Oil Exploitation and Regional Disparities of Poverty in Chad: An Analysis of the Oil Revenues Redistribution Policy

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Abstract

This study aims to explore local disparities of poverty in Chad within a context of oil exploitation. Firstly, it analyses the regional poverty dynamics between 2003 and 2011 by decomposing poverty trends into growth and redistribution components based on the Shapley value framework. Secondly, the paper assesses the causes of disparities in poverty incidence between counties according to the amounts of oil revenue allocated with respect to their demographic weights. Then, a generalization of the Oaxaca-Blinder decomposition for poverty analysis, based on Yun (2004) approach is employed to decompose inter-county poverty difference into characteristics and coefficient effects. Data used come from the most recent Chad Household Consumption and Informal Sector Surveys (ECOSIT 2 and ECOSIT 3) carried out by the National Institute of Statistics, Economic and Demographical studies (INSEED). Administrative data on the amounts of direct oil revenues allocated throughout the country by the College for Control and Monitoring of Oil Revenues (CCSRP) are also used. Results highlight that high-speed economic growth following the oil boom has not really helped to reduce poverty, not only in Chad on the whole, but also at the regional level where important disparities in poverty dynamics are observed. Also, significant differences exist while comparing poverty incidence between counties in regard to the amounts of oil revenues allocated. The characteristics that explain these inter-county disparities of poverty are mainly education, labour market status and access to public services, especially water and healthcare facilities. Therefore, it is expected that the oil revenue redistribution policy would better promote economic inclusion in Chad if oil revenue allocated by the central government throughout the country would reflect the specific local development needs.

Key words: Poverty, Redistribution, Decompositions, Local disparities, Oil exploitation, Chad.

1. Introduction

Chad has experienced oil extraction since 2000. The first contract of oil extraction was signed with a consortium of oil firms - Exxon Mobil (40%), Chevron-Texaco (25%), and Petronas (35%) provided only 12.5% of direct oil revenue made up of royalties and dividends to Chadian authorities. The indirect revenues collected since 2006 come from income taxes, fees and taxes paid by employees, work permits, customs duties and other charges. The rate of the taxes collected from the petroleum society's benefits is around 60%.

Oil provides essential resources to the Chadian economy. It represents 88% of total exports since 2004 (MPECI, 2013). The oil production covers, on average, 40% of GDP and provides at least 75% of the ordinary budget revenue (BEAC, 2013). Increased investments and the discovery of new oil fields bear witness to the importance given to the oil sector in the country, whereas its economy is mainly based on agriculture and livestock (Fondo et al, 2013).

Inevitably, oil revenue in Chad has significantly improved its macroeconomic performance. Oil exploration and the discovery of the first oil field since 2000 have produced significant stimulatory effects on the growth of gross domestic product (GDP). Before this date, the growth rate was estimated at 3% in the 1990s, mainly because of the recurrent political instability but also due to the inadequacy of public investments (Gadom, 2012). Investments in the oil sector between 2000 and 2003 and the effective oil production, which started in the third-quarter of 2003 have accelerated economic expansion. Oil GDP growth was 7.4%, on average, between 2002 and 2006, against 6.6% for the non-oil GDP in the same period (PND, 2013). The GDP growth rate reached an important peak[1] in 2004 and still averaged around 7% between 2001 and 2013 (INSEED, 2013).

Oil revenues are used to fund major investments in infrastructure, agriculture, education, and in the manufacturing sectors, to boost economic growth. However, even though the oil windfall has allowed Chad to improve its main macroeconomic indicators and to facilitate the attainment of the completion point of the initiative for Heavily Indebted and Poor Countries (HIPC) in 2015, the decline in oil prices since the middle of 2014 has harmed economic performance, leading to a decrease in public spending by 50% with direct negative impacts on job opportunities[2]. In addition, the country is still struggling to achieve the various targets of the Millennium Development Goals (ECA et al, 2014). Its human development index in 2013 was estimated at 0.35

and ranked the country 184th out of 187 countries (UNDP, 2013). Similarly, poverty indicators are not good compared to the average in sub-Saharan Africa (World Bank, 2014). Income poverty fell by only eight percentage points between 2003 and 2011, meaning that the reduction was only one percentage point per year on average. Table 1 below shows that approximately 47% of Chadians were poor in 2011.

Table 1: Poverty and inequality by areas of residence

Poverty and inequality measures	2003 year (ECOSIT 2)			2011 year (ECOSIT 3)		
	Urban	Rural	Total	Urban	Rural	Total
Distribution of the population	10.5	89.5	100	18.4	81.6	100
Poverty incidence	24.4	58.4	54.8	20.9	52.5	46.7
Poverty depth	7.4	23.1	21.5	6.6	22.6	19.7
Poverty severity	3.2	11.7	10.8	3.0	12.6	10.8
Distribution of poor	4.7	95.3	100	8.2	91.8	100
Gini index	0.379	0.382	0.394	0.362	0.416	0.421

Source: From ECOSIT 2 and ECOSIT 3

Furthermore, poverty remains a rural phenomenon in Chad. The incidence of poverty is twice as high in rural areas than in urban areas. It was 52% in rural areas against 21% in urban areas in 2011, although the reduction of poverty was greater in rural areas. Similar results comparing rural and urban areas can be derived from other poverty measures such as depth and severity. The depth of poverty decreased in urban and rural areas but the severity has increased in rural areas, showing that the mean expenditure of poor households has moved towards the poverty line as the proportion of the poorest households increased. Despite the decline in the incidence and depth of poverty between 2003 and 2011 at the national level, the absolute number of the poor almost doubled from 4.1 million in 2003 to 8.2 million in 2011. Indeed, the rate of poverty reduction was exceeded by the population growth rate.

In addition, the redistribution of growth products is still a real challenge. Inequalities measured by the Gini index increased by 6.9% from 0.394 in 2003 to 0.421 in 2011 at the national level. These inequalities are not only perceptible at individual level, but also at spatial level. The increase in inequalities is also observed in both urban and rural areas. A large disparity in poverty rates and the Gini index between regions is observed. The incidence of poverty has declined in almost all regions of Chad, except Mandoul, Logone Occidental, Ouaddai and Tandjilé regions. The results in these four areas are especially due to decline in agricultural activities, combined with lack of investment and the labour migration of farmers towards jobs in the oil sector (World Bank, 2013).

Apparent disparities are observed between regions in the investment of oil revenue. The oil revenue redistribution policy[3] did not take into account the population weight of the regions, and the level of poverty. Some widely poor regions such as Batha, Mayo

Kebbi, Guera and Salamat received very low shares, up to 3% of global oil revenue between 2003 and 2009, while other less poor areas as BET and Wadi-Fira received over 13% of oil revenue allocated to priority sectors (CCSRP, 2012). Similarly, the capital city N'Djamena is the most privileged and wealthy region, receiving about 50% of total oil revenue. Yet, before the start of oil production in Chad, the World Bank had suggested to the government to adopt a revenue management programme in exchange of financial support to ensure better use of oil wealth to reduce poverty in the country. In 2006, conflict arose between the Chadian government and the World Bank because of a unilateral modification of the oil revenue management programme by the government for military purposes (Ndang and Nan-Guer, 2011). Therefore, despite the restructuring of the regulatory and administrative framework to strengthen Law 001/PRC/99 passed in 1999, allocation of oil revenue remains highly arbitrary and less correlated with local development needs. The elaboration of national poverty reduction papers (PRSP1 for 2003-2006 and PRSP2 for 2008-2011) and the adoption of the National Development Plan (NDP) in 2013 did not improve the country's performance in terms of poverty reduction. However, less is known about the contributions of growth and income redistribution in alleviating poverty in Chad especially in oil exploitation context (Kakwani et al, 2004; Klasen, 2004).

The main objective of this study is to analyse the poverty dynamics between 2003 and 2011 in the context of oil extraction in Chad. Specifically, the study aims to: (i) provide empirical evidence of growth and redistribution effects on poverty trends between 2003 and 2011; (ii) identify factors that might explain the differences in poverty across localities according to the allocation of oil revenues by the government; and (iii) produce policy recommendations aimed at reducing horizontal and vertical poverty, and promote spatial inclusion in Chad.

The rest of the study is organized a follows. Section 2 presents the literature review. Section 3 exposes the management, allocation and redistribution policies of oil revenues implemented in Chad. The methodology is presented in Section 4, while Section 5 provides the results. Finally, Section 6 concludes and discusses policy implications.

2. Literature review

The link between natural resources and economic development has been extensively discussed in the literature. A large body of works tries to establish a negative relationship between abundance of natural resources and poor macroeconomic performances (Sachs and Warner, 2001; Auty, 2001; Gylfason, 2001; Neumayer, 2004; Davis and Tilton, 2005; Sala-i-Martin and Subramanian, 2012). Some studies found evidence to support the view that natural resource exploitation should not harm the economy (Tilton, 2007; Davis, 1995; Torvik, 2001; Stijns, 2005). In general, the result depends on the institutional environment of the country, the resources management and redistribution policy, and the extent of wasteful expenditure. Natural resources such as oil or minerals appear to be more linked to the resource curse (Boschini et al, 2003; Torvik, 2009). Another dimension of the presence of resource curse, apart from a negative growth impact, is the prevalence of poverty and the observation that resource-rich economies have a poor record in poverty alleviation and income distribution (Ross, 2001; Sarraf and Jiwanji, 2001). Natural resource-rich developing countries face high poverty rates and exhibit high levels of inequality (Ndikumana and Boyce, 2012). In oil-rich African countries such as Nigeria, Angola and Equatorial Guinea, more than 50% of the population live on less than US$ 2 per day (Gary and Karl, 2003; Schubert, 2006; Mallaye et al, 2015).

A number of studies have established that oil exploitation may affect economic activity through two main channels. While the first channel stresses on the direct effects of exploration and extraction of oil, the second channel is concerned with the indirect effects, highlighting the role of public spending of oil revenue. The relevance of these two channels relies on the nature of oil activity compared to exploitation of other natural resources such as mining. Indeed, in many developing countries such as Chad, mining is a highly labour-intensive activity. Thus, its impact on domestic employment and well-being is likely to be higher and direct. On the other hand, oil exploitation is a more capital-intensive activity which produces weak and indirect effects on the living standards of households, especially those living in the producing areas (Loayza et al, 2013; Zambrano et al, 2014). Therefore, it is appropriate to investigate the effectiveness of the second channel of impact of oil exploitation on economic well-being.

However, it appears in economic literature that efforts aiming to reduce poverty must essentially focus on economic growth (World Bank, 2001; Dollar and Kraay, 2002; Kray, 2006). Kray (2006) argues that sustained poverty reduction cannot be achieved

without continuous growth. But this widespread view can be limited when ignoring the redistribution issue. Oil is the main source of growth in some developing countries, such as Chad. If efforts devoted to promoting growth are not followed by efficient rents redistribution policies, the impact of growth on global poverty reduction can be marginal. Segal (2011) demonstrates that even a moderate and non-distortionary redistributive scheme can have a major impact on poverty, independently of aggregate growth. The transfer or the redistribution of rents to the population considerably reduces poverty (IMF, 2006; Pauw and Mncube, 2007; Gelb and Grasmann, 2010). Such redistribution policy presents an advantage that it concerns all citizens without discrimination and thus can easily target the poor class. In Namibia, for example, the transfer of 15 dollars to each Namibian per month has helped increase the schooling rate and reduced poverty (IMF, 2006). Rents distribution schemes reduce poverty and inequality and provide households with financial capacity to improve well-being (Pauw and Mncube, 2007). We do not discuss the issue of rents transfer or direct distribution of rents to households, but our findings state that growth and redistribution policy have to be synchronized to explain the poverty difference between different regions of Chad where oil revenue is invested in sectors such as education, health, agriculture and infrastructure.

