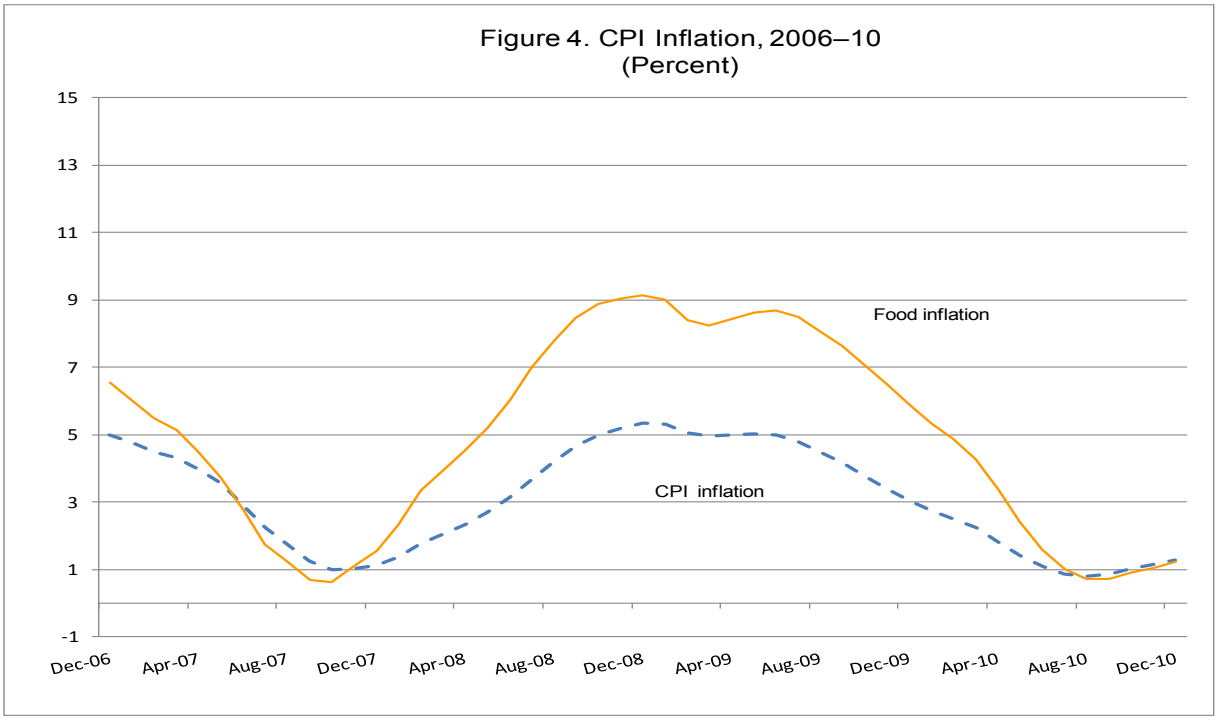
Source: WFP, MICS 2006.

- *The rate of global chronic malnutrition (GCM),* which measures stunting (size-age) in children under five years old, is highest in the two regions of Nord and Extrême-Nord. These rates, 44.4 per cent (Nord) and 36.9 per cent (Extrême-Nord) in 2004, remained virtually unchanged in 2006, at 43.3 per cent and 35.7 per cent respectively. They are above the national average of 30.4 per cent (MICS 2006) (see box 2 of the 2012 report of the World Bank on social safety nets in Cameroon for more details on the method of calculating rates of global chronic malnutrition (GCM)).
- *The causes for the high rates of malnutrition* are many and varied, but they are similar to those in many other countries of the Sahel. According to the UN Integrated Regional Information Network (IRIN) report of April 2009, among the most critical causes reference may be made to lack of primary health care, lack of access to essential services for child survival, unsatisfactory infant feeding practices, global food insecurity and the isolation of those regions, which increases their vulnerability even further.
- *The rates of malnutrition among pregnant and breastfeeding women* are among the highest in Nord and Extrême-Nord. These two regions have respectively 8.1 per cent and 17.2 per cent of pregnant and breastfeeding women with a body mass index (BMI) lower than 18.5, in other words percentages much higher than the national average, which is 6.7 per cent of pregnant and breastfeeding women. This situation is particularly troubling in the northern part of Cameroon, because it results in very low birthweight (LBW) as indicated in the third cycle of the Multiple Indicator Cluster

Survey (MICS 3) of UNICEF. The rates of LBW of 16.6 per cent in Extrême-Nord and 14.3 per cent in Nord are higher than the national average of 10.8 per cent. Furthermore the rate of low birthweight in Extrême-Nord exceeds the limit point of 15 per cent, which is an internationally agreed threshold for triggering emergency interventions in humanitarian situations.

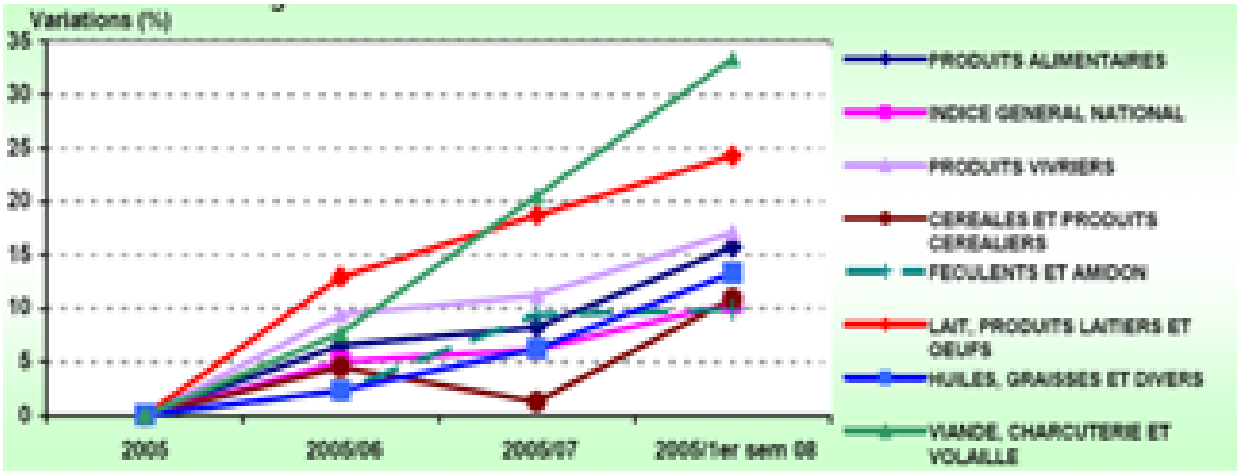
The recent surge in foodstuff prices and fuel prices, as well as the international financial crisis, have also worsened vulnerability to poverty. As has been observed in the earlier sections, a significant number of households in Cameroon – most strikingly in the regions of Nord and Extrême-Nord – are exposed to a poor consumption of foodstuffs and to malnutrition. An increase in prices of common consumption products is heightening these risks even further. Similarly, fuel is a product essential to household welfare, being an indispensable input to essential economic activities. The international financial crisis of 2008 affected key sectors of Cameroon's exports and, consequently, the households that live off the incomes from such industries. Similarly, a drop in the volume of foreign direct investment and of the amount of monetary transfers affect the flow of income to the households depending on it.

Figure 6: Comparative development of consumer price indices (foodstuffs and non-food products, 1998-2008



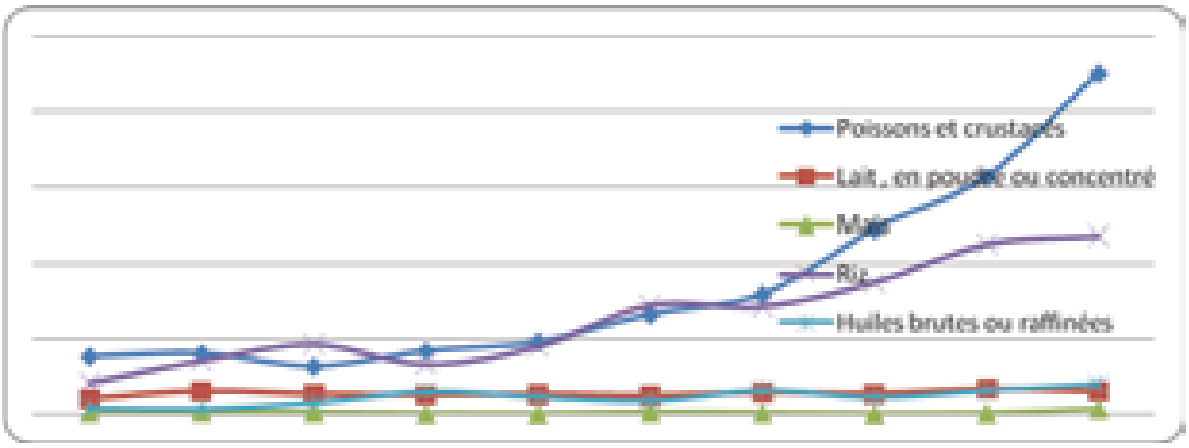
Source: IMF Article IV Consultation, June 2011.

Figure 7: Change in food price



Source: WFP (2007).

Figure 8: Imports by commodity consumption food trends in Cameroon



Source: WFP (2007).

4. Existing programmes of social protection for food security in Cameroon

Cameroon has only a very limited number of programmes of social protection for food security, and in most cases their reach and levels of coverage are insufficient to combat chronic poverty and vulnerability.

4.1. Existing social protection programmes

The most important of the social protection programmes relating to food security over the past five years can be classified into five major categories: school canteens, nutritional recovery, labour-intensive public works, emergency intervention initiatives and universal

subsidies. Apart from the programmes related to subsidies, the coverage of each programme barely exceeds 1 per cent of the total population and reaches only around two-thirds of the target beneficiaries identified as being vulnerable.

The school canteen programme is one of the main instruments used to create a link between the social safety nets and the objectives related to the attainment of certain levels of education. It seeks to remedy the nutritional shortcomings of the pupils and at the same time to encourage school attendance by numerous children. In the context of Cameroon, balanced meals are regularly served to the pupils in schools on 165 days a year and, in addition, food supplies to be taken home (50 kg of cereals per trimester) are provided to all the girls registered at least in primary school. This programme is particularly relevant to improvement of educational results and, consequently, to levels of education of girls in priority educational spheres.

Table 3: School canteen programme co-financed by WFP and the Ministry of Basic Education (MINEDUB)

	Budget (million CFA francs)		Beneficiaries (annual average) 2008 – 2010)	Cost per beneficiary (2010 estimate, million CFA francs)
	2009	**2010**		
WFP	1925	1925	55 366 pupils	0.035
MINEDUB	55	50		

Source: World Bank (2012).

The nutrition programme mainly concerns the health sector and, in a specifically targeted way, it supports orphans and vulnerable children, in particular those infected with HIV or who have lost their parents to AIDS. In 2003, Cameroon alone saw an increase in the number of orphans of the order of 230 000. The orphan crisis is exerting heavy pressure on wider families and on community groups.

Table 4: Nutrition programme

	Budget (million CFA francs)		Beneficiaries (annual average between 2008 and 2010)
	2008	**2010**	
UNICEF	40	-	2 614 children (585 families)
NGOs (CARE, CRS)	100	100	

Source: World Bank (2012).

The programmes of labour-intensive public works generally consist of short-term interventions directed towards the social safety nets and offering temporary employment opportunities in infrastructure projects. They may of the "money for work" or the "food for work" type. There are two principal initiatives related to public works in Cameroon, namely a clean-up project in Yaoundé known as (PADY) ("money for work") and the WFP projects ("food for work").

Table 5: Features of the public works programmes in Cameroon

	Budget (billion CFA francs)	Beneficiaries	Wages
PADY	6	6 000 employees	300 CFA francs/hour
WFP	0.106	16 590 families	50 kg of cereals

Source: World Bank (2012).

The emergency intervention initiatives are, to a large degree, designed for reaction in the event of natural disasters – such as drought, flooding and the flow of refugees – which constitute a threat to the food security of a large number of individuals. In Cameroon, it has thus been necessary to create reserves of food stocks which are then, in times of crisis, distributed to vulnerable populations, particularly refugees from the Central African Republic and Chad.

Table 6: Purchase and sale of stocks of cereals by MINADER, 2002/2009

	Total purchases		Total sales	
	Qty (tonnes)	Value (CFA francs)	Qty (tonnes)	Value (CFA francs)
2002	314.6	36 702 000	904.8	144 179 500
2003	2 919.3	348 485 000	0	0
2004	160	14 400 000	2 079.2	190 326 000
2005	60	7 200 000	3 066.25	49 682 000
2006	2 400	328 800 000	0	0
2007	2 148	214 800 000	0	0
2008	0	0	3 580.1	549 647 000
2009	2 148	214 800 000	72	1 401 000
Total	101 493	1 165 185 000	9 702.35	1 382 448 500

Source: MINADER.

Universal price subsidies. There are three types of universal price subsidies in Cameroon, namely: subsidies on the price of imported foodstuffs, subsidies on the price of oil products and subsidies on transport costs in the towns of Yaoundé and Douala.

Table 7: State expenditures on price subsidies (2008-2010)

	Percentage of the State budget				Percentage of GDP
	2008	2009	2010	avg. 2008-10	avg. 2008-10
Subsidies on energy prices	5.52	0.98	4.67	3.72	0.83
Subsidies on foodstuff prices	2.94	2.22	2.12	2.42	0.53
Subsidies on transport costs	0.13	0.14	0.13	0.13	0.03
Total	8.59	3.33	6.92	6.28	1.39

Source: Zamo (2010).

The principal actors in the programmes dealing with social safety nets in Cameroon are at national and international level. The Government carries out these programmes through sector ministries and the parapublic bodies concerned, while the donors work through intermediaries and nongovernmental organizations. At the government level, the competent ministries are the Ministries of Social Affairs (MINAS), of Basic Education (MINEDUB), and of Public Health (MINSANTÉ). MINEDUB and MINSANTÉ are essentially involved in nutritional support to vulnerable groups, through emergency intervention initiatives, school canteens and cost-free provision of education and health. Furthermore, the Ministry of Finance supports all the price subsidy programmes, in particular in the area of energy products and transport, in conjunction with the ministries concerned.

