Poverty and inequalities profile in Sudan
2009 - 2015

GROUPE DE LA BANQUE AFRICAINE
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Acknowledgement

This "*Poverty and Inequalities Profile in Sudan*" Report is based on the results of the National Baseline Household Budget Surveys conducted by Sudan's Central Bureau of Statistics (CBS) in 2009 and 2014 as part of the implementation of the Sudan Poverty Reduction Strategy. Both surveys were conducted with the financial support of the African Development Bank, with technical assistance provided by the Statistics Department (ECST) and the Gender, Women and Civil Society Department (AHGC).

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Introduction

Tackling poverty remains one of the most important challenges on the Sudanese development agenda. In 2012, Sudan adopted an Interim Poverty Reduction Strategy that seeks to reduce poverty through rapid and sustainable inclusive economic growth. The strategy is clustered around four broad pillars: (i) promoting economic growth and job creation, focusing on agriculture and infrastructure; (ii) developing human resources, emphasizing education, health and social protection; (iii) reintegrating IDPs and other displaced populations; and (iv) strengthening governance and institutional capacity of the public sector, focusing on human rights, peace and security, decentralization and public financial management.

Such a strategy reflects a need to progressively move on from earlier development visions to a new inclusive trajectory of the economy. The new development model is expected to focus on generating inclusive growth, and should ideally be oriented towards use of technology and skilled workers. This new vision will also rest on new distributional mechanisms which should create new momentum for development of remote regions and succeed at reducing spatial disparities.

Sudan is called upon to initiate a number of economic and social reforms in order to place the country onto a new development trajectory. It must establish new institutional and organizational foundations to better combat poverty, reduce inequality, and guarantee, above all, the fundamental rights of the population.

However, it is important to emphasize that both the success and durability of any new development vision depends in part on the capacity of the country to guarantee propitious conditions for the development of disadvantaged people and enhance their capacity to accumulate human capital, and most especially to break the vicious circle of intergenerational transmission of poverty. Initiating such a process requires that we establish objective diagnostic tools of the current living conditions faced by the Sudanese population and understand the dynamics and determinants of poverty and inequality.

Using data from the 2015 National Baseline Household Survey, this report aims to build a profile of monetary poverty and inequality, and to analyze disparities between different socioeconomic groups. Knowing the levels and extent of deprivation of individuals, their characteristics and determinants are indispensable for the design and implementation of adequate and effective policies to combat poverty and social exclusion.

More specifically, the report addresses the following objectives with particular emphasis on the analysis of different social welfare measures from regional and gender perspectives. This will be done by:

- Estimating a comparable national poverty line between 2010 and 2015;
- Using best international and methodological practices to measure and analyze poverty and inequality across population subgroups;
- Identifying the determinants of poverty and inequality with a special focus on the role of household income structure in the observed level of inequality.

The report is organized into six sections. Section 1 presents the socioeconomic context of Sudan and draws attention to the principal challenges faced by the Sudanese economy. The trends of poverty and inequality over the 2010-2015 period are presented in section 2. Section 3 presents the poverty profile and its main determinants. Section 4 focuses on consumption inequality and its decomposition across population subgroups. Section 5 analyzes income inequality from gender and regional perspectives. We conclude the report with the principal messages flowing from our analysis and make recommendations for future policies.

I. Socioeconomic Context of Sudan

1.1. Demographic structure:

The demographic structure of the Sudanese population, estimated at 41 million in 2017, hasn't experienced major changes over recent decades. The population growth rate has declined from its historic high of 3.8% in 1992 to nearly 2.4% in 2018. This trend is mainly due to the decline in the fertility rate of women from 6 children to less than 4.5 children during the same period. The improvement in health services have significantly contributed to amelioration of the health status of the population by reducing the prevalence of disease and malnutrition. According to UNICEF data and world development indicators from the World Bank[1], life expectancy at birth rose to 64.5 years in 2016 from 57 years in 1996. Infant mortality fell from 106 to 44 per 1000 live births during the period 1960-2017.