As highlighted above, the effect of natural resources on growth is not necessarily negative but depends on the quality of institutions. However, the issue of quality of institutions is wide and covers various aspects, including property rights or corruption. Regarding oil extraction, the legal and regulatory framework for revenue allocation remains a major political and economic concern. Our research is an extension of this literature and attempts to analyse the egalitarian nature of the policy of oil revenue redistribution for poverty reduction across administrative and geographical regions in Chad. This research concern is not really new and finds its interest in the transmission channels of the oil activity. Some studies attempted to assess the poverty situation in Chad (Ndang and Nan-Guer, 2011; World Bank, 2013) but none of them raised the issue of growth and redistribution in the context of oil exploitation. Mabali and Mantobaye (2015) tried to analyse oil and regional development in Chad, but their study did not consider the issue of oil revenue redistribution.

3. Management, allocation and redistribution of oil revenue in Chad

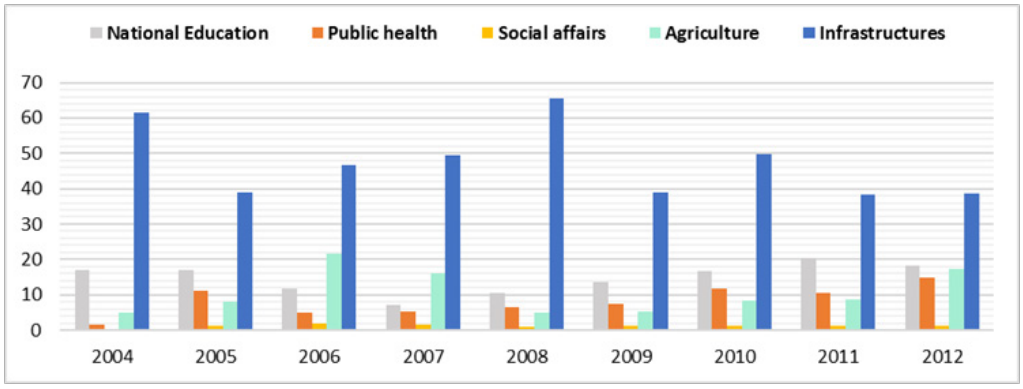
The management of revenue derived from the extraction of natural resources constitutes a serious issue in almost all countries. The main challenges revolve around the fairness and sustainability to avoid the resource curse phenomenon, especially in developing countries with weak governance and high level of corruption (Sala-i-Martin and Subramanian, 2003; Segal, 2011). Thus, most of the time, international development institutions suggest to national governments specific frameworks of resource management to overcome these challenges. This was the case in Chad since the discovery of the first oil wells in 1999. Indeed, in return for its financial support in the Chad-Cameroon oil development project, the World Bank suggested to the Chadian government a revenue management programme aimed at ensuring that the oil revenue would efficiently contribute to poverty reduction. This programme was adopted within the Law 001/PR/99 on Oil Revenue Management enacted in 1999[4].

The law explicitly states that 70% of direct oil revenues are allocated to priority sectors, 15% to functioning expenses and investment of the state, 5% to the producing region and 10% is devoted to future generations[5]. However, the World Bank pulled out from this agreement in 2006 because of unilateral amendments of the law by the Chadian government (Ndang and Nan-Guer, 2011; Thorbecke, 2013). The government expanded the list of priority sectors and placed emphasis on the Department of Defence and National Security. The fund for future generations was also abolished on the argument that it is more profitable to invest the available resources immediately to meet the urgent priority needs for development. Therefore, the World Bank suspended most of its operations in Chad and even froze the escrow account into which Chadian oil revenues were stocked. In 2008, the World Bank abandoned the Chad-Cameroon oil project. This withdrawal led Chad to honour an advance repayment of about FCFA 31 billion supported by direct oil revenues (Gadom, 2012; Fondo et al, 2013). In that context, Chad was struggling to achieve its development goals and was constrained to rely again on the World Bank. After several months of negotiations between the two parties, especially to facilitate the attainment of the completion point of the initiative for Heavily Indebted and Poor Countries (HIPC), a new oil revenue management strategy was implemented. The new programme stated that about 65% of the direct revenues would be oriented towards priority sectors, 30% in state spending and 5% allocated to the producing

region. In addition, after provisions for debt services, indirect revenues derived from oil exploitation would be directly transferred into an account of the public treasury. These resolutions are well set out by the government within the second National Poverty Reduction Paper (NPRP2 from 2008 to 2011) and the National Development Plan (NDP) in 2013 with the aim to use oil revenues better in reducing poverty (MPECI, 2013).

While a full discussion of the appropriateness of the allocation of oil revenues across priority sectors is beyond the scope of this paper, some brief comments may be made. The allocation of direct oil revenues to priority sectors is presented in Figure 1[6]. Since 2004, the Ministry of Infrastructure received an average of 50% of direct oil revenues from the CCSRP, mainly for construction of roads, bridges and interchanges. The trajectory of asphalted roads increased from 287km in 2000 to 1,602 in 2011 and reached 1,925km in 2013, facilitating transportation within and between cities. However, the ministries in charge of agriculture, national education, public health, and social affairs received on average, 10.6%, 9%, 7% and 1% of direct oil revenues, respectively, between 2004 and 2012. One can also note the inconsistent trend in the allocation of oil revenues over time. The revenues allocated to some sectors such as agriculture and health have changed considerably.

Figure 1: Evolution of oil revenues allocated to priority sectors (share in %)



Source: From CCSRP (2012)

Since the disagreement between the World Bank and the Chadian government in 2006, allocation of oil revenues across economic sectors is no longer a serious issue. Despite the decrease of poverty incidence of about 14.8% between 2003 and 2011, one of the main challenges remained the reduction of regional poverty disparities (Table 2). Indeed, some regions of the country experienced a reduction of poverty incidence (Moyen-Chari/Mandoul, Guéra/Salamat, Batha) while others witnessed an increase (Ouaddaï/Sila, Tandjilé and Logone occidental). However, Hoinathy (2013) pointed out that oil revenues constitute the main source of regional budgets. The oil revenue amounts allocated to each county are indicated in Table A3 in the Appendix.

Table 2: Poverty and inequality by region

Regions	Overall poverty incidence			Food poverty incidence			Gini coefficient		
	2003	2011	%Δ	2003	2011	%Δ	2003	2011	%Δ
Chari-Baguirmi/ Hadjer-Lamis	49.3	43.5	- 11.8	25.6	28.1	9.8	0.375	0.440	17.3
Moyen-Chari/ Mandoul	68.9	67.0	- 2.8	51.8	51.1	- 1.4	0.390	0.404	3.6
Ouaddaï/Sila	34.4	35.3	2.6	15.8	17.2	8.9	0.327	0.374	14.4
BET/Wadi-Fira	55.1	39.4	- 28.5	33.2	21.7	- 34.6	0.379	0.447	17.9
Logone Occidental	57.5	66.4	15.5	38.6	46.4	20.2	0.417	0.424	1.7
Logone Oriental	64.6	48.6	- 24.8	51.9	28.4	- 45.3	0.381	0.367	- 3.7
Tandjilé	61.8	65.3	5.7	40.5	42.5	4.9	0.411	0.441	7.3
Guéra/Salamat	62.4	59.8	- 4.2	35.9	42.8	19.2	0.316	0.408	29.1
Barh-el-Gazal/ Kanem/Lac	54.3	40.6	- 25.2	39.1	21.3	- 45.5	0.371	0.377	1.6
Mayo-Kebbi-Est/ Ouest	71.8	42.5	- 40.8	54.6	23.6	- 56.3	0.392	0.379	- 3.3
Batha	47.8	45.6	- 4.6	23.3	18.8	- 19.3	0.321	0.350	9.0
N'Djamena	23.7	11	-53.6	32.2	11.8	-63.3	0.341	0.328	-3.8
National	54.8	46.7	- 14.8	36.1	29.0	- 19.7	0.394	0.421	6.9

Source: From ECOSIT 2 and ECOSIT 3. Note: %Δ%Δ indicates the relative change between 2011 and 2003.

4. Methodology

The study uses data from two recent Consumption and Informal Sector surveys in Chad (ECOSIT 2 and ECOSIT 3) conducted by the National Institute of Statistics, Economic and Demographic Studies (INSEED) in 2003 and 2011, respectively. After controlling for missing data, 6,695 households are considered through the survey in 2003 against 9,259 in 2011. Besides the fact that these household surveys provide unique data sources suitable to analyse poverty in Chad at national and local levels, their choice is motivated by the ability to conduct a study covering the ex-ante (ECOSIT 2) and ex-post (ECOSIT 3) periods of oil production in Chad.

The indicator used to measure household welfare is the annual expenditure per adult equivalent. Table A1 in the appendix summarizes descriptive statistics of this indicator. The overall average expenditures increased significantly in 2011 compared to 2003, the pre-oil exploitation period. However, there is an unequal distribution of these expenditures by place of residence. The average expenditure in urban areas is almost double that in rural areas. For example, a household in urban areas spent an average of FCFA 769,261 in 2011 on overall needs against FCFA 494,297 only for a household in rural areas. Similarly, there are wide disparities in the distribution of spending across different administrative regions of the country. For example, average food expenditures in N'Djamena are almost twice the amount recorded in the Logone Occidental region.

The methodology used by INSEED to compute the poverty line is based on the essential needs approach[7]. The national absolute poverty lines are FCFA 144,570 and FCFA 237,942 for 2003 and 2011, respectively, while the national food poverty lines are estimated at FCFA 102,243 and FCFA 159,991 for the same dates. These amounts were normalized by an index of cost of living in different regions to account for regional disparities and compute regional deflators, which help for comparability of results across localities in Chad (INSEED, 2013)[8].

Decomposition of poverty changes

There are many theoretical frameworks allowing the decomposition of poverty changes in growth and redistribution effects between two dates[9]. Datt and Ravallion (1992) elaborated a decomposition approach for which the initial period is a reference point, and envisaged a third component as the difference between the two previous

ones. The major limits of this approach is the asymmetric treatment of initial and final periods using one period as a given reference. To overcome this drawback, Kakwani (1997) considers an axiomatic approach for which the residual component is not the difference but the mean of two other components. Similarly, Shorrocks (2013) offers an alternative decomposition method based on Shapley value for a better appreciation of the weights to be assigned to each component[10].

Formally, we consider that the change in poverty level ($\Delta P \Delta P$) is explained by two factors: growth (G) and inequality or redistribution (R). For a given poverty line, the poverty level at time t (t = 1, 2) can be expressed as a function $P(\mu_t, L_t)P(\mu_t, L_t)$ of mean income $\mu_t \mu_t$ and Lorenz curve $L_t L_t$. The growth factor is given by $G = \frac{\mu_2}{\mu_1} - 1$ $G = \frac{\mu_2}{\mu_1} - 1$, while that of redistribution is $R = L_2 - L_1 R = L_2 - L_1$.