Among the donors and the international organizations, the WFP and UNICEF are the most active in the sphere of support to the social safety net programmes. The WFP is particularly involved in the programmes relating to labour-intensive public works, school canteens and emergency intervention programmes, while UNICEF is involved in support to orphans, vulnerable children and their families through a programme of direct support (transport, food aid, school supplies, and so on) and through productive activities such as facilitation of families' access to loans granted by microfinance establishments.

The nongovernmental organizations involved in the interventions related to social safety nets are primarily CARE and CRS, which both target orphans and vulnerable children, following the same approaches as UNICEF.

Table 8: Summary of the social protection programmes relating to food security in Cameroon and the principal actors

Programmes/Projects	Principal actors
School canteens	WFP, MINEDUB
Nutrition programme (food distribution)	UNICEF, CARE, CRS, AWA, other NGOs
Public works	PADY (ILO, AfDB), WFP
Emergency interventions	WFP, MINADER, UNICEF
Price subsidies	MINFI

Source: World Bank (2012).

4.2. Analysis of the expenditure on existing social protection programmes

The analyses carried out based on available sources reveal that the expenditures on social protection initiatives are limited. Health and education account for the lion's share of the expenditures devoted to the social sector. The funding of the initiatives relating to social protection represent a tiny portion, 0.76 per cent, of the budget which the Government allocates in general to all social programmes. Between 2008 and 2010, the expenditures disbursed on interventions related to social safety nets amounted to around 4.42 per cent of the expenditure of the social programme, or 1.07 per cent of the State budget and only 0.23 per cent of GDP. However, if account is taken of the prices subsidies, this figure could reach approximately 7.4 per cent of the State budget, or 1.63 per cent of GDP and 30.77 per cent of expenditures on social programmes. Whereas the State allocates around 6 per cent of its budget to price subsidies, the latter are not well targeted. This leads to the supposition that the social safety nets and the other initiatives relating to social protection within the framework of the overall poverty reduction programmes are not appropriate to respond to the needs of the poorest strata of the population. This is all the more true in that nearly 80 per cent of the investments made in the sphere of social safety nets (excluding price subsidies) are allocated to specific one-off emergency intervention initiatives rather than to well-designed and effectively targeted programmes in the area of the search for solutions to chronic poverty and food insecurity. Generally speaking, expenditures relating to social safety nets vary between 1 and 2 per cent of GDP in most developing countries (Grosh et al., 2008).

The food and fuel price subsidy programmes are the most expensive, but have a degressive effect. The fiscal charge of all of the subsidies programmes together represented on average 6.28 per cent of the State budget and 1.39 per cent of GDP between 2008 and 2010. Furthermore, it should be noted that a dizzying rise in expenditures on subsidies, as occurred in 2008, translates into a corresponding drop in expenditures made in the social sector, in particular in the areas of education and health. However, expenditures on subsidies primarily have a degressive effect since most of the products subsidized are not found in the shopping basket of the lowest quintile in terms of income distribution. Only the subsidies on the price of oil products benefit the poor. As an example, the richest quintile spends practically five times as much as the persons in the poorest quintile on consumption of fish, but this product continues to be subsidized. Similarly, the subsidies on petrol, diesel fuel or LPG have a degressive effect since the persons in the richest quintile spend a large portion of their income on such products, as compared with the persons in the poorest quintile.

Table 9: Summary of expenditures on social safety net programmes between 2006 and 2010 (billion CFA francs)

	2006	2007	2008	2009	2010
PADY	4.6	4.6	4.6	4.6	4.6
School canteens	0.1	0.1	1.8	1.8	1.8
Emergency programme	0.3	0.2	26.1	6.8	14.9
Educational expenses	-	-	-	4.8	4.8
Hospitalization costs	1.4	1.6	4.4	1.6	1.6
Food subsidies	-	56.8	73.0	51.0	51.0
Fuel subsidies	-	-	136.9	22.5	112.5
Total food and fuel subsidies		**56.0**	**209.9**	**73.5**	**112.5**
Percentage of GDP	-	0.6	2.0	0.7	1.0
Percentage of Government	-	3.2	10.2	3.4	4.4
Programme Total	**6.0**	**62.2**	**226.6**	**91.1**	**117.1**
Percentage of GDP	-	0.6	2.2	0.8	1.0
Percentage of Government	-	3.6	11.0	4.3	4.6

Source: World Bank (2012).

5. Institutionalization of the programmes of social protection for food security in Cameroon

The reasons generally cited against extending the security social system to the population in precarious living conditions are the extent of the poverty, and thus the numbers of the population to be covered (almost half of the population lives below the national poverty line) and budgetary constraints. In our view, the poor capacity of the administration and the lack of political will are the most meaningful factors.

An approach based on human rights emphasizes that the right to food and the right to social protection are complementary to one another and that the observance of these two rights is not only a moral and juridical imperative, but it is essential to achieving the fundamental policy objectives of economic growth and human development. There is thus a need to institutionalize social protection by integrating it into the Government apparatus, ideally by enshrining in law the right of citizens and resident aliens to have the benefit of being able to assert their rights in the courts.

Certainly, it is difficult for a poor State to assume its social protection obligations vis-à-vis its entire population, but experiences in African countries have proved that political will

can overcome a situation that may initially appear insoluble. Social protection systems have been drawn up to respond to the food security needs of various groups in a situation of food insecurity, with or without employment, at different stages of their lives. Countries such as Namibia, South Africa, Ethiopia, Malawi and Kenya have demonstrated the feasibility of such a mechanism. The Productive Safety Net Programme (PSNP) put in place by Ethiopia stands out for its enviable success. This programme is based on three components: labour-intensive public works (for the working population), monetary transfers subject to conditions (for poor people who are not capable of engaging in other forms of productive work, such as pregnant or breastfeeding women, widows or schoolchildren), and unconditional monetary transfers (notably to persons who have absolutely nothing, in other words those who are totally destitute) (HLPE, op. cit.). Malawi has also set up widened social protection programmes, comprising the following instruments: direct aid (unconditional or conditional monetary transfers, school meals programmes and food aid programmes); programmes to help with productivity (for example, public works programmes and subsidies for the purchase of fertilizer); market intervention programmes (control of the price of maize, setting of minimum prices for agricultural products and establishment of strategic food reserves). Namibia administers a programme of social protection covering the school meals programme. South Africa has set up food grants for children, and these have considerably reduced the poverty gap suffered by the beneficiary families. Kenya has also set up programmes of school meals prepared locally.

In the area of social coverage, Cameroon could well learn from these experiences to develop its system of social protection by ensuring a balance between direct monetary transfers and the public works programmes as two of its main components. By introducing programmes relating to direct monetary transfers and to well-designed and effectively targeted public works, it would be possible to extend the social coverage based on social safety nets to the majority of the persons living in chronic poverty in Cameroon. World Bank simulations for Cameroon show that such a scenario is possible within the limits of the budgetary envelope currently available (World Bank, op. cit.). As an example, by transferring an annual average amount of 24 000 CFA francs per person, it would be possible to cover the needs of all the chronically poor households at a cost of approximately 1 per cent of GDP (World Bank, op. cit.).

The key to overcoming the budgetary constraint lies in the knock-on effets of a set of reforms not only affecting the social protection sector. As has been shown by the United Nations Research Institute for Social Development (UNRISD), this set includes budgetary

policy, agrarian reform, social legislation, regulation of the private sector, and more. (Mkandawire, 2006).

6. Conclusion and recommendations

Cameroon does not have a complete and well-coordinated system of social protection programmes firmly anchored in a national social protection policy, but only a number of isolated and one-off interventions. Armed with the support of its partners and of donors, the Government should absolutely turn its attention to the issue of chronic poverty and vulnerability so as to make a significant reduction in poverty. This should be a strategic priority anchored in a national social protection policy.

Within the framework of the current pattern of expenditures, there is evidence of a lack of effectiveness in the utilization of the resources intended for the vulnerable categories of people. The food and fuel subsidies cost the State 213 billion CFA francs for the financial year 2008 alone, which is an amount much higher than the average of the total annual expenditures on social safety nets (excluding subsidies). These subsidies are of more benefit to the better-off segments of the population. Within the framework of the other programmes of social safety nets, geographical targeting and self-selection have made it possible to cover almost two-thirds of the intended beneficiaries. Given the limited scale and the poor coordination of the individual programmes, each programme manages to cover only 1 per cent of the population, and all of the programmes together (excluding price subsidies) do not cover more than 6 per cent of the population.

Consequently, there is a need to create a coherent strategy of social protection and to put in place an effective system of social safety nets in order to combat chronic poverty and food insecurity in Cameroon. This strategy should identify the risks and vulnerabilities and link them up with the appropriate and necessary programmes. Priority should be given to investments in human capital as well as in the geographical areas most affected by poverty (chronic), namely the regions of Nord and Extrême-Nord.

It is thus necessary to recommend some policies aimed at establishing a complete social protection system for food security in Cameroon:

- **Draw up a social protection strategy enabling the fight against chronic poverty and food insecurity in Cameroon.**

Given the feeble results of the targeting of the interventions related to social safety nets, a reassignment of funds – in particular a reduction in the expenditures on subsidies and an

increase in the expenditure on targeted programmes – will probably be able to contribute significantly to poverty reduction and to lessening vulnerability. Such an approach will confer effectiveness on the interventions related to social safety nets and also make it possible to respond to emergency situations.

- **Put in place new social protection programmes with the aim of evolving towards a well-coordinated system of social protection, effectively targeting the resources to be allocated to the poorest and most vulnerable**.

A programme of direct monetary transfers which regularly allocates a fixed amount to vulnerable households, throughout the year, would make it possible to reduce considerably the vulnerability to chronic food insecurity. Other emergency programmes meant to respond to climate shocks could also be brought in to round out this programme. Finally, the integration of other forms of intervention related to social safety nets, such as programmes of labour-intensive public works within the context of programmes of monetary transfers, could render the targeting more effective.

- **Move, over several years, universal subsidy programmes towards targeted social protection programmes**.

An effective system of programmes of social safety nets covering the majority of the target beneficiaries requires major financial resources. Since the sources of revenue do not seem likely to create a substantial budgetary space, it appears more realistic to reassign the expenditures allocated to the less effective programmes. However, the appropriateness of reforms relating to universal subsidies should be considered as a function of the ramifications of economic policy.

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Small Area Estimation of Poverty in Ethiopia

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Abstract

Available data to compute poverty measures in Ethiopia come mainly from sample surveys, such as the household consumption expenditure (HCE) survey. These data can be used to produce accurate estimates only at national and regional level. However, regional and national estimates usually mask variations at the zone level and so yield only partial information for planning and allocation of resources at the local level. The purpose of this article is to estimate both total and food poverty measures at the zone levels in Ethiopia. Zones where the proportion of the population under the total poverty line is smallest (below 5%) are Nifas silk, Bole, Bahirdar and Mekelle. Zones with a high level of poverty incidence (over 65%) are Wolayta, Debub Omo, Basketo, Borena, Awi and Alaba. The diagnostic analysis shows that the EBLUP estimates are reasonably reliable. The results show that there is considerable geographical variation in poverty measures for zones belonging to the same region. Thus, conducting the analysis of poverty at regional level could mask important dissimilarities characterizing those territories. In summary, addressing poverty has been an important component of the MDGs as declared by the heads of states at the Millennium Summit in September 2000 that set out goals and targets to be met by the year 2015. Hence it would be desirable that the Ethiopian government implement polices to reduce poverty proportion in those zones in which poverty proportion is the highest.

Keywords: Fay-Herriot model, small area estimation, EBLUP, poverty

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1. Introduction

The generic dictionary meaning of the term “poor" is lack of means for comfortable subsistence and “poverty" is the state of being poor (Ray, Mazhari, Passah and Pandey, 2000). Poverty is a major concern and an important issue in Ethiopia. It is a chronic problem exacerbated by war, drought and inappropriate policies.

By any standard of measurement, Ethiopia can be categorized as one of the poorest countries in the world (Bogale, Hagedorn, and Korf, 2005, Tasew, Alemu, and Tekie, 2008, IFAD, 2012, Oxford Poverty and Human Development Initiative, 2014). Tasew et al. (2008, page V) state that “Ethiopia is one of the poorest countries in the world and ranks among the lowest for most human development indicators. Millions of Ethiopians are dependent on food aid every year." According to IFAD (2012, page 1) ``Ethiopia ranks 174th out of 187 countries on the United Nations Development Programme’s human development index, and average per capita incomes are less than half the current sub-Saharan average". Recently, the Oxford Poverty and Human Development Initiative (2014) reveals that multidimensional poverty index (MPI) of Ethiopia is 56.4% with the percentage of MPI poor (H) =87.3% and average intensity across the poor (A) = 64.6%, where MPI was developed in 2010 in order to use different indicators to determine poverty beyond income-based lists. According to this report Ethiopia is the second poorest country in the World next to Niger.

Over the years, the Ethiopian government has carried out several economic reform programs in order to achieve economic stability and renewed growth in the fight against poverty. Since 2007, Ethiopia has achieved the highest economic growth when compared to the sub-Saharan African countries even if it remains one of the poorest countries in the World. Though the programs have resulted in improved macro-economic performance, they have had limited impact on the poverty situation at household level. The situation has been aggravated by irregularity of natural conditions, war and other human and environmental factors. As a result poverty has become a ravaging phenomenon in Ethiopia.

Devereux and Sharp (2003) present several arguments to challenge the belief which says poverty in rural Ethiopia has fallen significantly since the early 1990s. There is no basis for extrapolating national poverty rates since the original sampling frame was so small and unrepresentative. The existing poverty estimates in Ethiopia are also dependent by seasonality, annual rainfall and food aid receipts. They have come with the following

conclusions. Firstly, a substantial number of households in Wollo are not able to meet basic needs, lack of key productive assets, and dependence on transfers. Secondly, the number of people who are destitute has been increased in the last ten years. Finally, the crisis of livelihoods underlying this trend is affecting entire communities the dominant pattern is an aggregate downward shift, rather than stratification and the decline of wealthier households is exacerbating the vulnerability of the poorest. Their findings cast serious doubts on generalisations about poverty trends in Ethiopia.