Table 1 presents the demographic structure by age group between 1965 and 2015. Sudan has young population with a low median age of 19 years. The share of the population under 15 years slightly declined from 45.7% in 1965 to about 41.5% in 2015, while the share of elderly remained constant at around 3%. Most children are of school age, between the age of 5 and 14. As shown in Table 1, the working age population aged 15-64 increased only by 4 percentage points, going from 51.2% to 55% over the same period.

About two-thirds of the Sudanese population lives in a rural area. The Darfur region alone accounts for about 25% of the population, followed by the central region (Gezira, White Nile, Sinnar, and Blue Nile) with 23%, and Kharthoum with 17% of the population. The rest of the population lives in Kordofan (14%) and the Eastern and Northern regions.

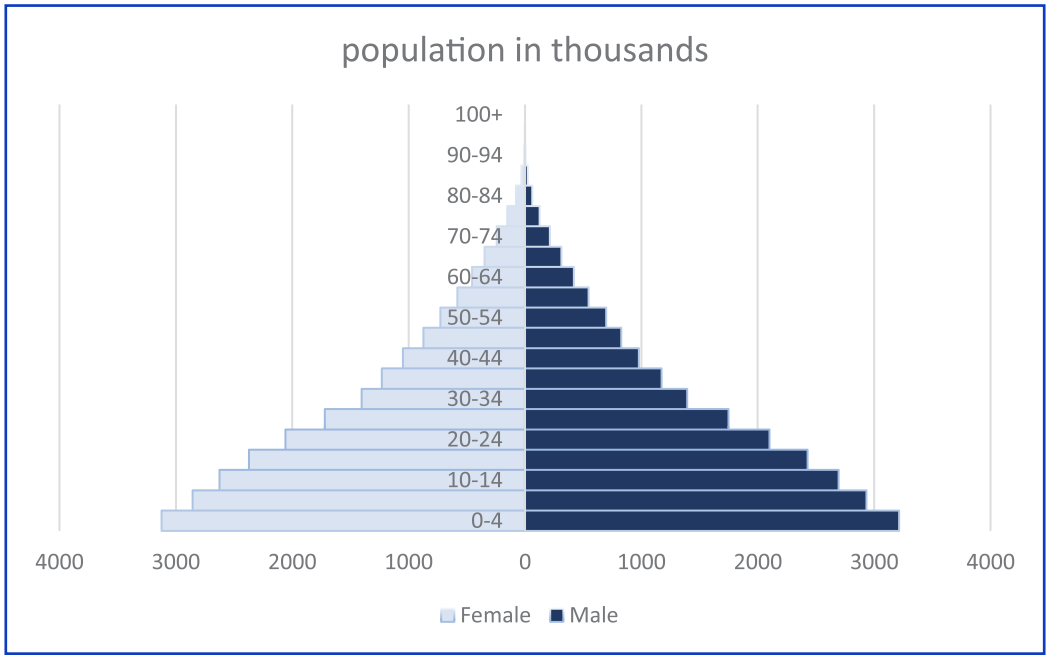
Table 1: Evolution of the demographic structure of the population by age.

year	0-4	5-14	15-24	25-49	50-64	65+	Total
1965	18.8	26.9	18.5	25.8	6.9	3.1	100.0
1970	19.1	27.2	18.6	25.3	6.8	3.0	100.0
1975	19.2	27.7	18.7	24.8	6.7	3.0	100.0
1980	19.0	28.1	18.8	24.6	6.5	2.9	100.0
1985	18.3	28.3	19.3	24.7	6.4	2.9	100.0
1990	17.5	28.0	20.0	25.2	6.4	2.9	100.0
1995	17.3	26.8	20.0	26.3	6.5	3.0	100.0
2000	17.1	26.7	19.9	26.6	6.6	3.1	100.0
2005	16.7	26.8	19.4	27.2	6.8	3.1	100.0
2010	16.1	26.9	19.3	27.3	7.1	3.3	100.0
2015	15.2	26.3	20.1	27.5	7.4	3.5	100.0

Source: United Nations, World Population Prospects: The 2017 Revision, DVD Edition.