The change of poverty is given by:

$$\Delta P = P(\mu_2, L_2) - P(\mu_1, L_1) = P(\mu_1.(1+G), L_1 + R) - P(\mu_1, L_1) = F(G, R) \quad (1)$$

Changes in poverty level depend on the factors G and R. Their contributions are easily obtained by Shapley value framework. Indeed, there are 2! elimination sequences because ΔP depends on the two factors. The sequences are $\varphi_1 = \{G, R\}$ and $\varphi_2 = \{R, G\}$. In the first sequence, G is eliminated before R. Consequently, the growth factor contribution is given by:

$$C_G^S = \frac{1}{2}.\left[\underbrace{\Delta_G F(S(G, \varphi_1))}_{Sequence\ \varphi_1} + \underbrace{\Delta_G F(S(G, \varphi_2))}_{Sequence\ \varphi_2}\right] \quad (2)$$

In Equation 2, the term $S(G, \varphi_1)$ indicates that all the factors have been eliminated until G through the sequence φ_1, then only the factor R remains. Thus, the first component relative to the sequence φ_1 is given by Equation 3. Similarly, the second component relative to the sequence φ_2 is given by Equation 4 as follows:

$$F(S(G, \varphi_1) \cup \{G\}) - F\big(S(G, \varphi_1)\big) = F(G, R) - F(R) \quad (3)$$

$$F(S(G, \varphi_2) \cup \{G\}) - F\big(S(G, \varphi_2)\big) = F(G) - F(\emptyset) = F(G) \quad (4)$$

Finally, the contribution of growth factor is obtained by:

$$C_G^S = \frac{1}{2}.[F(G,R) - F(R) + F(G)]$$
$$C_G^S = \frac{1}{2}\left[\left(P(\mu_2,L_2) - P(\mu_1,L_1)\right) - \left(P(\mu_1,L_2) - P(\mu_1,L_1)\right) + \left(P(\mu_2,L_1) - P(\mu_1,L_1)\right)\right] \quad (5)$$
$$C_G^S = \frac{1}{2}.\left[\left(P(\mu_2,L_2) - P(\mu_1,L_2)\right) + \left(P(\mu_2,L_1) - P(\mu_1,L_1)\right)\right]$$

Equation 5 shows that the contribution of growth factor is an average of two components: (a) the poverty change when inequality is constant and equal to its initial level; and (b) the poverty change when inequality is constant but equal to its level in the final period.

$$C_R^S = \frac{1}{2}.[F(G,R) - F(G) + F(R)]$$
$$C_R^S = \frac{1}{2}\left[\left(P(\mu_2,L_2) - P(\mu_1,L_1)\right) - \left(P(\mu_2,L_1) - P(\mu_1,L_1)\right) + \left(P(\mu_1,L_2) - P(\mu_1,L_1)\right)\right] \quad (6)$$
$$C_R^S = \frac{1}{2}.\left[\left(P(\mu_2,L_2) - P(\mu_2,L_1)\right) + \left(P(\mu_1,L_2) - P(\mu_1,L_1)\right)\right]$$

Equation 6 indicates that the contribution of redistribution factor is obtained as a mean of two components: (a) the poverty change when the mean income is constant and equal to its level of initial period; and (b) the poverty change when the mean income is constant but non-equal to its level of final period. To conclude, the poverty change is expressed as the sum of two contributions: $\Delta P = C_G^S + C_R^S$.

Assessing inter-county poverty disparities

Identification strategy of county-groups

We base our identification strategy on the assumption that the oil revenue redistribution policy (ORRD) could help reduce poverty and improve living standards across counties,[11] since investments in social sectors such as health, education, water provision, and infrastructure in Chad are mainly financed by oil revenues. It is acknowledged that to better alleviate the resource curse and achieve development goals, natural resource governance requires that redistribution mechanisms must be done according to development needs in different localities[12]. Thus, assuming that local development needs are highly correlated to the size of the population in each

geographic unit (county), it is possible to consider a ratio indicating for each county whether the redistribution policy has been favourable or not to its demographic needs[13]. The ratio is given by:

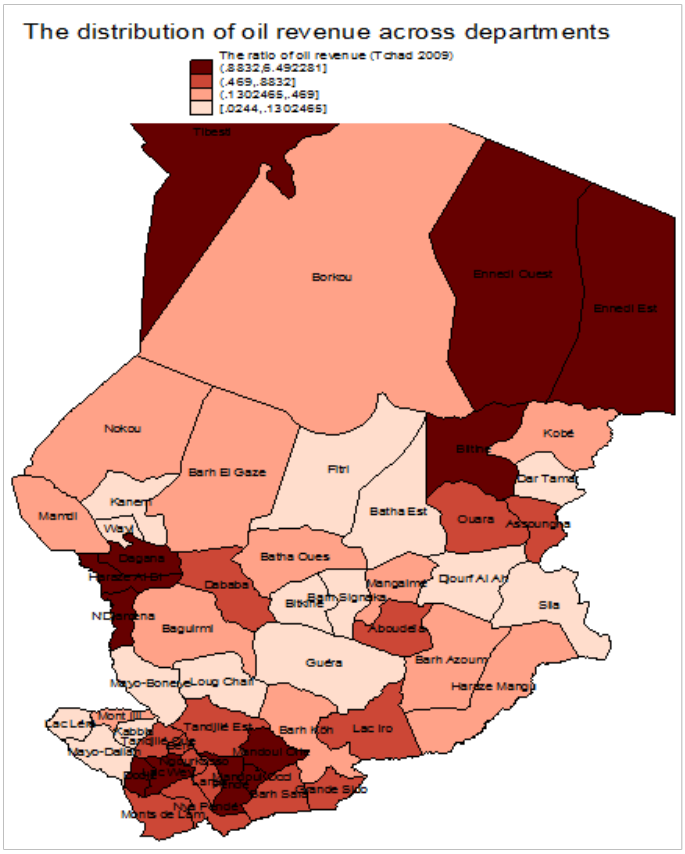
$$r_c = \frac{\frac{Oil\ Revenues\ Budget_{County}}{Oil\ Revenues\ Budget_{National}}}{\frac{Population_{County}}{Population_{National}}} = \frac{Oil_c}{Dem_c} \quad (7)$$

Where Oil_c represents the percentage of oil revenue budget received by the county c, and Dem_c indicates its demographic weight[14]. A ratio $r_c < 1$ shows that oil share allocated by the central government to the county is lower than what its population represents compared to the national population. Thus, such a redistribution seems disadvantageous for this county given that the percentage of the oil revenue invested does not match its demographic needs. Conversely, a ratio $r_c > 1$ indicates that the redistribution policy is favourable for the considered county. If $r_c = 1$, the demographic needs are exactly matched. Then, the per capita oil revenues budget for the county is exactly equal to the one at national level (see Equation 8). Table A3 in the Appendix shows in detail the computed values of Dem_c, Oil_c and r_c for each county graphically represented in Figure 2.

$$r_c = 1 \quad if \quad \frac{Oil\ Revenues\ Budget_{County}}{Population_{County}} = \frac{Oil\ Revenues\ Budget_{National}}{Population_{National}} \quad (8)$$

Therefore, our identification strategy assumes as a benchmark reference that better off counties are those which have received a per capita oil revenue at least higher than that at national level. Indeed, the ratio $r_c r_c$ allows us to build two groups of counties according to the investment of oil revenues done by the central government. The first one (say Group A) is represented by counties for which the ratio is greater or equal to 1. The second one (say Group B) is constituted by counties disadvantaged by the redistribution policy for which the ratio is less than 1. To sum up, out of the 62 counties in Chad, 24% and 76% are better off and worse off, respectively. Our basic hypothesis is that poverty incidence is higher in Group B than in Group A.

Figure 2: Distribution of oil revenues across counties (ratio r_c r_c)



Source: From CCSRP (2012) and INSEED (2013)

Regression-based estimation of poverty and Oaxaca-Blinder decomposition approach

This section outlines the decomposition approach used to explore the causes of differential levels of poverty incidence (head count ratio) in the two groups of counties. Within a binary variable setting, numerous studies link poverty incidence to various socio-economic covariates using Logit/Probit models[15]. Meanwhile, Ravallion (1996) and Mukherjee and Benson (2003) pointed out that binary models were relatively sensitive to specification errors and would lead to loss of some information. This point was also made by a World Bank study, which considered the ratio of income to poverty line as the dependent variable (World Bank, 2003)[16]. Retaining the World Bank method, the logarithm of the ratio of income to poverty line is regressed on a set of poverty covariates and the probability of poverty incidence is obtained for each household from the parameter estimates. The poverty incidence for a county-group is computed as the sample average of household level of poverty incidence. Then,

the disparity in poverty estimates between county-groups A and B is decomposed using the Oaxaca-Blinder decomposition approach (Oaxaca, 1973; Blinder 1973). We distinguish between two main components that are a characteristics effect (effects of the county characteristics) and a coefficients effect (effects of the differential impact of the characteristics over the counties).

Formally, we follow the model specified by Bhaumik et al (2006) and Chattopadhyay (2011) based on Yun (2004; 2005) approach, synthetizing the Oaxaca-type decomposition for poverty analysis. Poverty incidence can be computed by constructing the ratio $\frac{y}{z}$ of per adult equivalent total expenditure (y) to the poverty line (z) known to be the income-to-needs ratio in the literature. It can be used to explain the probability of a household to get into a state of poverty. Equation 9 is estimated for N households, where X is the set of poverty covariates and $\varepsilon \sim \mathcal{N}(0, \sigma^2)$ the error term.

$$ln\left(\frac{y_i}{z}\right) = X_i\beta + \varepsilon_i \tag{9}$$

The probability of poverty incidence for the i[th] household is obtained as follows:

$$\Pr\left(\frac{y_i}{z} < 1\right) = \Pr\left(ln\left(\frac{y_i}{z}\right) < 0\right) = \Pr(\varepsilon_i < -X_i\beta) = \Phi\left(\frac{-X_i\beta}{\sigma}\right) = \Phi(X_i\beta^*) \tag{10}$$

Φ is the Cumulative Distribution Function of standard normal distribution. Using the transformed coefficients $\beta^* = -\frac{\mu}{\sigma}$, Oaxaca-type decomposition can be implemented given that the head count ratio is asymptotically equivalent to the sample average of poverty incidence (P)[17]. Therefore, the poverty measure for each county-group is given by:

$$\boldsymbol{P_j} = \frac{1}{N_j}\sum_{i=1}^{N_j}\Phi\left(X_{ij}\widehat{\beta_j^*}\right) = \overline{\Phi\left(X_j\widehat{\beta_j^*}\right)} \tag{11}$$

Where $j = A$ and B. The over bar in equation (11) denotes sample average. The difference of poverty estimates between county-groups A and B is decomposed in the first moment into a linear combination of two components C and D at the aggregate level as follows:

$$\boldsymbol{P_A - P_B} = \overline{\Phi\left(X_A\widehat{\beta_A^*}\right)} - \overline{\Phi\left(X_B\widehat{\beta_B^*}\right)} = \underbrace{\left\{\overline{\Phi\left(X_A\widehat{\beta_A^*}\right)} - \overline{\Phi\left(X_B\widehat{\beta_A^*}\right)}\right\}}_{\hat{C}} + \underbrace{\left\{\overline{\Phi\left(X_B\widehat{\beta_A^*}\right)} - \overline{\Phi\left(X_B\widehat{\beta_B^*}\right)}\right\}}_{\hat{D}} \tag{12}$$