According to Bogale et al. (2005) poverty seems persistent in almost all areas of the rural Ethiopia. In order to fight poverty in rural Ethiopia, we should identify the determinant factors of poverty in rural Ethiopia. For this reason, the poor must be identified and the intensity of poverty must be determined. Bogale et al. (2005) investigates the determinants of rural poverty based on the 149 rural households in three districts of Ethiopia. They applied the Foster, Greer, and Thorbecke (1984) poverty index to examine the extent and severity of rural poverty. They found that nearly 40% of the sample households live below poverty line with an average poverty gap of 0.047. Even if the sample size is too small to represent a study in Ethiopia, they identified as lack of land, human capital and oxen are factors behind the persistence of poverty through binary logistic regression. They also suggest that improved targeting devices can be a useful instrument in reducing poverty, in particular to reach the poorest of the poor.

In 1991, after decades of civil war, the military Marxist-inspired regime of the Dergue came to an end with its defeat by a coalition of opposition forces in Ethiopia. Since 1990s bilateral and multilateral aid has increased dramatically, albeit from extremely low levels, resulting in significant investment in health and education infrastructure. A series of initiatives to stimulate agricultural productivity growth have been undertaken, including technology transfer based on extension, fertilizer and seeds. But serious instability remained. Dercon et al. (2011) argued that chronic poverty is associated with several initial characteristics: lack of physical assets, education, and 'remoteness' in terms of distance to towns or poor roads (Dercon et al., 2011).

Based on the analysis of the data from 2004/05 and 2010/2011 Household Consumption Expenditure (HCE) Survey 38.7 percent and 29.6 percent of the population were observed fall below the poverty line, respectively. Moreover, according to these data in 2004/05 about 39.3

percent of the rural population fall below the poverty line while the corresponding figure for the urban population was 35.1 percent. Similarly in 2010/11 about 30.4 percent of the rural population fall below the poverty line while the corresponding figure for the urban population was 25.7 percent (MoFED, 2012). In both years poverty was slightly higher in rural areas than in urban areas.

The HCE survey data can be used to produce accurate estimates only at national and regional level. However, regional and national estimates usually mask variations at the zone level and so yield only partial information for planning and allocation of resources at the local level. Regional estimates can lead policy makers into the `ecological fallacy' of assuming that the average value for a region applies to all zones within it when in fact there might be differences between zones. Due to this reason, we need population estimates at small geographic area level (e.g., zone level), for use in regional planning and policy and decision making (Nandram, 1999). For example poverty maps can be used as a basis for targeting disadvantaged areas and the evaluation of geographically oriented actions and programme's involved in the national poverty strategy (Goh and Virola, 2005; World Bank, 2010).

Small area estimation is a technique used by when the sample size of a geographic area, or of another sub-national 'domain' (e.g. Zones, districts (Woredas), etc.) is too small for a direct estimator to produce reliable estimates. This deficiency has led to the development of model based estimates which "borrow strength" from related local areas to obtain estimates which are more accurate. Such methods essentially use explicit models to combine information from the sample survey, various administrative or census records, and even previous surveys (Prasad and Rao, 1990, Rao, 2003). Ghosh and Rao (1994), Pfefferman (2002), Rao (2003) and Pfefferman (2013) provide a review of small area estimation methods. The term 'small' relates to the sample size of the domain, rather than to the size of the domain, rather than to the size of the domain's population. Examples of small areas include a geographical region (e.g. a state, county, municipality, etc.), a demographic group (e.g. a specific age x sex x race group), a demographic group within a geographic region, etc (Datta and Lahiri, 2000, Butar and Lahiri, 2003, Datta and Ghosh, 2012).

This paper aims to provide estimates of poverty measure at the zone levels in Ethiopia. We analyse the 2010/11 HCE survey and the 2007 Ethiopian census data sets and estimate poverty measures using a small area estimation techniques under the Fay-Herriot model. This

allows us to derive further meaningful insight about various poverty measures in Ethiopia and the relevance that specific policies can play in alleviating poverty.

After reviewing the literature on poverty measurement, this paper is organized as follows. In section 2, we describe the data and methods. In section 3, we use the 2010/11 HCE survey and the 2007 census data sets to estimate poverty measures. The final section presents concluding remarks.

2. Data and Methods

2.1 Data Sources

The HCE survey was conducted by the government statistical agency, Central Statistical Authority (CSA) in 2010/11. The survey covered the population in sedentary areas of all regions that included the rural and selected urban areas. In the rural and urban categories, the sampling methods that were implemented under the HCE survey was two stage stratified sampling by considering enumeration areas as the primary sampling units and households as the secondary sampling units. At country level in 2010/11 HCE, a total of 28032 households (10,368 in rural and 17,664 in urban areas) were covered. In order to fill the possible gap in the survey data we used the auxiliary information from the 2007 Ethiopian household and census data (CSA, 2012).

The census provides basic data for small areas and small population groups at all levels. The 2007 census of Ethiopia is the most recent census. It provides comprehensive information on housing and on household socio-demographic conditions, along with the characteristics of individuals household members such as age, educational attainment, and employment status, thus allowing for the finest geographical disaggregation.

2.2 Basic Small Area Model

Let *m* denote the number of small areas (zones) and θ_i represent the ith small area mean. Suppose y_i (i=1,...,m) represents the direct survey estimator of θ_i (obtained from the vector of observations ($y_{i1}, \ldots, y_{in_i}$)′ for area i); n_i denotes the sample size within a small area; $x_i = (x_{i1}, \ldots, x_{ki})'$ is a k X 1 vector of known covariates for area i related to the target

parameters and $\beta = (\beta_1, \ldots, \beta_{k_i})'$ is a k X 1 vector of regression coefficients. The aim is to estimate the population small area means

$$\theta_i = x_i \beta + v_i, \quad i = 1, \ldots, m.$$

Under this set-up, the Fay-Herriot basic area model described as follows (Fay and Herriot, 1979):

$$y_i = x_i \beta + v_i + e_i, \quad i = 1, \ldots, m,$$

where the area specific random effects v_i are assumed to be independent and identically distributed (iid) with E(v_i)=0 and Var(v_i)=A>0.

2.3 Empirical Best Linear Unbiased Predictor (EBLUP) Estimator

Das, Jiang and Rao (2004, page 818) state that "the term 'empirical predictor' refers to a two-stage predictor of a linear combination of fixed and random effects. In the first stage, a predictor is obtained but it involves unknown parameters; thus, in the second stage, the unknown parameters are replaced by their estimates". The EBLUP estimator is a linear combination of direct and synthetic estimator. The BLUP is not usable until we estimate the model parameters (β and A). Furthermore, a number of estimation procedures for the model variance of the FH model are available in the literature. For example, the method of moments proposed by Prasad and Rao (PR) (1990), Maximum Likelihood (ML) and Restricted Maximum Likelihood (REML) proposed by Datta and Lahiri (2000), the Fay and Herriot (FH) (1979) estimation method and so on. When the unknown parameters are replaced by their estimators, then we will have EBLUP of θ_i which is given by

$$\hat{\theta}_i^{EB} = (1 - \hat{\gamma}_i) y_i + \hat{\gamma}_i x'_i \hat{\beta}$$

where $\hat{\gamma}_i = \dfrac{\psi_i}{\hat{A} + \psi_i}$ and $\hat{\beta} = \left(X' \hat{V}^{-1} X\right)^{-1} X' \hat{V}^{-1} y$ with $X = \left(x'_i\right)_{1 \le i \le m}$, $y = \left(y'_i\right)_{1 \le i \le m}$, $V = A I_m + \psi$ and $\psi = diag(\psi_i, 1 \le i \le m)$. I_m represents the m-dimensional identity matrix.

2.4 Mean Squared Error Estimation

The most common practical problem in small area estimation is measuring the variability associated with the EBLUP. MSE is used as a measure of variability under the EBLUP estimator in small area estimation. Datta et al. (2005) derived the MSE estimator of $MSE\left(\hat{\theta}_i^{EB}\right)^{-1}$, for the FH estimator. Thus, using the FH estimator, the MSE estimator of $MSE\left(\hat{\theta}_i^{EB}\right)^{-1}$ is given by

$$\widehat{MSE}\left(\hat{\theta}_i^{EB}\right)=g_{1i}(\hat{A})+g_{2i}(\hat{A})+2g_{3i}(\hat{A})-\hat{b}\left(\gamma_i(\hat{A})\right)^2,$$

where $g_{1i}=\dfrac{A\psi_i}{A+\psi_i}$, $g_{2i}(A)=\gamma_i^2 x'_i\left(X'V^{-1}X\right)^{-1}x_i$, $g_{3i}(A)=\dfrac{\psi_i^2}{\left(A+\psi_i\right)^3}V(\hat{A})$,

$$\hat{b}=\frac{2\left(m\sum_i\left(\hat{A}+\psi_i\right)^{-2}-\left(\sum_i\left(\hat{A}+\psi_i\right)^{-1}\right)^2\right)}{\sum_i\left(\hat{A}+\psi_i\right)^{-2}},\text{ and } V(\hat{A})=2m\left[\sum_{i=1}^{m}\frac{1}{A+\psi_i}\right]^{-2}.$$

2.5 Method of Measuring Poverty in Small Areas

Consider a finite population D of size N partitioned into m areas D_i, i=1,...,m. The response variable is the estimate of poverty measures based on 2010/11 HCE survey data. An Ethiopian household is considered in poverty when its consumption expenditure is below a poverty line per adult person per year (Birr) 3,781 (MoFED, 2012). The Birr is the unit of currency in Ethiopia. Poverty line can be explained as the level of income sufficient to purchase the minimum standard of nutrition/food (Citro and Kalton, 2000, Ray et al., 2000).

The most widely used poverty measures are the percentage of the poor (headcount index), the aggregate poverty gap (poverty gap index), and the distribution of income among the poor (poverty severity index). These measures can be defined in terms of the well-known Foster et al. (1984) P_α class of poverty measures. We have modified their poverty measures to small area estimation as follows. Let $E_{i1},\ldots,E_{in_i}$ be a vector of real per-adult household

expenditure for area i, Z>0 is poverty line and n_i is the total number of households in area i. For α>0, let $P_{\alpha i}$ be defined by

$$P_{\alpha i} = \frac{1}{n_i}\sum_{j=1}^{n_i}\left(\frac{Z-E_{ij}}{Z}\right)^{\alpha} I\left(E_{ij} < Z\right), \quad \text{i=1,...,m, j=1,..., } n_i$$

where $I\left(E_{ij} < Z\right) = 1 \; if \; E_{ij} < Z$ (person under poverty) and $I\left(E_{ij} < Z\right) = 0$ otherwise (person not under poverty), $P_{\alpha i}$ is the poverty measures in area i.

If α=0, the poverty index is called the headcount ratio or poverty incidence (P_{0i}). Hence P_{0i} corresponds to the proportion of individuals under poverty in small area i.

If α=1, the poverty index is called the poverty gap index (P_{1i}) and measures the area mean of the relative distance to the poverty line (the poverty gap) of each individual. Poverty gap ratio can also be interpreted as an indicator of potentials for eliminating poverty by targeting transfers to the poor.

If α=2, the poverty index is called the poverty severity index and it measures the squared proportional shortfalls from the poverty line. This measure squares, and large values of P_{2i} point out to areas with severe level of poverty.

Let $S \subset D$ be a sample drawn from the population and let $S_i = S \cap D_i$ be the sample from area i. A direct estimator of $P_{\alpha i}$ for a sampled domain is the unweighted sample mean

$$\hat{P}_{\alpha i} = \frac{1}{n_i}\sum_{j \in S_i}\left(\frac{Z-E_{ij}}{Z}\right)^{\alpha} I\left(E_{ij} < Z\right), \quad \text{i=1,...,m, j=1,..., } n_i\text{, α=0, 1, 2.}$$

Let w_{ij} be the sampling weight of individual j from sampled area i. Then an approximately design-unbiased estimator of $P_{\alpha i}$ based on the 2010/11 HCE survey is the weighted sample mean

$$\hat{P}_{\alpha i} = \frac{1}{\hat{N}_i} \sum_{j \in S_i} w_{ij} \left(\frac{Z - E_{ij}}{Z} \right)^{\alpha} I\left(E_{ij} < Z\right), \text{ i=1,...,m, j=1,..., } n_i \text{, α=0, 1, 2.}$$

Where $\hat{N}_i = \sum_{j \in S_i} w_{ij}$ is a design-unbiased estimator of the population size is N_i of sampled area i.

One of the aims of this paper is to derive estimators of poverty measures which "borrow strength" from related zones, based on a model linking all zones using the Fay-Herriot model. Thus, Fay-Herriot model can be used with

$$\theta_i = P_{\alpha i}, \; y_i = \hat{P}_{\alpha i}, \quad \psi_i = Var(\hat{P}_{\alpha i}) = \hat{V}(y_i),$$

where the design-based variances of these estimators can be approximated by (see Esteban, Morales, Perez and Santamaria, 2012)

$$\hat{V}\left(y_i\right) = \frac{1}{\hat{N}_i^2} \sum w_{ij}\left(w_{ij} - 1\right)\left(E_{ij} - y_i\right)^2.$$

3 Results and Discussions

The response variable is the estimated proportion of households in poverty for the zones of Ethiopia calculated based on the 2010/11 household consumption expenditure survey data. Expenditure refers to total expenditure, including accommodation, food, purchases, travel, leisure activities and miscellaneous expenditure. The process of choosing the auxiliary variables is crucial since the small area estimation methods are mainly based on the development of a regression model. Good auxiliary information related to the variables of interest plays a vital role in determining suitable linking models (Rao, 2003).

In the selection of explanatory variables, the first step in the poverty measure is to select the explanatory variables in the regression model with consumption expenditure as the dependent variable. These variables should meet the following criteria:

- Available in both the household survey and the census
- Household survey and census are comparable
- Sufficiently correlated with household expenditure.