[1] See https://data.unicef.org/country/sdn/ and https://data.worldbank.org/country/sudan

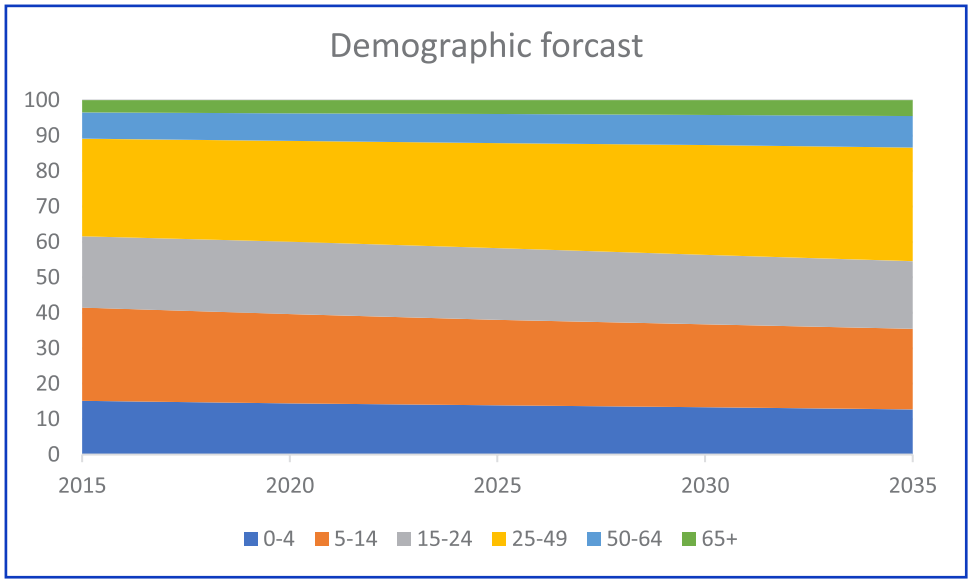
Figure 1: Population pyramid in 2018



Source: United Nations, World Population Prospects: The 2017 Revision, DVD Edition.

At a constant fertility behaviour, the statistical forecast performed by the United Nations in 2015 shows that demographic pressures will persist until 2035. As shown in Figure 1, the country has not experienced a real demographic transition. Moreover, the share of the population aged 25-49 years (generally the most active group in the labour market) will increase from 27.5% to about 32% by 2035 (see Figure 1). The demographic structure presented in Figure 1 (through the population pyramid) and the projections of population change for the next fifteen years to 2035 (see Figure 2), suggest that population pressures will remain fairly high. Sudan will face quite significant challenges in terms of investing in children (particularly in ensuring adequate health and education services) and also the need to create new employment opportunities while taking into account the changing nature of jobs to be created and the future of work.

Figure 2: Demographic forecast 2015-2035



Source: United Nations, World Population Prospects: The 2017 Revision, DVD Edition.

We are aware that well-being is a multidimensional concept and touches on many aspects related to living conditions that require an in-depth examination of the living conditions of vulnerable groups such as children. However, this report focuses mainly on income poverty in Sudan based on Household Budget Survey data.

1.2. Economic context

Despite positive growth rates, averaging 3%, over the recent period 2013-17, the Sudanese economy struggles to move onto higher and steady growth path. The country level economic situation remains challenging in particular with a difficult external environment, loss of oil production, and limited access to external financing. Oil revenues declined from 1.9% to 0.8% of GDP over the period 2013-2017. Public debt grew from 84.4% to 99.6% of the GDP during the same period and is expected to reach 102.9% in 2018. International reserves remain at a very low and critical level of around 1.4 month of total imports in 2017 (about 1 billion US $). The trade balance deficit improved by 2 percentage points from -6.8% to -4.9% of GDP, but international trade remains modest as reflected by the declining trend of exports and imports of goods (see Table 2 for selected economic indicators).