The component C is the aggregate characteristics effect which represents the portion of the difference of povertv due to the difference in the characteristics (poverty covariates X), given coefficients β β. On the other hand, the component D indicates the aggregate coefficients effect which represents the portion of the difference of poverty due to the difference in the coefficients, given the characteristics[18]. Both components C and D contain the effects of all the explanatory variables. Yet, a detailed decomposition analysis allows to capture the contribution of specific explanatory variable to the overall difference in the poverty incidence between the county-groups. This is possible by relying on the decomposition equation proposed by Yun (2004):

$$\boldsymbol{P_A - P_B} = \sum_{k=1}^{K} W_{\Delta X}^{k} \left\{ \overline{\Phi\left(X_A \widehat{\beta_A^*}\right)} - \overline{\Phi\left(X_B \widehat{\beta_A^*}\right)} \right\} + \sum_{k=1}^{K} W_{\Delta \beta}^{k} \left\{ \overline{\Phi\left(X_B \widehat{\beta_A^*}\right)} - \overline{\Phi\left(X_B \widehat{\beta_B^*}\right)} \right\} \quad (13)$$

Where $W_{\Delta X}^{k} = \frac{(\bar{X}_A^k - \bar{X}_B^k)\beta_A^{*k}}{(\bar{X}_A - \bar{X}_B)\beta_A^*}$, $W_{\Delta \beta}^{k} = \frac{\bar{X}_B^k(\beta_A^{*k} - \beta_B^{*k})}{\bar{X}_B(\beta_A^* - \beta_B^*)}$, and $\sum_{k=1}^{K} W_{\Delta X}^{k} = \sum_{k=1}^{K} W_{\Delta \beta}^{k} = 1$

$W_{\Delta X}^{k}$ and $W_{\Delta \beta}^{k}$ represent the weights of the k[th] explanatory variable in the aggregate characteristics effect and the aggregate coefficients effect, respectively. Then, the characteristic and coefficients effects due to the k[th] explanatory variable are defined as follows:

$$\boldsymbol{C_k} = W_{\Delta X}^{k} \times \boldsymbol{C} \text{ , i.e. } \boldsymbol{C} = \sum_{k=1}^{K} \boldsymbol{C_k} \quad (14)$$

$$\boldsymbol{D_k} = W_{\Delta \beta}^{k} \times \boldsymbol{D}, \text{ i.e. } \boldsymbol{D} = \sum_{k=1}^{K} \boldsymbol{D_k} \quad (15)$$

Finally, we can test for the statistical significance of the characteristics and coefficients effects at the aggregate and individual levels by employing the delta method (Yun, 2005). Bhaumik et al. (2006) and Chattopadhyay (2011) discuss in detail the estimation procedure of the variances of characteristics and coefficients effects from the estimated variance-covariance structure of the coefficients of model in Equation 9 estimated by maximum likelihood[19]. These variances are used to derive the test statistics asymptotically normally distributed under the null hypothesis $(\boldsymbol{C} = 0,\ \boldsymbol{D} = 0)$ at the aggregate level, and $(\boldsymbol{C_k} = 0,\ \boldsymbol{D_k} = 0)$ at the individual level.

5. Results

Analysis of growth and redistribution components of poverty changes in Chad

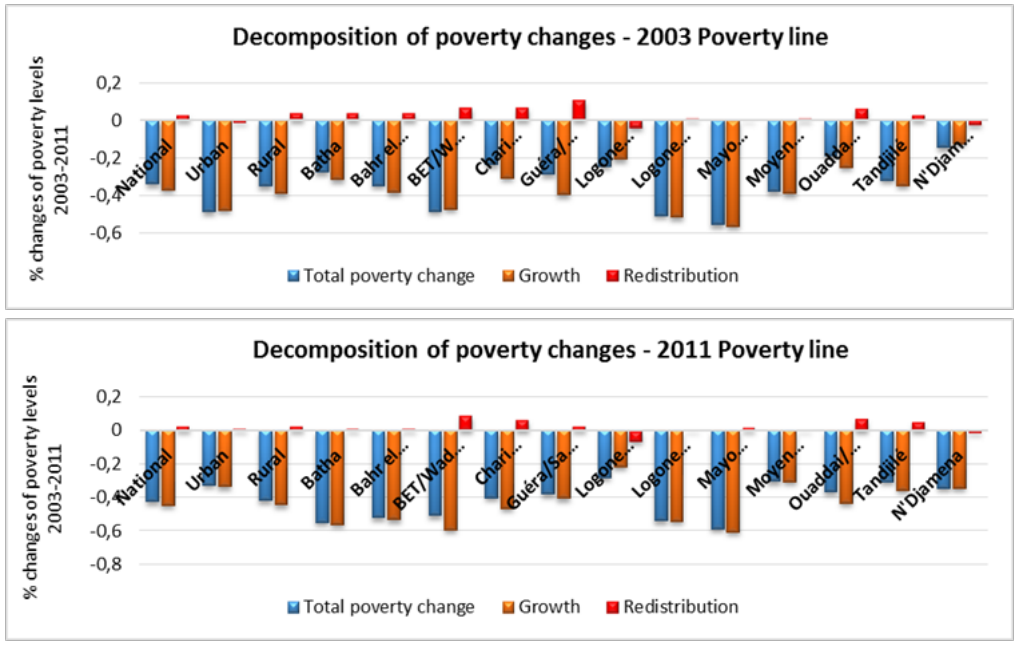
The results of the decomposition of changes in poverty are reported in Appendix Table A2. Poverty is decomposed into growth and redistribution components at national level, according to place of residence (urban versus rural) and administrative regions using both the 2003 and 2011 poverty lines. In addition, food and absolute dimensions of poverty are explored in this analysis.

Results show that poverty declined between 2003 and 2011 in Chad and the growth component largely contributed to this reduction. The growth effects on poverty reduction are considerably higher while the redistribution effects are almost negligible for both two-dimensional and poverty lines considered. The positive sign of redistribution component generally observed indicates a negative impact on poverty reduction due to increase of inequality. At the national level, and considering the 2003 poverty line, 37.2% of the 34.0% reduction of the poverty incidence is due to economic growth. Redistribution contributed only to 3.2% but in opposite directions. The results obtained using the 2011 poverty line show that poverty could fall further due to economic growth if inequality remained unchanged, meaning a decline of only 43% against a potential 45% due to growth alone. This significant contribution of growth to poverty reduction is also confirmed in urban and rural levels. Considering the 2003 poverty line, for example, the growth contributed 48% and 39% of the poverty reduction, respectively, in urban and rural areas. Redistribution contributed 0.9% of the reduction in urban areas, but it increased poverty by 4.2% in rural areas. Thus, the growth of per adult equivalent consumption of the household plays an essential role in reducing poverty in Chad.

The predominance of growth effects on global poverty reduction at the regional level is also confirmed, as shown in Figure 3. Specifically, the results show that poverty has declined in all regions, but the reduction rate is higher in Mayo Kebbi (56%), Logone Occidental (51%) and the BET/Wadifira (48%). These results are explained in part by the oil resources and their use. Indeed, Mayo Kebbi is the region which has effectively used its small share of oil revenue allocated in agriculture (World Bank, 2013); Logone Oriental, the oil producing region, receives 5% of direct oil revenues and uses them to grant agricultural loans; and BET/Wadifira is the least populated region but received a share of approximately 13% of total oil revenues (CCSRP, 2012). Other regions (as Hadjer-Lamis/

Chari-Baguirmi, Moyen-Chari/Mandoul, Ouaddaï/Sila, Tandjilé, Guéra/Salamat, Batha and Bahr-el-Gazal/Kanem/Lac) have experienced a remarkable decline in incidence of poverty through economic growth that prevailed between 2003 and 2011. Weak effects of oil revenue redistribution on poverty have also been proved in each region. These effects tend to counteract the effects of growth at national and regional levels, except in Logone Occidental and N'Djamena where redistribution has helped reduce poverty by 3.7% and 0.2%, respectively, given the 2003 poverty line. Using 2011 poverty line, the corresponding results are 6.3% and 1.2%, respectively, in the two regions.

Figure 3: Growth and redistribution decomposition of overall poverty changes in Chad



Source: From ECOSIT 2 and ECOSIT 3

The food poverty decomposition provides similar results in terms of poverty reduction and the contribution of growth-redistribution to this reduction. Compared to the analysis of global poverty, food poverty also reduced in all regions. The reduction rate is higher in Logone Oriental and Mayo Kebbi. The growth effect is dominant and favourable to this reduction, but the redistribution component tends to exacerbate food poverty at national level, in urban and rural areas and in the various regions for both two poverty lines considered. These results indicate that redistribution of income in Chad produces adverse effects, on average, on the households living below the poverty line. N'Djamena and Logone Occidental appear to be the exception. This corroborates the results of the World Bank's study according to which poverty reduced but inequalities have increased in Chad between the two dates (World Bank, 2013). In return, our results are relatively different from those obtained by

Mabali and Mantobaye (2015) who found that poverty increased in the production region compared to the non-oil producing regions. Indeed, the decrease of poverty is observed in the production region (Logone Oriental), the neighbouring regions (Logone Occidental, Mandoul, Tandjilé) and in the other regions.

Table 3: Overall poverty elasticity with respect to consumption and inequality

Poverty indicators	Poverty Incidence		Poverty depth		Severity of poverty	
	2003	2011	2003	2011	2003	2011
Poverty elasticity with respect to consumption						
Urban	- 0.82	- 0.72	- 0.86	- 0.65	- 0.79	- 0.60
Rural	- 1.48	- 1.48	- 2.17	- 1.95	- 2.56	- 2.30
Batha	- 1.75	- 1.43	- 1.70	- 1.03	- 1.51	- 1.08
Bahr el Gazel/Kanem/Lac	- 1.21	- 1.09	- 1.80	- 1.38	- 2.46	- 1.47
BET/Wadifira	- 1.66	- 1.31	- 2.25	- 1.45	- 2.22	- 1.37
Chari Baguirmi/ Hadjer-Lamis	- 1.52	- 1.34	- 1.65	- 1.52	- 1.67	- 1.85
Guéra/Salamat	- 2.08	- 1.70	- 2.29	- 2.29	- 2.49	- 2.82
Logone Occidental	- 1.40	- 1.79	- 2.27	- 2.51	- 2.69	- 3.20
Logone Oriental	- 1.02	- 1.66	- 2.42	- 1.78	- 3.38	- 1.81
Mayo Kebbi Est-Ouest	- 1.48	- 1.23	- 2.73	- 1.44	- 3.60	- 1.62
Moyen Chari/Mandoul	- 1.54	- 1.46	- 2.79	- 2.75	- 3.37	- 3.68
Ouaddai/Sila	- 1.17	- 1.11	- 1.17	- 1.31	- 0.97	- 1.24
Tandjilé	- 1.76	- 1.74	- 2.34	- 2.66	- 2.64	- 3.09
N'Djamena	- 0.73	- 0.43	- 0.67	- 0.32	- 0.61	- 0.24
National	- 1.40	- 1.34	- 2.03	- 1.71	- 2.37	- 1.98
Poverty elasticity with respect to inequality						
Urban	0.98	1.45	1.71	2.14	2.13	2.63
Rural	0.65	1.32	2.65	4.09	4.52	6.77
Batha	1.16	2.01	2.54	2.75	3.36	3.65
Bahr el Gazel/Kanem/Lac	0.56	1.45	2.57	3.45	4.82	5.07
BET/Wadifira	0.89	1.36	2.61	3.00	3.39	3.86
Chari Baguirmi/ Hadjer-Lamis	0.97	1.37	2.32	3.40	3.42	5.58
Guéra/Salamat	0.68	1.07	2.97	4.86	5.00	9.30
Logone Occidental	0.66	0.85	2.50	5.01	3.89	10.12
Logone Oriental	0.30	1.66	2.82	4.05	5.53	6.05
Mayo Kebbi Est-Ouest	0.30	1.51	2.76	3.56	5.25	5.29
Moyen Chari/Mandoul	0.33	0.76	2.83	5.44	5.47	10.17
Ouaddai/Sila	1.25	1.59	2.09	3.20	2.26	3.91
Tandjilé	0.63	1.20	2.56	4.57	4.43	7.42
N'Djamena	0.96	1.26	1.49	1.31	1.91	1.27
National	0.71	1.36	2.53	3.75	4.21	6.04