This includes explanatory variables namely, sex, age, marital status, number of years of schooling, employment and household size. Outliers are checked by plotting the residual versus fitted values. In order to avoid multicollinearity problems, we don't include all the

available covariates in each model. In the case of strongly correlated covariates, conditions being equal, we select the ones with a higher level of correlation with the poverty measure to estimate.

Zones within regions are unplanned domains and the sample sizes for zones in Ethiopia range from 0 households in the (Degahabor, Fik, Korahe, Gode, Warder, Afdera, Zone 2 and Zone 4) zones to 883 households in Semen Gonder zone with an average sample size of 303 households.

The annual consumption expenditure estimates had a mean 27881.93, sampling variances between 21923.09 and 2306517, and very skew distributions. The annual food consumption expenditure estimates had a mean 8575.3244, sampling variances between 3161.525 and 84874.11, and also very skew distributions. Because of the skew distributions we considered a logarithmic transformation.

3.1 Generalized Variance Function (GVF) for Poverty Measures

We use the generalized variance function (GVF) to smooth out the uncertainty of the design based variance estimate. The GVF will be used in the small area estimation of poverty measures. According to Hawalla and Lahiri (2010) "Fay and Herriot (1979) are probably the first to introduce GVF in a complex survey setting in order to motivate the sampling error component of their two level Bayesian model." In this paper we may consider the bias corrected GVF by fitting the following simple linear regression model

$$\log(\hat{V}(y_i)) = b_0 + b_1 y_i + \varepsilon_i$$

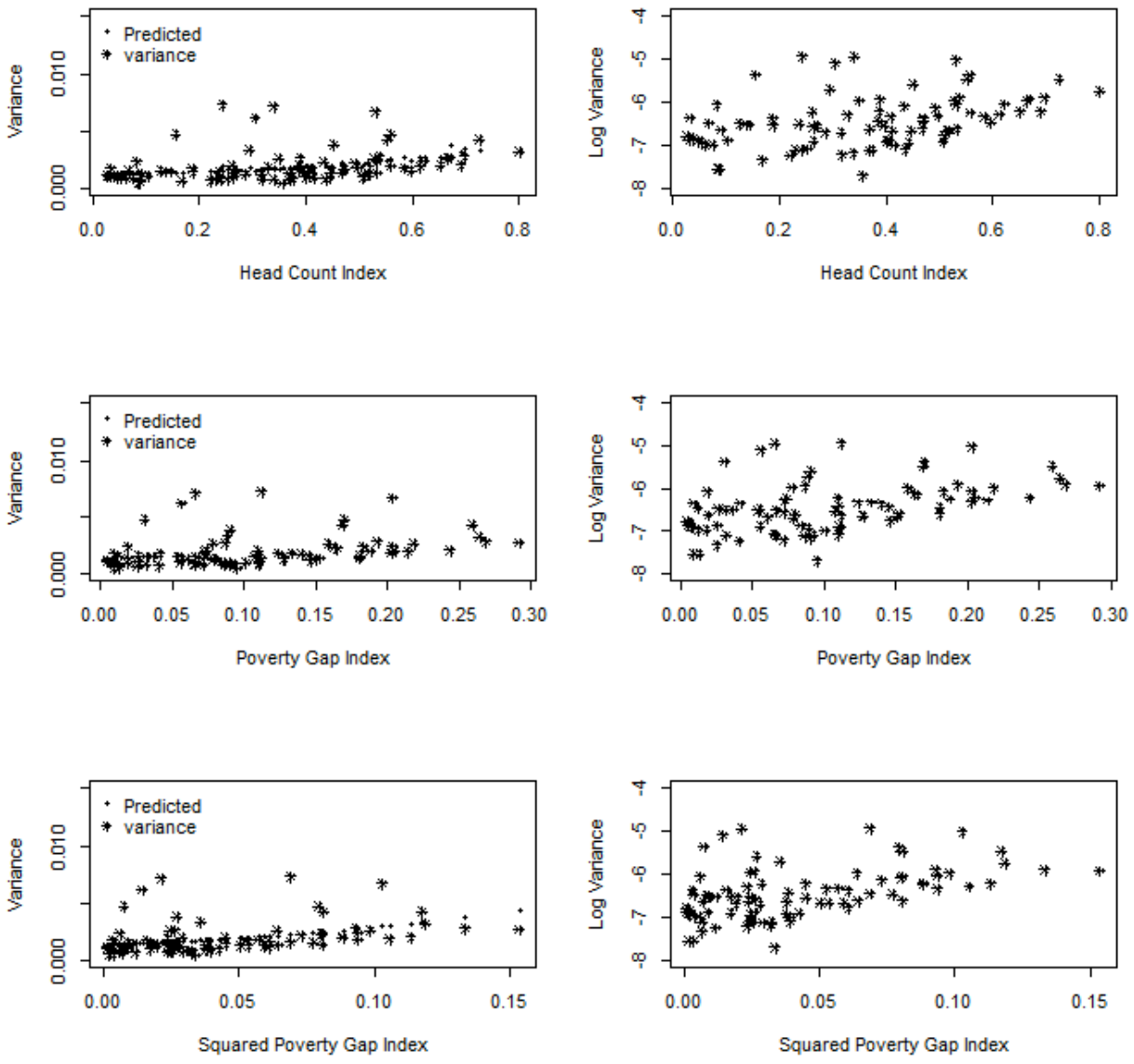
where $\log(\hat{V}(y_i))$ is the dependent variable, y_i as independent variable, $\hat{V}(y_i)$ is the design-based variance given above, b_0 and b_1 are the least squares estimates and $\varepsilon_i \approx iid\ N(0, \sigma^2)$, i=1,...,m. Then the GVF motivated from the above model is given by

$$G\hat{V}F = \exp(\hat{\sigma}^2/2)\exp(\hat{b}_0 + \hat{b}_1 y_i).$$

The factors $\left(\exp\left(\frac{\hat{\sigma}^2_{food}}{2}\right), \exp\left(\frac{\hat{\sigma}^2_{total}}{2}\right)\right) = (1.139798, 1.155714)$ are the bias-correction terms in the log-linear analysis for the food and total poverty estimates, respectively. Underestimation of the true variances will be occurred when we ignore the correction term in GVF method

(Rivest and Belmonte, 2000, Esteban et al. 2012). Figure 1 (right three) illustrates the scatter plot of $\log(\hat{V}(y_i))$ versus y_i in a dispersion graph. Figure 1 (left three) illustrates the $G\hat{V}F$ and $\hat{V}(y_i)$ in dots and stars respectively versus both food and total poverty measures. From the figure we can easily observe that how the GVF smooth out the unreliable and noisy design based estimated variances (Esteban et al. 2012, Hawala and Lahiri, 2010).

Figure 1: ***Dispersion plots for generalized variance function in 2010/11***



3.2 Incidence of Poverty (headcount Index), P_0

It is the measure of the proportion of households/individuals that is poor. It is the most commonly used methods of measuring poverty because it is easy to understand and measure. However, this measure does not indicate how poor the poor are.

Total Poverty Incidence Estimates: the measurement and analysis of poverty is crucial for understanding people's situations of well-being and factors determining their poverty situations. The outcomes of the analysis are often used to inform policy making as well as in designing appropriate interventions and for assessing effectiveness of on-going policies and strategies. Addressing poverty has been an important component of the MDGs as declared by the heads of states at the Millennium Summit in September 2000 that set out goals and targets to be met by the year 2015. The Ethiopian food poverty line and total poverty line in 2011 were 1985 and 3781 birr respectively (MoFED, 2012). These are the value used in the calculation of direct estimators of poverty proportion.

The aim of this paper is to derive indirect estimators which borrow strength from related zones, based on a model linking all zones called the Fay-Herriot model. This paper is the first to report model-based (EBLUP) estimates of poverty measures at the zone levels in Ethiopia. Estimates reveal a high degree of geographical variation in poverty measures. Zones where the proportion of the population under the total poverty line is smallest (below 5%) are Nifas silk (2.907%), Mekelle (3.071%) and Bahirdar (4.288%). On the other hand zones with higher poverty proportion (over 45%) are those situated in the Oromiya and SNNP regions. Many rural Ethiopian zones have a proportion greater than 35% of population with annual household expenditure below z=3781 birr. The zones with a high level of poverty prevalence (over 65%) are Wolayta (65.89%), Debub Omo (66.60), Basketo (70.35), Borena (65.87), Awi (65.29) and Alaba (75.43). Furthermore, Nifas Silk (2.91) have the smallest total poverty measure while Alaba (75.43) has the highest poverty measures.

Based on food poverty estimates zones are divided into two groups:

- 37.21% of the zones with total poverty estimates that are significantly lower than the national poverty level (which is 29.6%); and
- 62.79% of the zones with total poverty estimates that are significantly higher than the national poverty level.

Food Poverty Incidence Estimates: the food poverty index measures the proportion of food-poor people that fall below the food poverty line. The achievement of food self-sufficiency is consistent with the MDG goal of eradicating extreme poverty or hunger. As for total poverty, the direct and EBLUP estimates with different model diagnostics are also computed for food poverty measures. Alaba (84.62%), Konso (88.16%), Burji (80.66%), Derashe (87.41%), Wolayta (82.56%), Konta (82.56%) and Awi (80.92%) have the highest number (above 80%) of households below the food poverty line whereas Bole (15.48%), Arada (17.29%), Mekelle (15.97%), Gigjiga 15.51%, Harari (19.33%) and Kolfe (19.95%) have the lowest number (less than 20%) of households below the food poverty line.

Based on food poverty estimates zones are divided into two groups:

- 29.07% of zones with food poverty estimates that are significantly lower than the national food poverty level (which is 33.6%); and
- 70.93% of the zones with food poverty estimates that are significantly higher than the national food poverty level.

The purpose of small area estimation is to produce a reliable estimates of poverty measures for zones which only have small samples or no samples are available (Pfeffermann, 2013). Some of the zones of Ethiopia such as: Degahabor, Fik, Korahe, Gode, Warder, Afdera, Zone 2 and Zone 4 do not have direct survey estimates because they are non-sampled zones. Thus, we provide the total and food poverty measures in terms of the synthetic estimates. Synthetic poverty estimates for the zones that have not been sampled are estimated using information from the auxiliary variables. This is one of the advantages of using small area estimation.

3.3 Poverty Gap Index, P_1

It measures the depth of the poverty to which households/individuals fall below the poverty line. It is simply the sum of the poverty gaps in the population which gives the minimum cost of eliminating poverty using efficiently targeted transfers. But it does not show the changes in inequality among the poor households/individuals. Zones which have largest poverty gaps (>25%) are: Wolayta 33.31%, Amaro 23.45% and Konso 25.38%.

3.4 Squared Poverty Gap Index, P_2

It measures the severity of poverty for all zones of Ethiopia. It is the average of the square of the poverty gaps in the population relative to the poverty line, can be used to indicate the distribution of consumption expenditure among the poor people. This give more weight to

those that fail far below the poverty line than those near to it since their poverty gap is larger. Zones with the highest poverty severity index (>11%) are: Konso 11.52%, Amaro 11.15% and Wolayta 17.50%. These are zones in which the degree of inequality amongst the poor themselves are the highest.

3.5 Model Diagnostics for Poverty Estimates

After fitting a model it is crucial to determine the reliability of the model-based estimates before performing inference. If we see any violations, the resulting inference would be invalid resulting in wrong conclusions. Thus, it is important to perform an appropriate diagnostic procedures. Diagnostics procedures are planned to check the validity of the model-based estimates versus direct survey estimates. An evaluation of the diagnostic measures confirms that there is reasonably close correspondence between the model-based estimates and the direct survey estimates.

Figure 2 shows the scatter plots of the CVs of the EBLUP and direct estimates against the sample sizes and zones. It can also be seen from the plots that the CVs from the model-based estimates are less than the CVs from the direct estimates. Zones with large sample size have a lower CV than zones with small sample sizes. It is apparent that the standard errors of the direct estimates are larger than the standard errors of the EBLUP estimates. Direct estimators generally have large standard errors due to small sample sizes (Pfeffermann, 2013). As shown by Figure 3 model-based estimates of the poverty measures, based on a Fay-Herriot model, have lower estimated standard error than the direct estimates. This indicates that the EBLUP estimates are reliable than the direct estimates (Coondoo, Majumder and Chattopadhyay, 2011). Figure 3 shows the plots of the standard errors versus domains (zones). The scatter plots of the direct estimates are more dispersed than the model-based estimates. We observe that there is an overall clear gain of precision when using the EBLUP poverty estimates based on the Fay-Herriot model instead of direct estimators.

3.6 Bias check for model-based estimates

The bias diagnostic is used to assess the deviation of the model based estimates from the direct survey estimates. If the relationship between the poverty measures and the auxiliary variables has not been misspecified or misestimated, a linear relationship of the type y=x is expected between the direct survey estimates and the model-based estimates. To check for predictive bias in the model-based estimates, we plot model-based estimates against direct estimates. Then we test whether the regression line can be fitted to these points and is

significantly different from the identity line. Figure 4 shows the bias scatter plot of the direct survey estimates against the model-based (EBLUP) estimates. In this figure we observe that the slope of all model outputs were close to one for poverty measures. This plot includes all estimates without outlying estimates.