Under such economic settings inflation pressures remain high varying from 36.5% in 2013 to 29.8% in 2017 with a significant decrease recorded in 2015-2016 of around 17% mainly due to weaker demand and restrictions on imports of non-essential goods. Sudan's banking sector is underperforming as a source of financing the economy. Unsurprisingly, given internal and external environments, the ratio of banking credit to GDP has ranged between 17 to 29% except in 2017 where it was 40%. Such performance is clearly weak compared to regional and international standards.

Table 2: Selected Economic Indicators, 2013–18

	2013	2014	2015	2016	2017	2018
Annual change in %						
Real GDP (market prices)	**2.2**	**3.2**	**3**	**3.5**	**3.2**	**4**
Consumer prices index (yearly average)	36.5	36.9	16.9	17.8	29.8	23
In percent of GDP						
Revenues except grants	9.7	10.3	9.7	8.4	8.3	8.4
Of which oil revenues	1.9	2.1	1.5	0.8	0.8	0.7
Tax revenues	6	5.5	5.6	5.3	5	5.3
Expenditures	12.5	12.1	11.7	10.3	10.3	10.6
Wage bill	4.5	3.5	3.4	3.5	3.4	3.6
Subsidies	2.4	2.3	2.3	1.2	1	0.8
Transfers	3	2.7	2.4	2.3	2.3	2.4
Public debt	84.4	90.2	90.5	116.2	99.6	102.9
Credit to the economy (in % GDP)	23.2	17.6	20.8	26.5	40	28.9
Exports (in US$, annual percentage change)	-4.4	-9.4	-28.5	-2.6	9.8	3.3
Imports (in US$, annual percentage change)	2.3	-7	3.1	-12.5	-12.7	12.2
Merchandise trade balance in % GDP	-6.8	-5.9	-8.1	-7.3	-4.9	-5.9
International reserves (in millions USD)	1612	1461	1003	875	970	830
Reserves in months of next year imports	1.9	1.7	1.4	1.4	1.4	1.1
Nominal GDP (in billions of SDG)	331.8	452.5	541	660	917	1145

Source: IMF (2017)

The Sudanese authorities are striving to work on several fronts, mainly by improving the business climate, adopting greater exchange flexibility, and rationalizing public expenditure and fiscal consolidation to stabilize macroeconomic indicators toward strong, sustained and more inclusive growth. Improvement of the external economic environment, after a revocation of U.S. sanctions, would facilitate commitment to reform and increase the chances of unleashing the economic potential of the country.

II. Poverty and Inequality Trends since 2010

Using the most recent household surveys, the section presents an overview of evolution of both poverty and inequality between 2010 and 2015 based on aggregate consumption. Furthermore, we assess the extent to which changes in poverty are due to variations in the distribution of living standards.

2.1. Methodological considerations

Data source

Analyses presented in this report are based on the 2014/15 National Baseline Household Budget Survey (NBHBS). The survey, conducted by Sudan's Central Bureau of Statistics (CBS), is the fourth in this series of similar surveys undertaken by the CBS. The survey provides detailed information on households' socioeconomic characteristics, consumption patterns and incomes. The 2014/15 survey is based on a sample of 11,953 households surveyed during three rounds of data collection and is representative nationally and for each of 18 Sudanese states.

The NBHBS is a two-stage stratified survey. In the first stage, a 684 primary sampling unit (PSU) was drawn proportionally to their respective population sizes (number of households). In the second stage, an average of 20 households was randomly sampled within each PSU. Table 3 below gives the distribution of the sample across states.