Source: From ECOSIT 2 and ECOSIT 3

The results of poverty decomposition in growth and redistribution are also observed in the short-term through the elasticities of poverty to inequality and consumption between 2003 and 2011. These results are reported in Table 3. They strengthen the sense of growth and redistribution effects obtained previously for the poverty rate, and the other two selected poverty indicators (the depth and severity of poverty). Indeed, reduction of poverty in Chad requires strong growth and lower inequality. The increase of 1% of consumption resulted in a decrease at the national level of 1.40% of the poverty rate in 2003, against 1.34% in 2011. Moreover, the decline in the poverty rate resulting from a reduction of 1% of the level of inequality (measured by the Gini coefficient) changed from 0.71% in 2003 to 1.36% in 2011. Poverty indicators are highly elastic to any modification in the level of consumption in both 2003 and 2011. However, they are less important in terms of any changes in inequality particularly in 2003 for the poverty rate, except for the regions of Ouaddai and Batha/Sila. Therefore, the incidence of poverty is less sensitive to the level of income redistribution in the population before oil exploitation in Chad.

In general, growth produces major effects on poverty reduction but the redistribution of the growth products is a recurring problem in Chad. Therefore, it is necessary to promote more growth and improve income redistribution policies to offset the adverse effects of redistribution and therefore reduce poverty. Poverty reduction beyond the observed level could be achieved if consumption growth had been accompanied by reduction of inequality, as suggested by Yemstov (2001) and Seker and Jenkins (2013)[20]. The policy of redistribution of economic growth factors, especially oil resources, can play a major role in this dynamic.

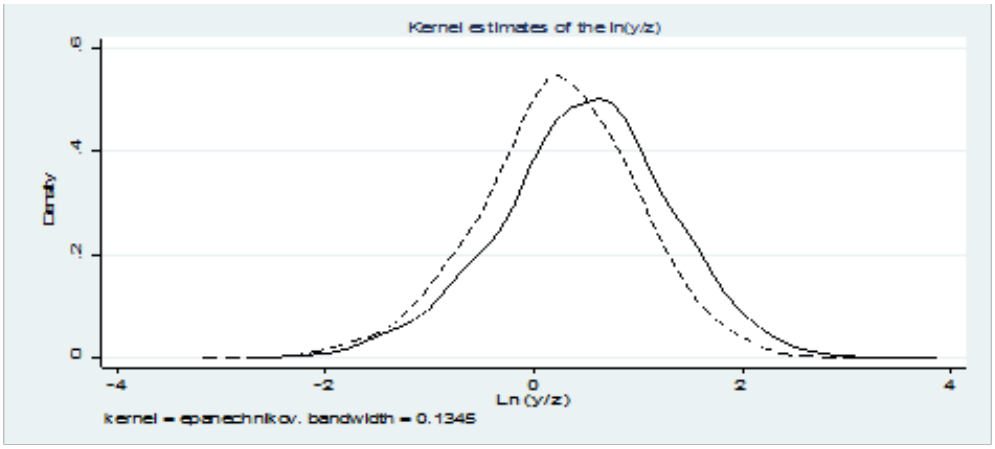
Poverty disparities and oil revenue redistribution across counties

Evidence of poverty disparities between county-groups

The first step of decomposition consists of estimating Equation 9 of the linear regression of the logarithm of income-to-needs ratio. The explanatory variables are broadly categorized into six groups[21]. The descriptive statistics of the dependent variable $ln\left(\frac{y}{z}\right)$ and the variables under these characteristics or groups are shown in Table 4. Results of the t-tests comparing the mean values of each variable between county-groups A and B are also reported. One can note that apart from the Houses variable, there exists a significant statistical difference between mean values of the two county-groups $\left(\bar{X}_A^k - \bar{X}_B^k\right)$. In addition, the sign of the difference for each k variable goes in accordance with our basic hypothesis that county-group A is better off compared to county-group B, since it is advantaged by the oil revenue redistribution policy across localities in Chad. For example, regarding the labour market status, in our sample 26.18% of household heads in group A are wage-earners. This proportion is statistically higher at 1% level of significance

than the 13.58% of wage-earners in group A. Similarly, in terms of access to public services, the time used to stock up with drinking water is statistically lower at 1% level of significance in group A (14.55 minutes) than in group B (19.68 minutes). This is the same for access to health services measured by the time used to go to the nearest health centre. The same pattern of the difference in mean values of explanatory variables is also observed when we look at the characteristics of the living environment. Indeed, urbanization and the schooling rates in districts of county-group A are significantly higher than those of county-group B, while the opposite is observed for poverty and unemployment rates. Finally, agriculture constitutes the main activity for more households in group B (47.28%) compared to those in group A (28.66%).

Figure 4: Kernel densities of logarithm of the income-to-needs ratio $\ln(y/z)$ $\ln(y/z)$ by county-group



Source: From ECOSIT 3

In addition to the previous descriptive statistics, we provide some evidence of poverty disparities between county-groups before discussing their causes. Indeed, the group A-group B poverty disparity is illustrated in Figure 4 of the kernel density estimates of logarithm of the income-to-needs ratio for each county group. The group A density is clearly to the right of group B density, implying that for the same level of expenditure exceeding the poverty line, there are more people in county-group A than in county-group B areas. It is also apparent that the difference between groups A and B densities is greater in the right tail of the density. Thus, rich households from group A are better off than their group B counterparts to a greater extent than are the poor households from group A better off than their group B counterparts.

Table 4: Definition and description of variables

Characteristics	Variables under characteristics	Description	Group A $\bar{X}_A^k$	Group B $\bar{X}_B^k$	t-test $\bar{X}_A^k - \bar{X}_B^k$
Dependent variable	$\ln(y/z)$	Logarithm of the income-to-needs ratio	0.4858 (0.831)	0.2365 (0.779)	14.7**
1. Demographic characteristics of the household (head	Household size	Household size (number of individuals living frequently in the household)	5.231 (3.086)	5.514 (2.849)	– 4.54***
	Sex	1 if the household is male-headed, 0 otherwise	0.7755 (0.417)	0.7360 (0.440)	4.33***
	Age	Age of the household head	41.15 (13.88)	42.51 (15.05)	– 4.41***
	Age^2/100	Squared age of the household head over 100	18.86 (13.13)	20.33 (14.67)	– 4.97***
	Couple	Marital status, 1 if the household head is in couple, 0 otherwise	0.7705 (0.420)	0.8174 (0.386)	– 5.54***
2. Educational status of the household (head)	Without education	1 if the head of household has never been provided with schooling, 0 otherwise	0.4646 (0.498)	0.6430 (0.479)	– 17.32***
	Primary education	1 if the head of household has successfully finished at least primary education, 0 otherwise	0.3032 (0.459)	0.2436 (0.429)	6.37***
	Secondary education	1 if the household head has successfully finished at least secondary education, 0 otherwise	0.1654 (0.371)	0.0946 (0.292)	10.23***
	Higher education	1 if the household head holds a higher education level, 0 otherwise	0.0666 (0.249)	0.0186 (0.135)	11.91***
3. Labour market status of the household (head)	Inactive	1 if the head of household is inactive, 0 otherwise	0.1912 (0.393)	0.2355 (0.424)	– 5.09***
	Unemployed	1 if the head of household is unemployed, 0 otherwise	0.0821 (0.274)	0.1016 (0.302)	– 3.15***
	Self-employed	1 if the head of household is a self-employed, 0 otherwise	0.4646 (0.498)	0.5269 (0.499)	– 5.90***
	Wage-earner	1 if the head of household is a salaried employee, 0 otherwise	0.2618 (0.439)	0.1358 (0.342)	15.47***
4. Wealth status of the household	Land	Logarithm of the value of land household owns (CFA francs)	2.336 (4.727)	3.148 (5.212)	– 7.65***
	Houses	Logarithm of the value of houses household owns (CFA francs)	0.6656 (2.806)	0.7279 (2.905)	– 1.02
	Livestock	Logarithm of the value of the livestock owned by the household (CFA francs)	1.2405 (3.755)	2.6630 (5.195)	– 14.44***

continued next page

Table 4 Continued

Characteristics	Variables under characteristics	Description	Group A $\bar{X}_A^k$	Group B $\bar{X}_B^k$	t-test $\bar{X}_A^k - \bar{X}_B^k$
5. Access to public services	Time to water	Time used to stock up with drinking water (minutes)	14.55 (25.30)	19.68 (28.24)	– 8.96***
	Time to health	Time used to go to the nearest health centre (minutes)	42.17 (57.38)	59.13 (79.30)	– 11.28***
6. Characteristics of the living environment of the household	Urban	Urbanization rate (proportion of households in urban area) in the district where the household lives	0.7847 (0.411)	0.5963 (0.490)	19.39***
	Schooling	Schooling rate in the district where the household lives	0.5353 (0.153)	0.3569 (0.197)	46.68***
	Poverty	Poverty rate in the district where the household lives	0.2310 (0.180)	0.2923 (0.121)	– 19.50***
	Unemployment	Unemployment rate in the district where the household lives	0.0821 (0.061)	0.1015 (0.065)	– 14.30***
	Agriculture	Proportion of households for which agriculture is a main activity in the district	0.2866 (0.253)	0.4728 (0.200)	– 39.45***
Constant		0.135	(0.0150)***		– 607

Source: From ECOSIT3. Note: The standard deviations are reported in parentheses. ***, ** and* indicate the significance levels at 1%, 5% and 10%, respectively.

It is possible to recover the same statistical results by comparing the poverty incidence estimated for each county-group from Equation 11[21]. Our basic hypothesis is confirmed. The poverty incidence in county-group A is lower than the one in county-group B as shown in Table 5. The difference of poverty estimates (P_A - P_B = – 0.0733) is statistically significant at 1%. However, without using a regression-based approach, the estimated poverty incidences are 0.2579 in county-group A and 0.3601 in county-group B. Therefore, it seems that the regression-based approach does not overestimate the poverty disparity (difference) between the two groups. Furthermore, our results provide justification for analysing separately, the poverty incidence in the two county-groups. The Chi-square test of independence to determine whether there is a significant relationship between the classification by being poor/non-poor and by living in county-group A/county-group B gives a highly significant $\chi^2_{(1)}\chi^2_{(1)}$= 107.73, indicating that these two classifications are not independent.