Figure 2: ***A plot illustrating the coefficient of variations of both food and total poverty along the Ethiopian zones, as well as the sample size in 2010/11***

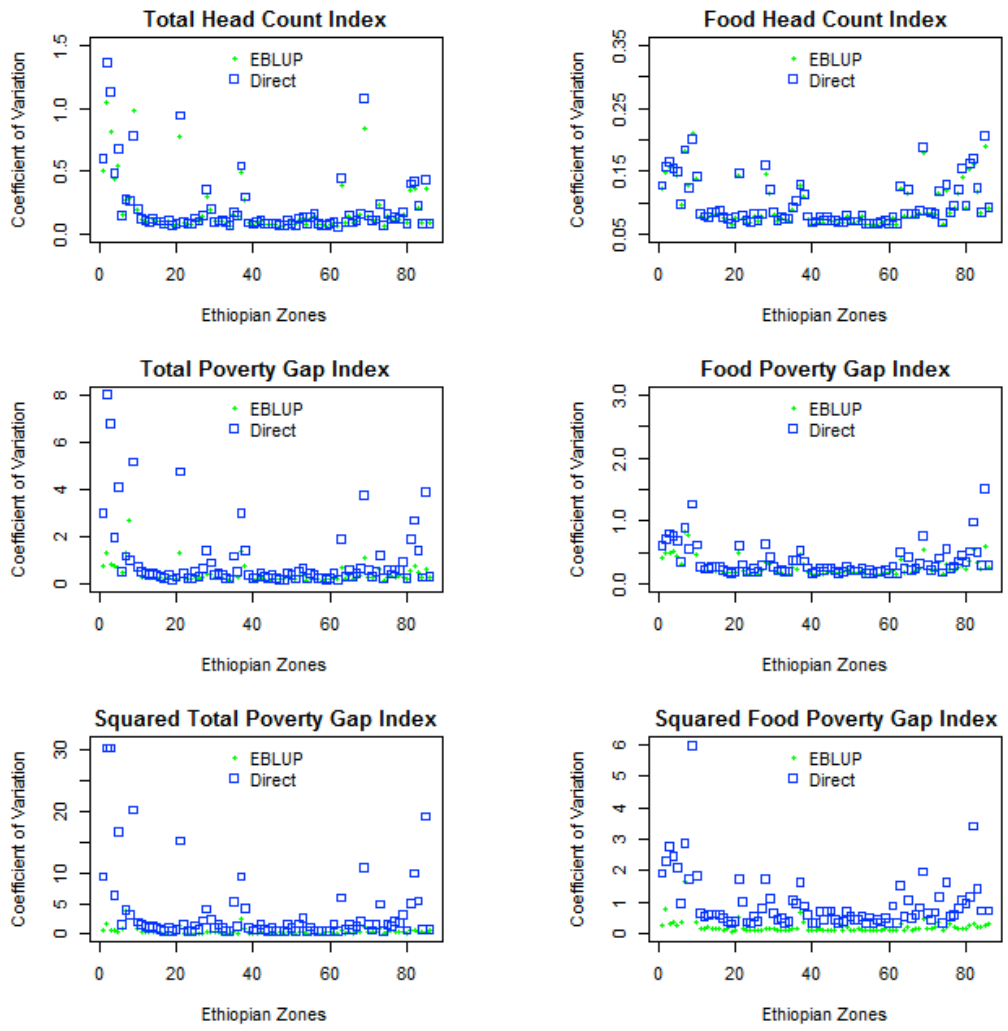


Figure 3: ***A plot illustrating the standard errors of both food and total poverty along the Ethiopian zones, as well as the sample size in 2010/11***

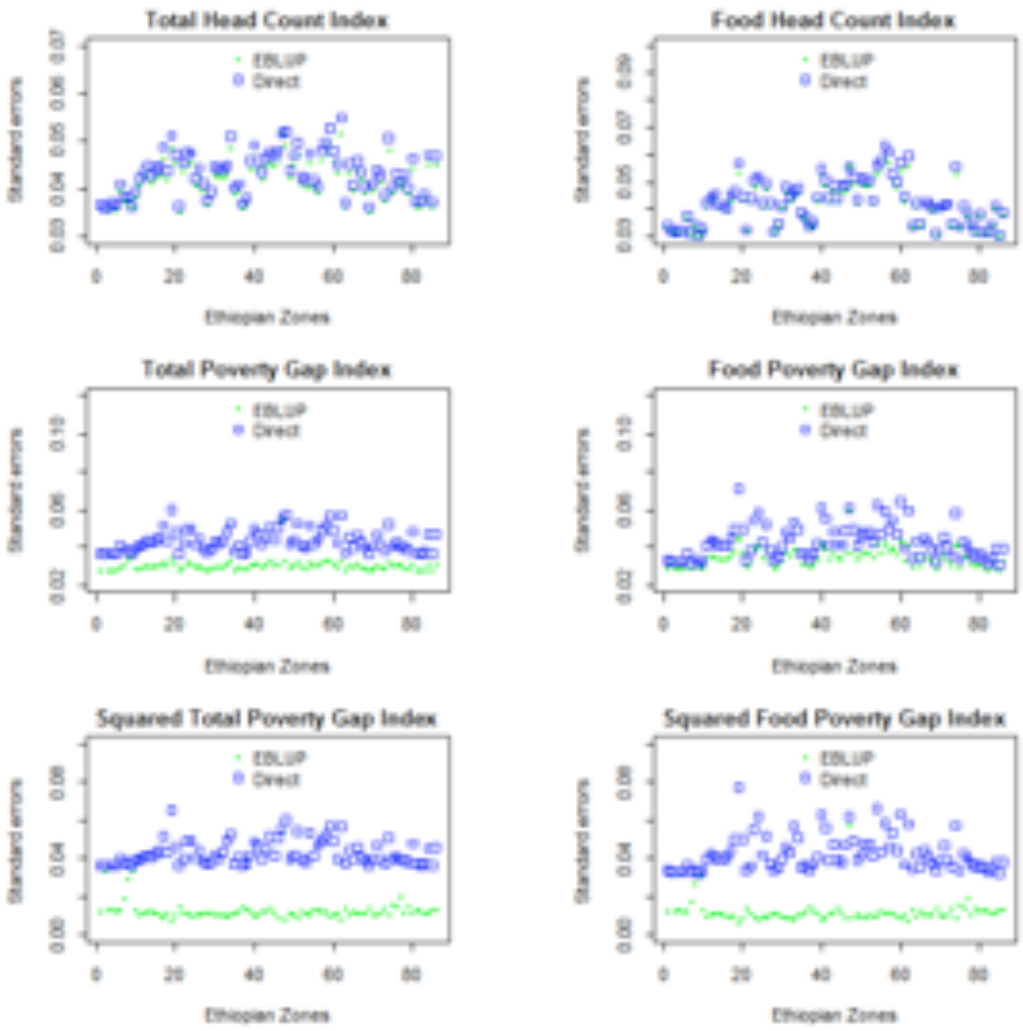
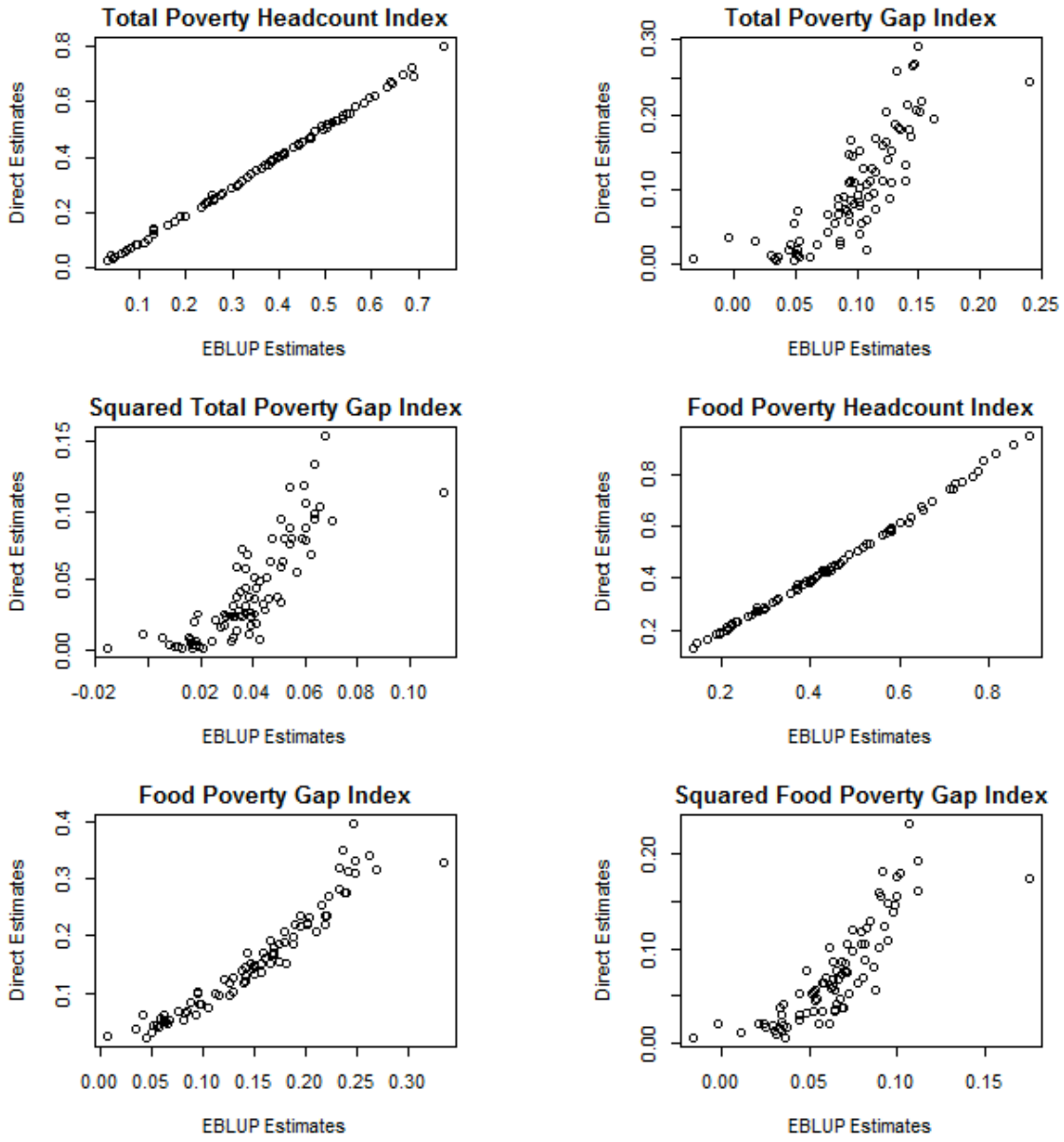


Figure 4: ***A plot illustrating the relationship among direct and EBLUP estimates of poverty measures in 2010/11.***



The use of the diagnostic measures confirms that the model-based zonal estimates are robust enough to provide reliable information for the guidance of policy, resource allocation, and the planning and evaluation of poverty measure programmes. The results of this study demonstrate the feasibility of producing small area poverty estimates based on the 2010/11 HCE sample survey.

4 Summary

We derive zonal-level estimates of poverty measures by using small area estimation techniques to link data from the 2010/11 HCE and 2007 population and housing Census. The total poverty measure varies from 3.36% to 75.26%, and the food poverty measure varies from 13.61% to 88.76%. The poverty measures are particularly low in the Addis Ababa zones and regional towns. It somehow surprising how large the number of zones having a proportion greater than 50% of population with annual consumption expenditure below the poverty line. Hence it would be desirable that the Ethiopian government implement polices to reduce poverty proportion in those zones in which poverty proportion is the highest. The EBLUP estimates for the total poverty measures are less than that of the EBLUP estimates of the food poverty measures in almost all zones of Ethiopia. This is in agreement with the MoFED (2012) national poverty report. The proportion of poor people and food poor people in the country is estimated to be 29.6% and 33.6%, respectively in 2010/11 (MoFED, 2012). These results show that there is considerable geographical variation in the poverty measures for zones belonging to the same region; thus, conducting the analysis of poverty at regional level could mask important dissimilarities characterizing those territories. The model-based method has been found to be very effective for developing zonal level estimates of poverty measures. For most of the zones the reduction in CV and standard errors are quite evident. Our results demonstrate the feasibility for using small area estimation techniques to improve EBLUP estimates at the zone level for planning and programme evaluation.

Lastly, this paper is very important for the government, policy makers, NGOs, and other concerned bodies. This is because before taking any remedial action, there is a need to identify zones in which the poverty measures are high. All the methods of estimating poverty is the recommended tools for monitoring progress towards MDG achievement.

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Does Agricultural Productivity Really Matter for Food Security in a Landlocked Sub-Saharan African Country? The Case of Burkina Faso

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Abstract

This paper makes use of a Computable General Equilibrium (CGE) model to analyse the impact of various trends of agricultural productivity on poor households' food security in Burkina Faso. On the one hand, negative trends may result from several factors, including land degradation, climate change and harmful agricultural practices. On the other hand, positive trends may result from enhanced public investment in agriculture, notably in research and development, extension, irrigation, rural roads, rural electrification and rural education. The results point to the poor's food consumption being highly sensitive to agricultural productivity, with the urban poor being particularly affected. The current situation is already characterized by severe food insecurity, such that a decline in agricultural productivity is likely to further plunge the urban poor into a deep food crisis. By contrast, positive trends in agricultural productivity may help alleviate poverty and food insecurity. Agricultural productivity may indeed affect the poor's food consumption, mainly through large changes in agricultural prices and real incomes.

Keywords: Food security, Poverty, Computable General Equilibrium, Burkina Faso
JEL classification: C68, I32, Q18

1. Context and issue

Burkina Faso is an agricultural-based country. Over 80 percent of the active population derive their income from agriculture. The primary sector accounts for more than 30 percent of gross output. Agriculture plays a major role in households' food security, by serving as their main source of income, as well as supplying markets. Domestically produced millet, sorghum and corn account for 80 percent of households' grain consumption, while 40 percent of the country's rice consumption is domestically produced.

Since 1995, Burkina Faso has recorded annual GDP growth rates of more than 5 percent on average. This exceeds the performances of the two previous decades as well as the average in the neighbouring West African Economic and Monetary Union (WAEMU). Despite this strong growth, food and nutrition insecurity remains a major source of concern, having shown no significant improvement over the past two decades. Between 1990 and 2014, Burkina Faso recorded a decline in the percentage of undernourished people among its population (from 26 percent to 20.7 percent). The prevalence of food inadequacy also declined over the same period, from 34.2 percent to 25.6 percent, but the number of people suffering from undernourishment and the number of people in food inadequacy increased, owing to the strong demographic growth rate (3.1 percent per year). Anthropometric indicators are all in the red. In 2010, the percentage of emaciated children was at the same level as in 1993 (15.4 percent); the percentage of children suffering from delayed growth fell by only 5 percentage points over the last two decades, while those underweight still accounted for 26 percent in 2010, against 29 percent in 1993. The prevalence of anaemia in the same population category was very high at 86 percent in 2011, slightly below its level in 1990 (89 percent). The large majority of the population remains therefore highly vulnerable to acute food and nutrition insecurity.

Several studies have focused on the causes of persistence of food and nutrition insecurity in Burkina Faso and in sub-Saharan Africa (SSA) more broadly (Smith et al., 2000; Destombes, 2003; Poussart-Vanier, 2006; Zidouemba, 2014). The poor living standards, precarious livelihoods and poor capacities to minimize dietary risks are found to have led to structural poverty. The use of agricultural practices that are harmful to natural resources in a fragile agroecological environment, and the persistence of high demographic growth rates, which increase the dependency ratio and the marginal ability of food producers to invest in their farms, are the root causes of this structural poverty. In addition, these factors lead to weak labour productivity, especially in a context of scarce off-farm job opportunities, as Burkina Faso's cereal productivity is not only among the lowest in the world but has also experienced a relative stagnation over the past two decades (FAO and IFAD, 2013; Tittonell

and Giller, 2013).

There is a legitimate concern about a future decline in agricultural productivity in Burkina Faso, as agriculture indeed faces major constraints that hamper its productivity. Scientific nutrient-balance studies and surveys among peasant farmers support the idea that the depletion of natural resources and land degradation are prominent matters of concern (Lindqvist and Tengberg, 1993; Taonda et al., 1995; Gray, 1999; Visser et al., 2003). Strong population growth is translating into mounting pressure on natural resources, not to mention the depletion of fertile arable land by 2030, which stands as another constraining factor (OECD, 2012). Moreover, climate change may deteriorate agricultural production conditions (IPCC, 2007; Somé et al., 2012).

However, assessing the loss of agricultural productivity associated with the above-mentioned factors remains challenging, as stressed in the literature. On the one hand, detailed data on these factors, especially natural factors such as the amount of nutrients and organic matter lost following erosion, are limited. On the other hand, the impacts are very sensitive to adaptive choices made by farmers (such as applying more labour or fertilizers or extending their use of land). Most studies that attempted to quantify these effects focused instead on the impact of land degradation and climate change on agricultural productivity (Lal, 1995; Pagiola, 1996; IPCC, 2007; Somé et al., 2012).

To the best of our knowledge, no study has so far assessed the impact of land degradation on agricultural productivity in Burkina Faso. The existing studies looked at the issue at the regional and country levels. Bojö (1996) reviewed 12 studies on the cost of land degradation in seven SSA countries and concluded that annual productivity losses are generally small (1 percent or less in most studies, with larger estimates in Malawi (4 to 11 percent per year) and Mali (2 to 10 percent per year)). Using a model of crop growth, Pagiola (1994, 1996) found that soil erosion only reduces agricultural productivity on steeper slopes in Morocco by about 20 to 30 percent over 50 years, which implies annual losses of 0.4-0.7 percent, while in Kenya these reductions stand at about 20 percent over 10 years (i.e. an annual loss of 2.2 percent). Lal (1995) showed that losses of grain, vegetables, roots and tuber yields over the 1970-1990 period were estimated at 6.2 percent (0.3 percent per year) for SSA and 9 percent (0.5 percent per year) for Africa as a whole.

It is very difficult to isolate the causal impact of soil degradation on the loss of productivity. Change in productivity requires substantial information regarding production and degradation processes, and the extent to which the specific nature of land degradation

affects production. Moreover, the methodologies used are often inadequate. First, crop production is highly sensitive to the reliability of rain, especially in rain-fed production. Thus, yield declines are not always ascribable to land degradation. Second, physical soil loss is only a rough proxy for soil fertility decline (Bishop, 1995), and crop yields can hardly be attributed to differences in past erosion (Olson et al., 1994). Finally, it can take many years for soil erosion to affect crop productivity, and there is rarely a one-to-one relationship between the amount of soil lost and the effect on yields. The effect of erosion on productive capacity depends on the depth and quality of the remaining soil, and not on soil lost (Scherr and Yadav, 1996).

Regarding climate change, there is a growing consensus about its likely negative effect on natural resource productivity, particularly in SSA (IPCC, 2007). The quantitative assessment of this productivity decline has generally been carried out through crop growth simulation models. Forecasts from different models indicate that declines in agricultural productivity for SSA could be estimated at about 28 percent on average without carbon fertilization by the 2080s, and at about 18 percent with carbon fertilization. However, these figures mask the extreme nature of losses for some countries. For example, in highly dryland-agriculture-dependent countries, productivity losses could reach as high as 100 percent (Cline, 2007; Asafu-Adjaye, 2010). In the specific case of Burkina Faso, simulations of various climate change scenarios using General Circulation Models (GCMs) show that the large majority of the country is likely to experience a decline in agricultural productivity by up to 25 percent by 2050 compared with its 2000 level (Somé et al., 2012). Such a decline represents an annual decrease of 0.57 percent. Some areas in the northern part of Burkina Faso might even experience a productivity drop of 100 percent, corresponding simply to land abandonment.

Besides these natural factors, weak public infrastructure and services in rural areas may be an additional cause of likely decline in agricultural productivity. Indeed, such weaknesses make these areas not very profitable for private activity, thus leading to a very low level of private investment. In addition, the low number of scientists involved in agricultural research (240 agricultural researchers) as well as the low budgets allocated to research underline the weakness of public capital in research and development (Stads and Kaboré, 2010). Agricultural extension services are almost non-existent. According to some experts in this field, one extension officer alone is responsible for 10,000 producers on average, spread over a very large area, with a very low travel budget.[1] Road infrastructure is very poor (56 km/1,000 km^2) with an estimated 46,095 km (FAD, 2004) of rural roads, which are

[1] Public extension agents are responsible for providing farmers with information on farming techniques and promoting innovations.

inaccessible when it rains. Only 15 percent of the rural population have access to electricity (MMCE, 2007). The literacy rate is low at the national level (29 percent), owing to a largely illiterate rural population (World Bank, 2012). Meanwhile, the potential for irrigation remains largely unexploited, with the Organisation for Economic Co-operation and Development (OECD) estimating that irrigated agricultural areas represent only 0.81 percent of total cultivatable areas and 14.9 percent of irrigable potential (OECD, 2012).

Public investment in the rural sector may partly change the situation on the ground, given the current circumstances as mentioned above and the prominence of yield gaps in Burkina Faso. Yields of main grain crops are estimated at only 25 percent of maximum yields (Mutegi and Zingore, 2013). Public policies that can improve the supply of infrastructure and agricultural services might play a vital role in achieving food and nutrition security. Indeed, investment in rural areas is seen as an essential engine in the fight against poverty and food insecurity (World Bank, 2008; Barrett et al., 2010; De Janvry, 2010; De Janvry and Sadoulet, 2010). It is thought that investment growth positively affects food security in rural areas as well as in urban areas, and brings prices down, thanks to the increase in production that helps meet both rural and urban populations needs (Timmer, 2000; FAO, 2012). Many authors highlight the need for public infrastructure to create a more business-friendly environment for private activities, with a view to achieving this much-needed increase in investment (Barro and Sala-i-Martin, 1995; Aghion and Howitt, 1997; Anderson et al., 2006).

The existing literature points to six complementary areas wherein public investment may help boost agricultural productivity: agricultural research and development, extension, irrigation, rural roads, rural electrification and rural education (Zidouemba and Gérard, 2015). Agricultural research leads to the development of improved techniques, adapted to local realities, for increasing agricultural productivity and promoting a more sustainable use of natural resources. However, to take full advantage of these techniques, farmers must be able to acquire and use the technology from agricultural research appropriately. Agricultural extension thus develops systems through which these technologies are taught to farmers. Public investment in irrigation helps increase agricultural productivity beyond its input function, by increasing the productivity of other inputs, including improved seeds and chemical fertilizers. Rural road density has been shown to be among the most important contributors to productivity growth in agriculture (Fan et al., 2000; Zhang and Fan, 2004). This is due to the impact of better roads on reducing the transport component of input costs and transaction costs of marketing products. In addition, roads improve the flow of information on market conditions, facilitate new technologies and mitigate risks associated with embracing such technologies. Meanwhile, rural electrification opens non-agricultural

employment opportunities through the development of the food industry, which also opens new market doors for agricultural products, thus increasing the producer price and rural incomes. Finally, public investment in rural education may increase labour productivity and off-farm incomes by increasing the stock of human capital. Investment in education is also complementary to the investment in research and extension, since better-educated farmers are more likely to adopt (and encourage their colleagues to do so) improved production techniques and better management of natural resources.

This paper seeks to answer three fundamental questions that have not been answered so far in the case of Burkina Faso: what will be the consequences of a loss in agricultural productivity on economic growth and food and nutrition security in Burkina Faso? Are urban households likely to be hit by the agricultural productivity degradation as well? Is the effect symmetric, in the case of agricultural productivity growth, assuming that such growth may be generated through public investment in agriculture?

In line with Weyerbrock (2001) and Wiig et al. (2001), we build on a dynamic Computable General Equilibrium (CGE) model, with a particular focus on Burkina Faso. The CGE model allows us to simultaneously consider households' economic behaviour and the impacts of prices and incomes on their food security as well as on the intersectoral, factor-market, budgetary and macroeconomic implications of productivity changes.

The remainder of the paper is organized as follows. Section 2 describes the model and introduces the database. Section 3 presents and discusses the simulation results, with a special reference to the agricultural sector. Section 4 summarizes the results and provides some policy implications.

2. Model and database

2.1 The CGE Model

We use a recursive dynamic model to study the impact of agricultural productivity change.[2] This model reproduces the main characteristics of a classical CGE model (Dervis et al., 1982; De Melo, 1989), but has been slightly modified to account for some of the key characteristics of Burkina Faso's economy. First, we disaggregate households according to income levels (poor versus non-poor) and residency (rural versus urban). Second, we take account of the prominence of urban unemployment. Third, we model the difficulty for workers to move

[2] The starting point of this CGE model is a series of models developed at CIRAD (Gérard et al., 2002; Boussard et al., 2005; Gérard et al., 2012; Gérard et al., 2013). Any readers interested in the model equations can contact the authors.

from one sector to another. Finally, we convert households' food consumptions into volume (kilogram per capita per year) and compare them to the standards recommended by the Permanent Interstates Committee for Drought Control in the Sahel (CILSS).

Producers are assumed to maximize profits in perfectly competitive markets with production prices equal to marginal costs. The production function is a two-layer nested Leontief-CES function. At the bottom level, a CES function is used to combine primary factors (capital and labour), while a Leontief function describes the demand for intermediate inputs. At the top level, the composite primary factors and intermediate inputs are combined with a CES function to create the sectoral output. Domestic production is valued at basic prices net of taxes and inclusive of production subsidies from the Government.
Households receive income from primary factors and transfers from other institutions. A fixed share of disposable income net of taxes is set aside for private savings, the leftover being spent on consumption. With this constraint on total consumption expenditure, consumption is allocated to different goods and services according to a linear expenditure system (LES) demand function. Total government revenues consist of taxes and transfers from the rest of the world. These revenues are allocated to current public consumption according to a Leontief function and spent as subsidies to production and transfers to households and to the rest of the world. The difference between government revenues and expenditures constitutes government savings. Investment demand in each sector is a fixed share of total savings and is added to the stock of equipment from previous periods to determine the capital available to this sector for the next period.

Standard assumptions apply for international trade: a small open economy, in which exports and imports are elastic at given world prices. Domestic output is allocated between exports and domestic sales subject to a constant elasticity of transformation (CET) function, while domestic market demands are derived from the Armington function (Armington, 1969). These functions allow for limited substitution possibilities to be introduced between domestic sales and exports for producers and between domestically produced goods and imports for consumers.

An exogenous price for salaried workers accounts for wage rigidities and unemployment. Initial unemployment is set at 18 percent for the non-agricultural salaried labour and at 1.1 percent for the agricultural salaried labour. These rates correspond to the 2005 urban and rural unemployment rates respectively (INSD, 2008). This may have important consequences for the results, as any increase in activity will result in an increase in the volume of employment rather than an increase in labour payments (which would have been the case

under a full employment assumption). Commodity prices are assumed to balance commodity markets.

We explicitly model the difficulty for workers to move from one activity to another, with a view to reproducing jobs opportunities scarcity outside the agricultural sector as well as the required skills and the time required for training (Gérard et al., 2012). We define four aggregate sectors: agriculture, agro-industries, other industries, and services. Labour is then assumed to be perfectly mobile within the 10 years simulation horizon only among sectors belonging to the same aggregate sector (e.g. agricultural labour can move from the rice sector to the corn sector but not to the education sector). This implies differentiating labour wages between aggregate sectors. Capital is assumed to be sector-specific.

Three macroeconomic balances are embedded in CGE models: the government balance, the external balance and the savings-investment balance. For the government balance, government savings and all tax rates are fixed, while government consumption is flexible, to balance government accounts. As regards the external balance, the nominal exchange rate is

set at its initial level, which reflects the peg between the CFA franc and the Euro. Both foreign savings and the real exchange rate thus clear the external balance (as the consumer price index is flexible). Regarding the savings-investment balance, the closure is savings-driven (or a neoclassical closure), wherein investment is determined by the sum of private, government and foreign savings.

The dynamic of the model is based on population growth, capital accumulation, and productivity trends. The population is expected to increase at an exogenous rate of 3.1 percent (INSD, 2006), which will increase both labour supply and the demand for goods and services. We assume that the agricultural labour supply will increase at a rate below the average national rate (by 2.5 percent against 5.3 percent for non-agricultural labour), to account for rural exodus.[3]

Productivity changes are included in CGE models by varying the scale parameter of the production function – commonly considered as the productivity parameter or total factor productivity (TFP) (Pauw and Thurlow, 2011; Löfgren et al., 2013). We introduce a trend parameter – $prodtrend_{asec}$ – in the production function (equation 2) to allow it to be changed according to the scenario.

[3] The rural population growth rate differs from one decade to another, but is around 2.5 percent against around 5.3 percent for the urban population (INSD, 2006).