Table 5: Estimates of poverty incidence in county-groups A and B

County-groups	Sample size	Poverty incidence using regression-based approach	
		No	Yes
Group A	$N_A = 3796$	$P_A = 0.2579$	$P_A = 0.2622$
Group B	$N_B = 5463$	$P_B = 0.3601$	$P_B = 0.3355$
Difference in poverty incidence: $(P_A - P_B) = -0.0733$ t-test = -20.57^{***}			
Independence between the classification by being poor/non-poor and by living in Group A/Group B: $\chi^2_{(1)}\chi^2_{(1)} = 107.73^{***}$			

Source: From ECOSIT 3. Note: ***, ** and* indicate the significance levels at 1%, 5% and 10%, respectively.

Inter-county poverty decomposition

The difference in the average probability of being poor between county-groups ($P_A - P_B$) can be algebraically decomposed into characteristics and coefficient effects. The results are reported in Table 6. Both aggregate characteristics and coefficient effects are highly significant. The aggregate characteristics effect is -0.017, and its share in poverty difference is 78.3%. This means that if households of county-group A had the same characteristics as those of county-group B, given the group A coefficients, then the difference in poverty incidences would have been reduced by 78.3%. On the other hand, the aggregate coefficient effect is -0.005, and its share in poverty difference is 21.3%. Therefore, the inter-county poverty disparities would have been less by 21.3% if the coefficients of the variables influencing poverty were the same for both county-groups, given the characteristics of group B. Referring to what Chattopadhyay (2011) calls the resource effect, it is worth noting that the scale of the characteristics effect shows that inter-county poverty disparities would be considerably reduced if the oil revenue redistribution policy offered the same resources (characteristics) in both county-groups.

Yet, we can look at the detailed decomposition. Firstly, the individual characteristics effects capture the contributions of explanatory variables to the aggregate characteristics effect. The access to public services, especially water and health, has the highest contribution with a share of 54.7% in the differences of poverty incidences. This is followed by educational status (28.6%) and the demographic characteristics of the household (21.5%). These are a set of characteristics through which the resource effects may considerably reduce poverty disparities between county-groups. All the individual characteristics effects turn out to be highly significant, except the inactive explanatory variable.

Secondly, the aggregate coefficients effect D is also decomposed into contributions of individual poverty covariates. Within the Oaxaca-Blinder decomposition, these contributions can be interpreted as the efficiency effect, which gives the differential degree of utilization of resources (merely captured by the coefficient estimates from Equation 9 assessing the determinants of income-to-needs ratio). The characteristics

of living environment of the household contributes to 74.2% of the aggregate efficiency effect. This is followed by educational status (68.6%) and access to public services (54.7%). The variables with negative individual coefficient effect have positive share because the difference in poverty ($P_A - P_B$) is negative. It would mean that county-group A is having a lower coefficient attached to that variable compared to county-group B. In other words, county-group A is less efficient than county-group B[22] with respect to utilization of the resource. This is the case for variables such as access to public services (time taken to access water and health facilities), educational status (under higher education) or even the labour market status (wage-earner). These variables have more return effects in county-group B in lowering poverty disparities. Therefore, it seems appropriate for the oil revenues received in county-group B to foster provision of public services such as health centres and drilling water to boost schooling and create more employment opportunities. Variables characterizing the wealth status of households have positive coefficient effects. It indicates that equalization of the coefficients between the two county-groups will make county-group A worse off because by increasing the coefficients, poverty will decrease in county-group B and the poverty difference will be widened.

Lastly, it may be observed that the main reason why households from county-group A have lower probability of being poor than those from county-group B is due to coefficients effect of constant term, which is positive with a share of -607. This indicates that the average baseline per capita expenditure level is higher in county-group A. In other words, even though households living in county-group B hold characteristics which can lower poverty and help them enjoy stronger poverty mitigating effects of these characteristics compared to households from group A, the coefficients effect of the constant term shows that there is an important baseline gap in poverty incidence between the two county-groups. Therefore, this baseline disparity in poverty incidence is due to the oil revenue redistribution policy, which does not allocate oil revenue shares to localities according to their development needs. A better inclusion may be achieved if the ratio of oil revenue shares received to the demographic weights of each locality equals 1 as discussed previously through Equation 7.

Table 6: Decomposing the difference of poverty incidence between county groups ($P_A - P_B$)

Characteristics	Variables under characteristics	Characteristics effect				Coefficients effect			
		Estimate		Percentage		Estimate		Percentage	
Aggregate effect		Aggregate characteristics effect (C)				Aggregate coefficients effect (D)			
		- 0.017	(0.0012)***	78.3		- 0.005	(0.0018)***	21.3	
Decomposition of the aggregate effect		Individual characteristics effect (Ck)				Individual coefficients effect (Dk)			
1. Demographic characteristics of the household (head)	Household size	- 0.002	(0.0001)***	8.9	21.5	- 0.026	(0.0087)***	118.1	456.3
	Sex	0.001	(0.0015)***	- 6.9		- 0.000	(0.0031)	0.1	
	Age	- 0.030	(0.0006)***	137		- 0.094	(0.0219)***	423	
	Age2/100	0.027	(0.0006)***	- 124		0.035	(0.0101)***	- 157	
	Couple	- 0.001	(0.0001)***	6.5		- 0.016	(0.0040)***	72.1	
2. Educational status of the household (head)	Without education	- 0.009	(0.0004)***	40.9	28.6	- 0.010	(0.0017)***	48.1	68.6
	Primary education	0.004	(0.0003)***	- 21.8		- 0.005	(0.0013)***	23.8	
	Secondary education	- 0.000	(0.0001)***	2.2		- 0.000	(0.0003)	1.6	
	Higher education	- 0.001	(0.0001)***	7.3		0.001	(0.0002)***	- 4.9	
3. Labour market status of the household (head)	Inactive	- 0.000	(0.0001)	0.9	-16.5	0.000	(0.0004)	- 3.1	- 9.0
	Unemployed	0.001	(0.0001)***	- 5.8		0.001	(0.0003)**	- 3.5	
	Self-employed	0.001	(0.0001)***	- 5.4		0.003	(0.0017)	- 12.1	
	Wage-earner	0.001	(0.0002)***	- 6.2		- 0.002	(0.0004)***	9.7	
4. Wealth status of the household	Land	0.000	(0.0001)***	- 3.8	- 3.4	0.001	(0.0012)	- 5.8	- 16.5
	Houses	0.002	(0.0001)***	- 6.7		0.000	(0.0003)	- 2.1	
	Livestock	- 0.002	(0.0003)***	7.1		0.002	(0.0009)**	- 8.6	
5. Access to public services	Time to water	- 0.000	(0.0001)***	1.6	54.7	- 0.002	(0.0015)	10.3	54.7
	Time to health	- 0.011	(0.0003)***	53.1		- 0.009	(0.0026)***	44.4	
6. Characteristics of the living environment of the household	Urban	0.010	(0.0004)***	- 48.8		0.003	(0.0012)**	- 13.3	
	Schooling	- 0.007	(0.0009)***	33.8	- 6.6	- 0.028	(0.0060)***	130.2	74.2
	Poverty	0.001	(0.0003)***	- 5.9		- 0.006	(0.0056)	27.1	
	Unemployment	- 0.002	(0.0002)***	8.8		0.007	(0.0023)***	- 32.1	
	Agriculture	- 0.001	(0.0004)***	5.5		0.008	(0.0044)*	- 37.7	
Constant						0.135	(0.0150)***		- 607

Source: From ECOSIT3. Note: The robust standard errors are reported in the parentheses. ***, ** and* indicate the significance levels at 1%, 5% and 10%, respectively. Group A is the reference group of comparison.

6. Conclusion and policy implications

This study aimed to explain the dynamics of poverty in Chad in a context of oil exploitation. First, we estimated the growth and redistribution effects induced by the change in poverty observed between 2003 and 2011; that is, before and after oil exploitation in Chad. The results of the decomposition based on the Shapley value confirmed that poverty reduction beyond the observed level could be achieved if consumption growth had been accompanied by reduction of inequalities, and if the initial poverty levels and the demographic weight of the regions were used as criterion to make redistribution of oil revenues in the various regions in Chad.

The growth component produces significant effects on poverty reduction, but the redistribution of the growth products is a recurring challenge in Chad. Thus, it seems sensible to promote more growth and improve income redistribution policies to offset the adverse effects of redistribution and therefore reduce poverty. Moreover, these components have the effects and the magnitudes somewhat differentiated according to the administrative regions. Therefore, shortcomings are observed for spatial inclusion in the country, notably the reduction of poverty gaps between the regions induced by the oil revenue redistribution policy.

The second objective of this study explored the causes of inter-county poverty disparities in Chad within a context of oil exploitation. We distinguished between two groups of counties. Group A had counties which received oil revenues at least greater than their demographic weights, and then assumed that they were advantaged by the oil revenue redistribution policy (ORRP). On the contrary, counties of group B were assumed disadvantaged by the ORRP since they received amounts of oil revenues less than their demographic weights. Then, we applied Oaxaca-type decomposition inspired by the methodologies of the World Bank (2003) and Yun (2004; 2005) to find out the effect of the difference in the characteristics of the two county-groups that cause the disparities in poverty incidences, but also determine the differential impact of the characteristics over the two county-groups.

As expected, the results show that county-group B has a higher head count ratio (33.55%) than its counterpart county-group A (26.22%). This difference in poverty incidences is highly significant. As the results of the decomposition of this difference suggest, there is a disparity in the availability of the resources between the two county-groups. This characteristics effect accounts for 78.3% of the difference in poverty. At the same time, there is a disparity in the utilization of these resources; i.e. the efficiency

effect which is found to be less prominent. Basically, the baseline consumption is lower in county-group B which lags county-group A in terms of both availability of resources and their utilization. Thus, to better promote economic inclusion in Chad, oil revenue investments should fit the specific local development needs. Attention should be paid in county-group B with respect to enhancement of important policy variables such as access of public services (water drilling and healthcare facilities), education level and employment opportunities. Also, the return effect should be investigated and the causes of low resource utilization need to be considered.

Notes

1. The GDP growth peak reached in 2004 coincided with the short period of maximal oil production spread from 2004 to 2005 with 8.9 million tons per year (MPECI, 2013)

2. Most of the firms involved in the oil sector, and infrastructure and housing reduced their activities and proceeded to mass dismissal of employees due to decline of oil price and government failure in debt payment. Important development projects were suspended in 2015

3. Under the redistribution mechanism, the central government defines the amounts of oil revenue to be redistributed in each locality (county). Oil revenues are not directly provided in cash to the local authorities, but within a form of public investments (in education, health, infrastructure, etc.) which fit into the national budget and its allocation at local level. Then, the role of local authorities (heads of the regions and counties) is to ascertain the effectiveness of local investments. The mechanism is also supervised by the CCSRP organ (College for Control and Monitoring of Oil Revenues)

4. Such laws are usually enacted in resource-rich countries to ensure better use of revenues derived from the extraction of natural resources. For example, the Canon law in Peru defines the management framework of mining revenues from mining activities (Loayza et al, 2013; Zambrano et al, 2014).

5. Priority sectors defined under the law No. 001/PR/1999 were education, health and human services, rural development, infrastructure, and environment and water resources. In addition to the 5% of direct oil revenues, producing regions benefited from financial compensations aimed at creating economic activities for people who suffer of negative externalities of the oil project, especially environmental damages and losses of jobs. Hoinathy (2013) and Mabali and Montobaye (2015) document these.

6. Oil revenues are made up of direct revenues (royalties and dividends) controlled by the CCSRP and indirect revenues (income tax, fees and taxes paid by employees, work permits, customs duties and other fees) exclusively managed by the government through the public treasury (IMF, 2007). Information about indirect oil revenues are inaccessible in Chad, and to the best of our knowledge, no reference presenting detailed figures exists. According to the report of the oil company Esso (2012), total oil revenues

received between 2003 and 2012 is estimated at about 10.2 trillion CFA francs of which 65% comes from taxes on the profits made by oil companies

7. The food poverty line is calculated first and the global poverty line is obtained by adding to the food poverty line an amount corresponding to non-food basic needs. To compute the food poverty line, INSEED defined a basket of foods respecting the choice of the consumers, then evaluated the value of this basket using the mean price determined from the survey. The basket of goods chosen is the equivalent to 2,400 kcal by individual per day.

8. These deflators are obtained from a Harmonized Index of Consumer Prices (HICP) computed for N'Djamena city. It is a Laspeyres-Paasche price index that covers household consumption according to national accounts. Households living in N'Djamena serve as the reference population because of the availability of pertinent information on food prices in the capital city. The methodology used by INSEED to compute this price index is similar to that used by each National Statistics Institute in all the 17 sub-Saharan African countries within the French-speaking zone. The HICP considered a housewife's shopping basket of 330 foodstuffs that were monthly followed throughout 320 selling points in N'Djamena. About 3,000 prices were considered each month. The baseline year of this price index for all the foodstuffs is 2005. The weights of this price index come from the ECOSIT 2 survey carried out in 2003-2004 within 1,024 households in N'Djamena.

9. Two main decomposition methods of poverty change are retained in the literature: static method by Kakwani (1993) and dynamic method (Datt and Ravallion, 1992; Kakwani, 1997; Shorrocks, 2013).

10. See Baye (2006) for critical presentation of the three decomposition approaches

11. In Chad, sub-national administrative units are called regions, counties, districts, and sub-districts in decreasing order of size since the Decree No. 419/PR/MAT/02 on 17th October 2002. County is the lowest administrative unit retained because data from CCSRP about amounts of oil revenues redistributed do not go beyond this geographical and administrative scope

12. Several works discuss the social and economic efficiencies of different redistribution mechanisms of natural resource rents around the world; see for example Sala-i-Martin and Subramanian (2003), Sandbu (2006), Segal (2011), Maguire and Winters (2016) for a detailed literature review.

13. Each county received oil gain fall in terms of amount of investment in these sectors as indicated in Table A3 in the Appendix. Considering the framework of oil revenue allocation in terms of amount of the investment, fair redistribution could be done by factoring in the density of the population and the initial level of population well-being in each county

14 The percentage of oil revenues will be computed through data from CCSRP based on the average amount of direct oil revenues redistributed throughout the country between 2008 and 2011. Information before 2008 are not available, while data after 2011 go beyond the scope of this study. However, demographic weights are given by the second General Population and Housing Census conducted by INSEED in 2009. These demographic weights are easily imputed in year 2011 under the assumption that the population has not highly changed between the two dates. However, a specific harmonization was required to match data from the two main sources. Indeed, ECOSIT 3 and CCSRP do not cover the same number of geographical units. ECOSIT 3 covers 20 regions and 73 counties, while CCSRP covers 12 regions and 62 counties. But, we are still able to recover each region and each county of the CCSRP from the ECOSIT 3 coverage scheme because the high number of geographical units from ECOSIT 3 is derived from the division/explosion of some units from CCSRP. Therefore, our baseline coverage scheme is the one of CCSRP because it provides the lowest number of geographical units. Then, we regroup counties from the ECOSIT 3 coverage scheme to again find the counties from the baseline

15. See for example Geda et al (2001) in a study case of Kenya, Golo (2014) in Togo, Bokosi (2007) in Malawi, Adoho and Boccanfuso (2007) in Guinea, and Bigman and Srinivasan (2002) in India.

16. More precisely, the World Bank study considers the logarithm of this ratio which is a common way of allowing for the log normality of the variable. Coudouel et al. (2002) provide a discussion about this World Bank method using linear regression to assess the determinants of poverty. The World Bank method has been used by several works studying differences in poverty between groups. Bhaumik et al. (2006) applied it between Serbians and Albanians in Kosovo; Gang et al. (2008) contrasted the situation of scheduled caste and scheduled tribe households with the general population in India; Chattopadhyay (2011) studied the case of West Bengal, an eastern state of India, and compared its two regions (North Bengal and South Bengal)

17. The decomposition is done from the viewpoint of county-group B. Indeed, $\Phi\left(X_B\,\widehat{\beta_A^*}\right) = \frac{1}{N_B}\sum_{i=1}^{N_B}\Phi\left(X_{iB}\,\widehat{\beta_A^*}\right.$ is the counter factual poverty in county-group B; that is, the poverty level that would prevail in county-group B if it would have the same coefficient vector as is county-group A. Therefore, the aggregate characteristics effect (C) represents the difference between the actual poverty level in county-group A and the counter factual poverty level in county-group B with county-group A's coefficients $\left(\widehat{\beta_A^*}\right)$. Similarly, the aggregate coefficients effect (D) is the difference between the counter factual poverty level in county-group B with county-group A's coefficients and the actual level of poverty in county-group B

18. The World Bank (2003) method proposes the estimation of equation (9) using Ordinary Least Squares (OLS). However, a drawback associated with the OLS estimation is that it produces only a covariance matrix of β, while the covariance matrix of (β, σ) is required to derive the covariance matrix of $\beta^* = -\frac{\beta}{\sigma}$. We follow Bhaumik et al. (2006) to consider the Maximum Likelihood (ML) as the best estimation approach to address this issue.

19 Yemstov (2001), and Seker and Jenkins (2013) studied a similar topic in the case of Turkey.

20. An important group of characteristics retained in the literature concerns the transfers received by the household, especially private transfers and government aid. Data on these variables are not available from ECOSIT 3 survey, leading to missing out on this group of characteristics. However, we expect that the group of characteristics capturing some aggregated socio-economic variables of the living environment (counties) of the household may help to control for the missing variables since, in general, transfers are oriented towards poor environments (counties).

21. This is derived from the estimates of the parameters of Equation 9 as reported in Table A4 in the Appendix. In general, the poverty covariates are highly significant and affect the logarithm of the income-to-needs ratio as expected.

22. See demonstration provided by Chattopadhyay (2011: 113)

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Appendix

Table A1: Descriptive statistics – household expenditure per adult equivalent

Regions / residence areas	Observations		Overall expenditure			Food expenditure		
	2003	2011	2003	2011	%Δ	2003	2011	%Δ
Urban	4 815	6 237	438 741.4	769 261.9	75.33	210 260.2	431 271.9	105.11
Rural	1 880	3 022	267 772.5	494 297.0	84.60	176 911.4	309 122.1	74.73
Batha	281	349	270 239.9	729 859.5	170.08	178 681.7	425 340.7	138.04
Bahr el Gazel/Kanem/Lac	479	1 217	268 144.4	584 156.6	117.85	198 705.4	356 723.1	79.52
BET/Wadifira	382	765	524 981.8	851 469.3	62.19	363 917.1	494 253.9	35.81
Chari Baguirmi/ Hadjer-Lam.	572	743	269 165.5	536 099.4	99.17	180 500.9	351 164.9	94.55
Guéra/Salamat	334	732	218 283.0	521 049.1	138.70	140 324.4	300 937.6	114.46
Logone Occidental	474	418	330 143.5	522 209.5	58.18	172 281.5	274 777.6	59.49
Logone Oriental	383	385	217 679.8	509 214.9	133.93	144 249.0	307 343.2	113.06
Mayo Kebbi Est-Ouest	575	781	218 439.4	633 595.5	190.06	141 152.0	358 408.2	153.92
Moyen Chari/Mandoul	860	834	233 069.7	517 024.6	121.83	139 042.3	272 281.0	95.83
Ouaddai/Sila	853	847	377 461.4	771 122.8	104.29	224 284.1	445 263.3	98.53
Tandjilé	381	395	237 075.6	534 300.4	125.37	125 545.4	326 721.1	160.24
N'Djamena	1 021	1 793	467 327.3	942 750.0	101.73	213 451.7	521 891.7	144.50
National	6 695	9 259	315 781.7	679 517.4	115.19	186 276.0	391 404.0	110.12

Source: From ECOSIT 2 and ECOSIT 3. Note: %Δ%Δ indicates the relative change between 2011 and 2003

Table A2: Decomposition of poverty changes by growth and redistribution components

Regions / Residence areas	Poverty line (PL)	Poverty incidence				Change in poverty incidence		Shorrocks decomposition			
		Overall		Food				Overall		Food	
		2003	2011	2003	2011	Overall	Food	G	R	G	R
Urban	2003	0.521	0.032	0.302	0.092	-0.488	-0.210	-0.479	-0.009	-0.212	0.002
	2011	0.441	0.113	0.568	0.200	-0.328	-0.368	-0.338	0.010	-0.385	0.017
Rural	2003	0.521	0.171	0.539	0.252	-0.350	-0.287	-0.392	0.042	-0.326	0.039
	2011	0.788	0.368	0.759	0.447	-0.420	-0.312	-0.447	0.026	-0.342	0.031
Batha	2003	0.345	0.067	0.347	0.132	-0.278	-0.214	-0.317	0.039	-0.288	0.074
	2011	0.725	0.175	0.684	0.209	-0.550	-0.474	-0.563	0.013	-0.460	-0.014
Bahr el Gazel/Kanem	2003	0.432	0.085	0.449	0.164	-0.347	-0.285	-0.386	0.039	-0.291	0.005
	2011	0.761	0.239	0.674	0.295	-0.522	-0.378	-0.535	0.013	-0.395	0.016
BET/Wadifira	2003	0.484	0.080	0.409	0.136	-0.484	-0.272	-0.474	0.070	-0.362	0.089
	2011	0.759	0.248	0.687	0.298	-0.511	-0.388	-0.596	0.085	-0.454	0.066
Chari Baguirmi/ Hadjer-Lamis	2003	0.368	0.130	0.359	0.187	-0.238	-0.172	-0.309	0.070	-0.280	0.108
	2011	0.702	0.297	0.646	0.371	-0.404	-0.275	-0.469	0.064	-0.394	0.118
Guéra/Salamat	2003	0.526	0.238	0.528	0.303	-0.287	-0.225	-0.397	0.110	-0.297	0.072
	2011	0.843	0.461	0.790	0.535	-0.382	-0.255	-0.409	0.026	-0.291	0.036
Logone Occidental	2003	0.564	0.318	0.602	0.379	-0.245	-0.223	-0.208	-0.037	-0.168	-0.054
	2011	0.818	0.533	0.800	0.659	-0.285	-0.141	-0.221	-0.063	-0.130	-0.011
Logone Oriental	2003	0.609	0.101	0.603	0.174	-0.507	-0.429	-0.518	0.011	-0.443	0.013
	2011	0.807	0.258	0.782	0.387	-0.541	-0.394	-0.544	0.002	-0.398	0.004
Mayo Kebbi Est-Ouest	2003	0.660	0.101	0.617	0.213	-0.558	-0.404	-0.566	0.008	-0.415	0.011
	2011	0.849	0.258	0.815	0.350	-0.590	-0.465	-0.608	0.017	-0.448	0.017