The production function is as follows:

$$XD_{i,t} = \chi_{i,t}\left(\eta_i * CI_{i,t}^{-\phi_i} + (1-\eta_i) * VA_{i,t}^{-\phi_i}\right)^{-1/\phi_i} \quad (1)$$

Where $XD_{i,t}$ is the production of sector *i* at period *t*; $CI_{i,t}$ the level of intermediate consumption of sector *i* at period *t*; $VA_{i,t}$ the value added of sector *i* at period *t*; η_i and ϕ_i are parameters of production function; χ_i is the productivity of sector *i* at period *t*;

Agricultural productivity is defined by:

$$c_{asec,t+1} = c_{asec,t} * prodtrend_{asec} \quad (2)$$

2.2 Data

The data set relies heavily on the Social Accounting Matrix (SAM) and on various behavioural parameters. The SAM was constructed for the reference year (2005) by Burkina Faso's Ministry of Agriculture, Hydraulics and Fishing Resources and contains 24 production sectors and 22 commodities sectors. Since our study is mainly focused on agriculture, 11 agricultural sectors are included as part of these 22 sectors. Employing the household expenditure survey data from INSD (2003), the household income and consumption data were disaggregated into four household groups according to income levels and residency (rural versus urban). These groups are representative of the situation of about 6 million poor in rural areas, 600,000 poor in urban areas, 5 million non-poor in rural areas, and 2 million non-poor in urban areas. Annual per capita incomes are about CFA francs 62,100 (US$ 106.78) for the rural poor, CFA francs 56,000 (US$ 96.03) for the urban poor, CFA francs 201,000 (US$ 344.60) for the rural non-poor and CFA francs 291,000 (US$ 498.90) for the urban non-poor. Per capita income for the rural poor is 25 percent below the poverty line (CFA francs 83,000) and 32 percent for the urban poor.

Labour supply has been split into three groups (agricultural salaried labour, agricultural family labour, and non-agricultural salaried labour); capital is split into two categories: agricultural capital and non-agricultural capital. As shown in Table 1, most of the rural poor's income comes from the remuneration of agricultural primary factors, while the urban poor's income is mainly derived from the remuneration of non-agricultural factors.

Table 1. ***Sources of households' primary incomes (percentage)***

	Agricultural primary factor			Non-agricultural primary factor		
	Salaried agricultural labour	Agricultural family labour	Agricultural capital	Non-agricultural salaried labour	Non-agricultural capital	Total
Rural poor	7.36	48.62	18.13	3.70	22.19	100
Urban poor	2.97	19.66	10.71	23.50	43.16	100
Rural non-poor	4.73	31.23	19.50	19.62	24.93	100
Urban non-poor	0.45	2.98	1.62	51.99	42.96	100

Source: Authors' calculations from the Social Accounting Matrix

The weakness of the poor's income is mainly the result of their low factors endowment (Table 2). They have little access to capital (20 percent of agricultural capital and 13 percent of non-agricultural capital) and are largely affected by underemployment in urban areas. In addition, the urban poor are deprived of almost all access to primary factors. They face difficulties in finding jobs, as underlined by the fact that they represent only 1 percent of non-agricultural employment.

Table 2. ***Allocation of factors of production (percentage)***

	Agricultural primary factor			Non-agricultural primary factor	
	Salaried agricultural labour	Agricultural family labour	Agricultural capital	Non-agricultural salaried labour	Non-agricultural capital
Rural poor	30	30	19	2	10
Urban poor	1	1	1	1	2
Rural non-poor	65	65	70	36	42
Urban non-poor	4	4	10	61	46
Total	100	100	100	10	100

Source: Authors' calculations from the Social Accounting Matrix

The food security analysis is based on two groups of products: grains (millet, sorghum, fonio, rice and corn) and animal products (meat and fish). Indeed, these products play a major role in Burkina Faso's food security. According to the Ministry of Agriculture and Food Security (MASA, 2010), grains account for more than 42 percent of households' food expenditure and constitute the main source of energy intake, while meat and fish provide animal proteins. Moreover, grains and animal products provide, on average, more than 80 percent of carbohydrate intake, 70

percent of energy intake, 42 percent of lipid intake, and 32 percent of protein intake. When compared with the recommendations of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS, 2004) of 203 kg/capita/year for grains and 14 kg/capita/year for animal products in Burkina Faso, households consumption levels showed high food insecurity in 2005 (Table 3).

The grains deficit is particularly significant for the urban poor (33 percent). Deficits for the rural poor are more limited (14 percent). The gap with the standard is also more marked for animal products, where the deficit reaches 31 percent and 22 percent for the urban poor and the rural poor respectively, pointing, beyond the deficit in quantity, to low quality of food.

Table 3. Annual per capita income and grain consumption in kilograms*

	Corn	Rice	Other*	Grains	Meat/fish
Rural poor	40 (23%)	15 (8%)	120 (69%)	175	10
Urban poor	68 (50%)	25 (18%)	43 (32%)	136	8
Rural non-poor	74 (28%)	41 (16%)	145 (56%)	260	31
Urban non-poor	90 (41%)	80 (37%)	47 (22%)	217	38

*Other grains consist of millet, sorghum and fonio

Source: Authors' calculations from the Social Accounting Matrix

At the macroeconomic level, the contribution of the agricultural sector to national GDP as provided by the SAM was 35 percent, compared to 22 percent for industry and 43 percent for services. Traditional grains – millet, sorghum and fonio – are the largest contributors to agricultural GDP (33 percent), followed by livestock (27 percent), cotton (12 percent), and other agricultural products (10 percent). Export revenues come mainly from agricultural products (57 percent). Cotton forms the bulk of these exports, accounting for 45 percent of total exports. Most of the country's imports are non-agricultural products (93 percent), and 80 percent of agricultural product imports consist of rice, followed by other agricultural products (10 percent) and fruit (7 percent).

The behavioural parameters included in the model are trade elasticities (Armington and CET), income elasticities, substitution elasticities for the primary factors, and the elasticities between aggregate primary factor and intermediate demand. Since Burkina Faso is a small trading country, and thus a price taker in most global commodity markets, export demand curves should be fairly flat, reflecting export demands elasticity. As a result, for most goods, large values are attributed to export demand and Armington elasticities (around 12). Regarding the agricultural sectors, elasticity values are even larger (about 17), given the relatively small size of agriculture exports. Income elasticities are based on a study by

Burkina Faso's Ministry of Agriculture and Food Security (MASA, 2010) (Table 4). Substitution elasticities for primary factors as well as elasticities between aggregate primary factors and intermediate demand have been assigned low values (0.75 and 0.3 respectively), in line with Breisinger et al. (2009). We perform sensitivity tests to check the robustness of the modelling results.

Table 4. ***Income elasticities***

	Urban poor	Urban non-poor	Rural poor	Rural non-poor
Corn	0.91	0.33	0.91	0.33
Rice	1.35	0.77	1.35	0.77
Other grains	0.94	0.56	0.94	0.56
Vegetables	0.89	0.78	0.89	0.78
Groundnuts	0.92	0.82	0.92	0.82
Fruit	0.45	0.39	0.45	0.39
Livestock	1.46	0.97	1.46	0.97
Other agricultural products	0.92	1.24	0.92	1.24
Minerals	0.92	1.24	0.92	1.24
Meat and fish	1.46	0.97	1.46	0.97
Textile	0.92	1.24	0.92	1.24
Fertilizer	0.92	1.24	0.92	1.24
Other industrial products	1.02	1.34	1.02	1.34
Restoration	1.05	0.63	1.05	0.63
Transport	0.92	1.24	0.92	1.24
Other market services	0.46	0.62	0.46	0.62
Education	0.92	1.24	0.92	1.24
Health	0.92	1.24	0.92	1.24
Other non-market services	0.46	0.62	0.46	0.62

Source: Ministry of Agriculture and Food Security (MASA, 2010)

3. Simulation analysis

As emphasized in section 1, there is legitimate concern about a likely decline in agricultural productivity in Burkina Faso, which could worsen the poorest's conditions (land degradation, climate change, population pressure on natural resources, the lack of public infrastructure, etc.). Given our focus on the impact rather than the cause of a decline in productivity, we modelled it as an exogenous trend. In light of the uncertainty about future declines in productivity levels, we assumed that productivity would decline at an annual rate of between -0.5 percent (optimistic scenario) and -1.5 percent (pessimistic scenario).

However, public investment in the agricultural sector could help avoid the materialization of such a pessimistic scenario (Anderson et al., 2006; World Bank, 2008; De Janvry and Sadoulet, 2010). Zidouemba and Gérard (2015) estimate the impact on agricultural productivity of an annual investment of CFA francs 100 billion (US$ 171 million) in six types of capital

(agricultural research and development, extension, irrigation, rural roads, rural electrification and rural education). While the impact decreases over time, this investment allows for average annual productivity growth of 2.38 percent over a five-year period. We then rely on these results to simulate productivity growth that is supposed to come from an increase in agricultural public investment. Accordingly, this scenario is assumed to increase agricultural productivity by 2.38 percent per year from 2010 to 2015. This productivity gain comes at a cost of CFA francs 100 billion (US$ 171 million), which is assumed to be covered by foreign public aid. However, because of the approach retained for closing the model (foreign savings are endogenous, while investment is set to be equal to available savings), foreign savings and foreign aid are substitutable. Foreign savings are therefore diverted into financing the public investment programme.

Tables 5–13 summarize the results. Sim-0, Sim-1, Sim-2, and Sim-3 refer to the baseline (the situation without degradation or improvement in agricultural productivity), optimistic productivity degradation, pessimistic productivity degradation, and productivity improvement scenarios respectively. We parameterize Sim-0 to reproduce the main trends of the economy over the 2005-2012 period. We then use it to reproduce the evolution of the economic system over the 2005-2015 period. Key noticeable facts stand out from this scenario: food security, as measured by the amount of grains and animal products consumption, improves very gradually. The economic system comes of course to cope with the population growth (3.1 percent per year); however, growth in per capita consumption of grains as well as in animal products is insufficient for reaching the CILSS standards for food security. Grain deficit remains at 4.5 percent for the rural poor and 23.4 percent for the urban poor, while animal product deficit remains at 10.2 percent for the rural poor and 11.8 percent for the urban poor. The slow growth in the poor's real per capita income (annual average of 1.7 percent) explains the weak progress towards food security. Meanwhile, real per capita income for the non-poor grows by 2.3 percent annually, underlining the nature of the pro-rich growth observed in Burkina Faso (Zidouemba, 2014).

Let us now take a closer look at the effects of alternative scenarios on food security (Tables 4 and 5). The figures in these tables refer to the amount of food consumption at the end of the simulated period (year 2015) as well as the gaps (in volume and percentage of volume) between Sim-0 and 2015. Large effects on the poor's food consumption are observed. In productivity degradation scenarios (Sim-1 and Sim-2), grain consumption drops significantly, ranging from -8 kilograms to -24 kilograms for the rural poor and from -15 kilograms to -28 kilograms for the urban poor. The same applies to animal products, the drop in which can reach -9 percent for the rural poor and -18 percent for the urban poor. By

contrast, results from Sim-3 (improvement in agricultural productivity) point to a significant and fast improvement in food security for the poor. Grain consumption gains amount to 35 kilograms for the rural poor and 46 kilograms for the urban poor. The increase in animal products consumption is 11 percent and 24 percent for the rural and the urban poor respectively. Under this scenario, improvement in agricultural productivity leads to a consumption growth that is sufficient for reaching CILSS standards, despite large initial gaps.

Table 5. ***Impacts on annual per capita consumption of rural poor***

	Quantity of grains consumed (kg)				Deviation from Sim-0					
					Sim-1		Sim-2		Sim-3	
	Sim-0	Sim-1	Sim-2	Sim-3	volume (kg)	percenta	volume	percenta	volume	percenta
Corn	43.7	41.9	38.7	51.5	-1.8	-4.2	-5.0	-11.5	7.8	17.7
Rice	17.7	17.4	16.5	20.1	-0.3	-1.6	-1.2	-6.8	2.5	14.0
Other grains	132.	126.	115.4	158.1	-6.1	-4.6	-17.5	-13.1	25.2	18.9
Total grains	**194.**	**186.**	**170.6**	**229.7**	**-**	**-4.2**	**-23.7**	**-12.2**	**35.4**	**18.2**
Meat and fish	12.7	12.5	11.6	14.1	-0.2	-1.8	-1.1	-8.6	1.4	11.0

Table 6. ***Impacts on annual per capita consumption of urban poor***

	Quantity of grains consumed (g)				Deviation from Sim-0					
					Sim-1		Sim-2		Sim-3	
	Sim-0	Sim-1	Sim-2	Sim-3	volume (kg)	percenta	volume (kg)	percent	volume	percen
Corn	79.4	72.3	66.2	101.5	-7.2	-9.0	-13.3	-16.7	22.0	27.7
Rice	33.2	30.1	27.7	42.2	-3.1	-9.5	-5.5	-16.5	9.0	27.0
Other grains	51.8	46.8	42.4	67.1	-5.0	-9.7	-9.5	-18.3	15.2	29.4
Total grains	**164.**	**149.**	**136.3**	**210.7**	**-**	**-9.3**	**-28.3**	**-17.2**	**46.2**	**28.1**
Meat and fish	12.5	11.3	10.2	15.5	-1.2	-9.8	-2.3	-18.2	3.0	24.1

These scenario results raise two issues: 1) the high sensitivity of food consumption to changes in agricultural productivity; 2) the impact of changes in agricultural productivity is stronger for the urban poor than for the rural poor, which is at odds with the latter being more involved in farming activities.

In Sim-1 and Sim-2, the decline in agricultural productivity leads to a sharp drop in agricultural production, ranging from -2 percent to -30 percent depending on the product and on the scenario (optimistic or pessimistic) (Table 7). The fall in agricultural production leads to an increase in agricultural prices (ranging from 1 percent to 28 percent) (Table 8). This is despite very strong changes in the percentage of imports and exports (Tables 9 and 10), which nevertheless represent only small changes in volumes for most agricultural products, because of the very low initial shares in domestic consumption (for imports) and domestic production (for exports) (Table 11).[4] These small changes in volume are thus insufficient for limiting the rise in prices of the corresponding products. To illustrate this point, let us consider the case of two products: corn and rice. In 2005, imports of corn represented less than 1 percent (0.4 percent) of national consumption, while imports of rice accounted for more than half of national consumption (57 percent). However, a 10 percent growth in rice imports allows its price to be limited to a 3 percent increase, while strong growth of corn imports (2670 percent in sim-2) does not prevent a surge (21 percent) in corn price. In sim-3 (improvement in agricultural productivity), an opposite effect is observed. Agricultural outputs skyrocket (between 7 and 31 percent, depending on the product) and cause a significant drop in agricultural product prices, especially of those products that are the least imported. King's law is checked here. This law stipulates that because of the rigidity of the demand for agricultural staples, a small change in their supply is likely to lead to an important change in their prices.