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Table A2 Continued

Regions / Residence areas	Poverty line (PL)	Poverty incidence				Change in poverty incidence		Shorrocks decomposition			
		Overall		Food				Overall		Food	
		2003	2011	2003	2011	Overall	Food	G	R	G	R
Moyen Chari/ Mandoul	2003	0.670	0.290	0.681	0.390	-0.379	-0.290	-0.391	0.011	-0.298	0.007
	2011	0.850	0.545	0.835	0.645	-0.305	-0.189	-0.308	0.002	-0.186	-0.003
Ouaddai/Sila	2003	0.256	0.067	0.283	0.106	-0.189	-0.177	-0.252	0.062	-0.220	0.043
	2011	0.591	0.220	0.601	0.257	-0.370	-0.343	-0.435	0.065	-0.348	0.004
Tandjilé	2003	0.550	0.230	0.618	0.344	-0.320	-0.274	-0.348	0.027	-0.349	0.075
	2011	0.803	0.494	0.795	0.579	-0.309	-0.216	-0.360	0.051	-0.272	0.056
N'Djamena	2003	0.152	0.007	0.300	0.056	-0.145	-0.244	-0.125	-0.020	-0.217	-0.027
	2011	0.405	0.057	0.570	0.112	-0.348	-0.458	-0.348	-0.012	-0.442	-0.016
National	2003	0.486	0.146	0.497	0.223	-0.339	-0.274	-0.372	0.032	-0.309	0.034
	2011	0.751	0.322	0.725	0.402	-0.428	-0.323	-0.449	0.020	-0.354	0.031

Source: From ECOSIT 2 and ECOSIT 3. Note: G and R indicate the Growth and Redistribution components, respectively

Table A3: Ratio and some indicators by region and county

Regions/Counties	Population	Demographic weights	Oil revenues (million CFA francs)	Oil shares	Ratio
Batha	488 458	0.0442	3381.03	0.0079	0.1792
Batha-Ouest	197 712	0.0179	2027.42	0.0048	0.2655
Batha-Est	180 343	0.0163	844.75	0.0020	0.1213
Fitri	110 403	0.0100	508.85	0.0012	0.1193
Borkou	93 584	0.0085	1308.75	0.0031	0.3620
Borkou	68 370	0.0062	916.69	0.0021	0.3471
Borkou Yala	25 214	0.0023	392.05	0.0009	0.4025
Guera	538 359	0.0488	5747.16	0.0135	0.2764
Guera	172 447	0.0156	2873.53	0.0067	0.4314
Abtouyour	167 433	0.0152	1149.41	0.0027	0.1777
Barh Signaka	103 572	0.0094	574.70	0.0013	0.1437
Mangalmé	94 907	0.0086	1149.52	0.0027	0.3136
Hadjer Lamis	566 858	0.0513	91668.06	0.2150	4.1865
Dagana	188 348	0.0171	55000.83	0.1290	7.5599
Dababa	228 440	0.0207	13750.21	0.0322	1.5583
Haraze Al Biar	150 070	0.0136	22917.01	0.0537	3.9534
Logone Oriental	779 339	0.0706	62576.31	0.1467	2.0787
La Pendé	160 456	0.0145	21666.99	0.0508	3.4958
Kouh Est	101 350	0.0092	9156.14	0.0215	2.3388
Kouh Ouest	49 515	0.0045	3576.91	0.0084	1.8702
La Nya	140 940	0.0128	10481.33	0.0246	1.9253
La Nya Pendé	108 090	0.0098	6754.57	0.0158	1.6178
Monts de Lam	218 988	0.0198	10940.33	0.0257	1.2933
Mandoul	628 065	0.0569	59944.09	0.1406	2.4709
Mandoul Oriental	256 116	0.0232	35528.21	0.0833	3.5912
Barh Sara	217 251	0.0197	11838.03	0.0278	1.4107
Mandoul Occidental	154 698	0.0140	12577.84	0.0295	2.1049
Ouaddaï	721 166	0.0653	5985.73	0.0140	0.2149
Ouara	328 647	0.0298	4834.75	0.0113	0.3808
Abdi	106 881	0.0097	522.74	0.0012	0.1266
Assoungha	285 638	0.0259	628.23	0.0015	0.0569
Mayo Kebbi Ouest	564 470	0.0511	1742.47	0.0041	0.0799
Mayo-Dallah	334 745	0.0303	1045.48	0.0025	0.0809
Lac Léré	229 725	0.0208	696.98	0.0016	0.0785
Wadi Fira	508 383	0.0460	43880.62	0.1029	2.2345
Biltine	169 050	0.0153	40459.96	0.0949	6.1961

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Table A3 Continued

Regions/Counties	Population	Demographic weights	Oil revenues (million CFA francs)	Oil shares	Ratio
Darh Tama	179 380	0.0162	1343.97	0.0032	0.1940
Kobé	159 953	0.0145	2076.67	0.0049	0.3361
Sila	305 933	0.0277	871.23	0.0020	0.0737
Kimiti	305 933	0.0277	522.74	0.0012	0.0442
Djourouf Al Almar	81 528	0.0074	348.49	0.0008	0.1107
Chari Baguirmi	578 425	0.0524	4492.72	0.0105	0.2011
Baguirmi	209 721	0.0190	2245.86	0.0053	0.2772
Chari	182 903	0.0166	1347.51	0.0032	0.1907
Loug-Chari	185 801	0.0168	899.34	0.0021	0.1253
Lac	433 790	0.0393	4013.57	0.0094	0.2395
Mamdi	222 899	0.0202	2800.39	0.0066	0.3252
Wayi	210 891	0.0191	1213.17	0.0028	0.1489
Logone Occidental	689 044	0.0624	55969.44	0.1312	2.1029
Lac Wey	331 496	0.0300	27951.96	0.0655	2.1829
Dodjé	106 362	0.0096	8385.58	0.0197	2.0410
Gueni	92 014	0.0083	8451.11	0.0198	2.3777
Ngourkosso	159 172	0.0144	11180.78	0.0262	1.8185
Kanem	333 387	0.0302	1751.36	0.0041	0.1360
Kanem	153 176	0.0139	1045.48	0.0025	0.1767
Nord-Kanem	90 965	0.0082	348.49	0.0008	0.0992
Wadi-Bissam	89 246	0.0081	357.38	0.0008	0.1037
Mayo Kebbi Est	774 782	0.0702	4981.81	0.0117	0.1665
Mayo-Boneye	235 968	0.0214	1589.82	0.0037	0.1744
Kabbia	228 834	0.0207	395.76	0.0009	0.0448
Mayo-Lemié	82 051	0.0074	384.86	0.0009	0.1214
Mont Illi	227 929	0.0206	2611.37	0.0061	0.2966
Moyen Chari	588 008	0.0533	16301.63	0.0382	0.7177
Barh Koh	306 775	0.0278	10180.97	0.0239	0.8592
Grande Sido	107 038	0.0097	3825.41	0.0090	0.9252
Lac Iro	174 195	0.0158	2295.24	0.0054	0.3411
Salamat	302 301	0.0274	6689.82	0.0157	0.5729
Barh Azoum	182 207	0.0165	3292.21	0.0077	0.4678
Aboudéia	64 679	0.0059	2848.90	0.0067	1.1403
Haraze Mangueigne	55 415	0.0050	548.70	0.0013	0.2563
Tandjilé	661 906	0.0600	22490.17	0.0527	0.8796
Tandjilé Est	254 635	0.0231	8996.06	0.0211	0.9146

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Table A3 Continued

Regions/Counties	Population	Demographic weights	Oil revenues (million CFA francs)	Oil shares	Ratio
Tandjilé Ouest	407 271	0.0369	13494.10	0.0316	0.8578
Barh-El-Gazal	257 267	0.0233	2613.71	0.0061	0.2630
Barh-El-Gazal Sud	195 376	0.0177	1829.59	0.0043	0.2424
Barh-El-Gazal Nord	61 891	0.0056	784.11	0.0018	0.3280
Ennedi	167 919	0.0152	21542.58	0.0505	3.3213
Ennedi	60 617	0.0055	20889.15	0.0490	8.9214
Wadi Hawar	107 302	0.0097	653.43	0.0015	0.1577
Tibesti	25 483	0.0023	9359.59	0.0219	9.5085
Tibesti Est	14 387	0.0013	9098.22	0.0213	16.371
Tibesti Ouest	11 096	0.0010	261.37	0.0006	0.6098

Source: From CCSRP (2012) and INSEED (2013). Note: In absence of data on oil revenues redistribution within the capital city N'Djamena, this region is considered as a county and its ratio greater than 1

Table A4: Determinants of poverty – dependent variable $\ln(y/z)$ $\ln(y/z)$

Characteristics	Variables under characteristics	Group A (NA = 3796)		Group B (NB = 5463)		National level (N = 9259)	
1. Demographic characteristics of the household (head)	Household size	- 0.081	(0.008)***	- 0.092	(0.007)***	- 0.088	(0.005)***
	Sex	0.033	(0.055)	- 0.019	(0.044)	- 0.009	(0.034)
	Age	0.001	(0.007)	- 0.014	(0.005)***	- 0.009	(0.004)**
	Age2/100	- 0.005	(0.007)	0.011	(0.005)**	0.005	(0.004)
	Couple	0.041	(0.056)	- 0.037	(0.050)	0.009	(0.037)
2. Educational status of the household (head)	Primary education	0.067	(0.048)	0.135	(0.037)***	0.102	(0.030)***
	Secondary education	0.192	(0.066)***	0.303	(0.055)***	0.244	(0.044)***
	Higher education	0.368	(0.056)***	0.507	(0.088)***	0.396	(0.045)***
3. Labour market status of the household (head)	Unemployed	- 0.045	(0.071)	- 0.016	(0.063)	- 0.014	(0.049)
	Self-employed	0.043	(0.054)	0.021	(0.041)	0.043	(0.033)
	Wage-earner	0.090	(0.056)	0.216	(0.060)***	0.164	(0.040)***
4. Wealth status of the household	Land	0.010	(0.003)**	0.007	(0.002)***	0.007	(0.002)***
	Houses	0.012	(0.006)*	0.020	(0.004)***	0.016	(0.003)***
	Livestock	0.012	(0.004)***	0.014	(0.002)***	0.013	(0.002)***
5. Access to public services	Time to water	- 0.001	(0.001)	- 0.000	(0.000)	- 0.000	(0.000)
	Time to health	- 0.000	(0.000)	- 0.001	(0.000)***	- 0.001	(0.000)***
6. Characteristics of the living environment of the household	Urban	0.476	(0.052)***	0.308	(0.027)***	0.359	(0.025)***
	Schooling	- 0.711	(0.134)***	- 0.613	(0.077)***	- 0.535	(0.065)***
	Poverty	- 1.876	(0.203)***	- 2.079	(0.139)***	- 1.819	(0.119)***
	Unemployment	0.770	(0.293)***	0.625	(0.256)**	0.411	(0.191)**
	Agriculture	0.281	(0.146)*	0.106	(0.096)	0.039	(0.082)
Constant		1.049	(0.197)***	1.588	(0.131)***	1.371	(0.112)***

Source: From ECOSIT3. Note: The robust standard errors are reported in the parentheses. ***, ** and* indicate the significance levels at 1, 5 and 10% respectively. Group A is the reference group of comparison

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