[4] We deliberately attributed large values to the Armington elasticities to represent relatively homogeneous goods.

Table 17. *Production trends (percentage of variation compared to the baseline)*

	Sim-1	Sim-2	Sim-3
Corn	-4.9	-27.6	11.1
Rice	-11.4	-29.3	33.7
Other grains	-2.0	-6.0	6.9
Total grains	**-3**	**-6**	**9**
Vegetables	-6.4	-17.1	21.4
Groundnuts	-2.5	-8.8	9.8
Cotton	-7.4	-12.8	31.3
Fruits	-5.2	-15.3	16.8
Livestock	-4.9	-14.4	16.4
Other agricultural products	-9.0	-22.8	30.2
Manufactures & industries	-0.8	-2.8	3.2
Services	-0.8	-3.3	4.6

Table 18. *Evolution of real consumer prices in percentage of baseline price*

	Sim-1	Sim-2	Sim-3
Corn	7.9	21.4	-14.6
Rice	1.2	2.8	-2.9
Other grains	8.5	24.7	-15.1
Total grains	**8**	**2**	**-6**
Vegetables	8.2	23.8	-15.6
Groundnuts	9.6	28.3	-17.2
Cotton	7.5	22.3	-14.1
Fruits	1.2	3.5	-2.9
Livestock	3.7	13.4	-5.9
Other agricultural products	5.8	17.5	-10.7
Meat & fish	1.2	5.0	1.3
Industries & manufactures	-0.9	-2.9	4.6
Services	-1.3	-4.0	5.8

Table 19. *Imports trends (percentage of variation compared to the baseline)*

	Sim-1	Sim-2	Sim-3
Corn	266.5	2670.3	-93.2
Rice	4.7	10.3	-8.7
Other grains	307.5	4381.8	-93.9
Total grains	**0**	**5**	**-0**
Vegetables	45.3	174.2	-53.3
Groundnuts	384.7	7235.9	-96.0
Fruits	5.1	15.5	-10.1
Livestock	83.5	711.5	-62.5
Other agricultural products	29.1	104.6	-37.3
Meat & fish	20.0	114.2	35.5
Textile	-1.9	-6.5	10.8
Fertilizer	-0.3	-2.3	3.6
Manufactures	-0.2	-2.3	2.2

Table 10. ***Exports trends (percentage of variation compared to the baseline)***

	Sim-1	Sim-2	Sim-3
Corn	-62.2	-94.0	637.1
Rice	-14.3	-33.4	46.4
Other grains	-63.0	-93.3	656.4
Total grains	**-36.6**	**-61.0**	**323.**
Vegetables	-29.2	-61.8	114.8
Groundnuts	-67.4	-95.5	930.3
Fruits	-8.1	-23.1	25.8
Cotton	-46.8	-83.4	186.4
Livestock	-37.1	-80.1	125.0
Other agricultural products	-22.4	-52.0	73.2
Meat & fish	-15.1	-48.8	-8.2
Textile	2.3	6.5	-9.4
Fertilizer	1.8	5.6	-7.2
Manufactures	0.5	1.3	-2.7

Table 11. ***Share of exports/imports in total production/absorption (percentage)***

	Import	Export
Corn	0.36	0.47
Rice	56.67	0.71
Other grains (millet, sorghum, fonio)	0.00	0.15
Vegetables	2.00	6.98
Groundnuts	0.01	0.52
Cotton	0.05	80.85
Fruit	38.06	27.38
Livestock	0.08	6.13
Other agricultural products	5.14	6.84
Minerals	22.18	39.79
Meat and fish	0.10	1.76
Textile	27.54	6.70
Fertilizer	72.78	4.83
Other industrial products	45.88	9.39
Transport	13.81	0.50
Other market services	2.45	2.02
Other non-market services	9.13	7.95

Source: Authors' calculations from the Social Accounting Matrix

The decline in agricultural production and its associated rising prices in Sim-1 and Sim-2 result in a decline in secondary and tertiary sectors output (ranging from -1 percent to -3 percent). Household demand decreases, because of a decline in real incomes (-1 percent to -4 percent for the rural poor; -7 percent to -13 percent for the urban poor) (Table 12). Urban unemployment increases (+1.5 to + 5.2 percentage points) through general equilibrium effects. In contrast, in Sim-3, the additional economic activity generated by an improved agricultural productivity results in an increase in household demand associated with income growth, which through spillover effects across the economy leads to lower urban underemployment (-7.5 percentage points). Sim-3 is particularly favourable, as real incomes increase by 8.5 percent in rural areas and 18.5

percent in urban areas.

Growth of agricultural prices in Sim-1 and Sim-2 causes a reduction in food consumption in both rural and urban areas, which strengthens the belief that households in both areas of residence are net food buyers (Badolo and Traoré, 2011). However, the decline in real incomes resulting from high agricultural prices is partially offset by better remunerations of agricultural primary factors (Table 13). Insofar as rural poor incomes mainly come from agricultural primary factors (see Table 1), they are less adversely affected by agricultural productivity degradation compared with the urban poor. The latter are further adversely affected by a decrease in the remuneration of non-agricultural primary factors and an increase in urban unemployment as a result of a decline in both the activity of non-agricultural sectors and corresponding consumer prices. Symmetrically, improving agricultural productivity (Sim-3) is beneficial to both the rural and urban poor, but the urban poor gain more. Indeed, the decline in agricultural prices provides them with a higher purchasing power, while the combination of better remuneration of non-agricultural primary factors (resulting from higher prices of non-agricultural products) and a decline in urban unemployment leads to an increase in their nominal wages. For the rural poor, the decline in the remuneration of agricultural primary factors, which results from lower agricultural prices, explains why this scenario is less beneficial to them than urban poor.

At the macroeconomic level, the increase in agricultural prices and the decline in real income (in Sim-1 and Sim-2) affect the economy as a whole (Table 13). Indeed, the sectors that use agricultural goods as intermediate consumption experience an expansion in their production costs and a contraction in the demand for final goods, owing to the decline in per capita real incomes. Consequently, economic activity contracts by between -3 percent and -9 percent. All three aggregate sectors experience a recession, but this recession is less marked for the agricultural sector, thanks to the rise in agricultural prices. Agricultural activity only contracts by -0.3 percent to -2 percent, against -2.8 percent to -9.4 percent for industry and -4.5 percent to -13.4 percent for the services sector. The decline in overall economic activity, especially in industry and services, translates into higher urban unemployment, which rose from 19.4 percent in the baseline scenario to 20.9 percent in Sim-1 and 24.6 percent in Sim-2. In Sim-3, the momentum given to the agriculture leads to stronger economic growth. GDP is 10.4 percent higher than the baseline. Impacts on growth of aggregate value added are stronger for non-agricultural sectors as a whole than for agriculture, owing to the strong decrease in agricultural prices. The deviations of values added are 5.2 percent, 6.2 percent, and 16.9 percent for agriculture, industry and services respectively. Agricultural productivity growth is also accompanied by a significant

improvement in the trade balance, thanks to a strong growth in export volume (Table 13). The trade deficit is reduced from CFA francs 640 billion (US$ 1.1 billion) in Sim-0 to CFA francs 498 billion (US$ 861 million) in Sim-3, due to a decrease of about 22 percent. Moreover, the activity growth of the various sectors of production, as well as rising incomes and consumption, bring about more tax revenues. The government budget balance increases by 17 percent compared to the baseline, rising from CFA francs 773 billion (US$ 1.3 billion) in the baseline scenario to CFA francs 903 billion (US$ 1.6 billion) through agricultural productivity improvement. Finally, agricultural productivity growth, by increasing households and enterprises incomes, promotes private savings, and thus private investment. Total private savings rise from CFA francs 551 billion (US$ 953 million) in the baseline scenario to CFA francs 607 billion (US$ 1.05 billion) in the agricultural productivity improvement scenario, corresponding to an increase of about 10 percent.

Table 12. ***Impacts on real income per capita (FCFA/capita/year)***

	Per capita income (FCFA)				Deviation from Sim-0					
					Sim-1		Sim-2		Sim-3	
	Sim-0	Sim-1	Sim-2	Sim-3	amount (CFA)	percenta	amount (CFA)	percenta	amount	percer
Rural poor	71440.	70831.	68306.	77517.5	-	-0.9	-3134.6	-4.4	6076.7	8.5
Urban poor	69297.	64188.	60289.	82909.2	-5109.2	-7.4	-9007.8	-13.0	13611.9	19.6

Table 13. ***Macroeconomic effects***

	Sim-1	Sim-2	Sim-3
Real GDP	**-3.0**	**-9.4**	**10.**
Agricultural GDP	-0.3	-1.9	5.2
Industry GDP	-2.8	-9.4	6.2
Services GDP	-4.5	-13.4	16.9
Real factor returns			
Agricultural salaried labour	1.4	3.2	3.5
Agricultural family labour	3.4	7.6	-1.5
Agricultural capital	4.8	12.8	-5.4
Non-agricultural labour	0.0	0.0	0.0
Non-agricultural capital	-2.6	-8.1	9.7
Urban unemployment (percentage points)	1.5	5.2	-7.5
Consumer price index	1.6	4.7	-1.5
Import volume index	0.3	1.1	1.7
Export volume index	-17.7	-40.2	58.8
Trade deficit	7.6	17.2	-22.3
Government revenue	-0.9	-3.8	16.7
Private savings	-1.8	-5.9	10.1

3.1 Sensitivity tests

Some behavioural parameters are used in the implementation of the model. Some of these parameters are based on estimations by econometricians, whereas others are values that are assigned based on economic knowledge and assumptions. It may not be reasonable to consider that all the retained parameter values fit the reality well. For this reason, sensitivity testing is undoubtedly necessary for checking the robustness of the results.

The sensitivity tests carried out show that the values for Armington elasticities (between imports and domestic goods) and export elasticities are either insensitive or marginally sensitive. Substitution elasticities for the primary factors and the elasticities between aggregate primary factor and intermediate demand exhibit moderate sensitivity.[5] The moderate sensitivity of these elasticities indicates that the modelling results may vary moderately when different elasticity values are used. For example, the higher the value used for these elasticities, the greater the increase in aggregate sectors' values added and global GDP. Since the higher elasticity value means an easier substitution between primary factors and between aggregate primary factor and intermediate demand, a much greater and quicker improvement in food and nutrition security can be achieved in the agricultural productivity improvement scenario. In this study, very small values of 0.75 and 0.3 are used for these elasticities; the modelling results are thus relatively conservative. This means that with advances of new technologies that facilitate these two substitutions, more effective and efficient results can be achieved in the long term.

An alternative closure consisting of clearing the external account by the nominal exchange rate rather than foreign savings has also been tested and the results point to significant variations. For example, in the agricultural productivity improvement scenario, when this closure is adopted, a 6.1 percent appreciation of the nominal exchange rate is observed, which contributes to reducing economic competitiveness. However, GDP growth is higher than in the previous closure. Indeed, GDP is 15.6 percent higher than the baseline under the exchange rate-based closure, against 10.4 percent higher under the foreign savings-based closure. Consequently, the exchange rate-based closure accelerates household income growth and food and nutrition security improvements. These results indicate that the expected benefits from agricultural productivity improvements can be greater than those obtained in this study.

[5] Test results are available upon request.

4.0 Conclusion

This paper highlights the likely consequences of possible future trends in agricultural productivity. While food security status is already a concern for the poorest in Burkina Faso, a decline in agricultural productivity could have dire consequences on the most vulnerable segments of the population, particularly in a context of agricultural land depletion (OECD, 2012). In such a scenario, agricultural prices increase, hampering economic growth and decreasing real incomes. These impacts are notably severe for the urban population, because of the associated contraction in economic activity and increase in food prices. Such a scenario may be a cause of social unrest, thus threatening social peace, given that urban populations are both the most affected and the most politically sensitive. This result is in line with Alfsen et al. (1996), who found similar results for Nicaragua. Simulating a land degradation-induced decline in agricultural productivity, these authors showed that rural populations were less affected, thanks to the very low price-elasticity of demand forgrains.

By contrast, an increase in agricultural productivity has strong positive impacts on food security and on alleviating food insecurity within five years. In line with the recommendations from international agencies such as the International Food Policy Research Institute and the Food and Agriculture Organization of the United Nations (IFPRI, 2012; FAO, 2012), the simulation results confirm the potential progress in the fight against poverty and food security expected from an improvement in agricultural productivity. This study underlines an interesting result: agricultural productivity development can have a greater impact on the urban population than on the rural population.

In both scenarios, the stronger impacts on the levels of consumption and incomes are attributable to strong fluctuations in domestic prices, which are in turn explained by the low transmission of international prices, using the Armington function. This situation reflects the reality in Burkina Faso, a landlocked country with weak transportation infrastructure. Given the prominence of agriculture in Burkina Faso's economy, the productivity of this sector largely determines the performance in food and nutrition security and employment.

The results of this paper stem from a stylized model that does not pretend to represent all the complex relationships of Burkina Faso's economy and its diversity. However, the model represents the main characteristics of the production and consumption system, and produces an approximation of the observed situation of poor households. These simulation results could therefore be a legitimate part of the poverty-oriented toolkit of results that help shape the policy debate in Burkina Faso in particular, and in Sub-Saharan Africa more broadly.

Improved agricultural productivity is expected to come from public investment in agriculture, which is considered effective. However, several issues associated with public spending do not factor in this paper, as this would have required a stand-alone study. These issues include multiple diversions of public funds and corruption. As pointed out by López (2005), governments in developing countries systematically under-provide public goods because of the political lobby that incentivizes politicians to spend public resources on private goods instead.

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