Table 3: Distribution of primary sampling unit by state

State	Primary Sampling Unit (PSU)	State	Primary Sampling Unit (PSU)
Northern	30	Blue Nile	50
River Nile	30	North Kordofan	50
Red Sea	40	South Kordofan	30
Kassala	30	West Kordofan	40
Al-gadarif	29	North Darfur	27
Khartoum	50	West Darfur	49
Al-gezira	30	South Darfur	40
White Nile	40	Central Darfur	50
Sinnar	30	East Darfur	39
Total		**684**	

Source: AfDB Statistics Department

Calculating welfare indicator

As in many developing countries, Sudanese poverty analysis uses household consumption as the key welfare indicator. First, household consumption, defined here as the sum of yearly expenditures, better reflects population living standards than income, given that individuals' well-being is defined in terms of consumed goods. Second, large fluctuations in income may have small welfare effects if households can smooth their consumption against transitory variations or shocks. Hence, consumption might provide more reliable pictures of long-term individual welfare. Third, in countries with relatively substantial informal economic activities it is easier to observe consumption than income. According to the 2014-2015 National Baseline Household Budget Survey (NBHBS), the consumption aggregate captures both food and non-food consumption. The non-food consumption captures expenditures on: (1) Housing, water, electricity, gas and other fuels, (2) Clothing and footwear, and Furnishings, household equipment, (3) Health care, (4) Transport, (5) Communications, (6) Recreation and culture, (7) Education, (8) Restaurants and hotels, (9) Miscellaneous goods and services. The recall periods of these items are 1 to 12 months. All spending on non-food goods and services is converted into yearly expenditures. An individual welfare indicator is defined using the per capita household consumption.

Setting the poverty lines

Having defined the welfare indicator, the crucial step is to define poverty lines that identify the poor population. Several methods have been used in the literature to define the poverty lines in a relative or absolute way. While most developed countries follow the relative approach whereby poverty lines have often been set as a proportion—generally around 60%—of the median income, in this report we use an absolute approach and we estimate a monetary threshold that corresponds to the minimum consumption needed to meet individuals' basic needs. Specifically, the estimated poverty lines are the sum of the food poverty line, which represents the cost of a food bundle that provides 2110 kilocalories per day—considered as the minimum required caloric intake for good health and normal activity levels—and an additional allowance for non-food needs.

To take into account differences in the cost of living across areas, specific poverty lines are estimated for urban and rural areas. Based on the 2014-15 NBHBS, the food poverty line was estimated at 2,966 SDG and 2,698 SDG for urban and rural areas, respectively.

Once the food poverty line (FPL) is defined, the next step is to estimate the expected average cost of a basket of basic non-food goods to obtain the total poverty line. For this purpose, we define a lower (extreme) poverty line which is equal to the FPL plus the average non-food consumption of households whose total per capita consumption is close to the food poverty line.

Formally, we have $LPL=FPL/((1-\alpha)$, where ***LPL*** denotes the lower poverty line, ***FPL*** is the food poverty line, and α the share of non-food per capita consumption. Similarly we define a higher (global) poverty line which is equal to the sum of the FPL and non-food consumption of households whose food consumption per capita is exactly equal to the food poverty line. Unlike the extreme poverty line, the global poverty line assumes that households are able to cover 100% of their basic food needs.
Table 4 below gives the estimated poverty lines by type of area.

Table 4 : *Poverty lines* per capita and per year in *SDG: Sudan* 2014-2015

Area	Food poverty line	Extreme poverty line	Global poverty line
Urban	2,966	4,124	5,110
Rural	2,698	3,605	4,044

Source: AfDB Statistics Department

Re-estimating the poverty lines for 2009/10 survey.

Consistent temporal comparisons of poverty should be based on constant poverty lines in terms of standard of living; that is, poverty lines that provide the same purchasing power to households regardless of the period of analysis. This can be easily done by adjusting the estimated poverty lines for a given period by the appropriate consumer price indices (CPI). For the present case study, we use the official Consumer Price Index (CPI) to deflate the estimated thresholds in 2014/15 and update the 2009/10 poverty lines. This approach gave values close to those of the re-estimation of poverty lines from the raw data of the 2009/10 survey using a basic needs approach. The values of the poverty lines for 2009/10 are given in Table 5.

Table 5: Poverty lines per capita and per year in SDG: Sudan 2009-2010

Area	Food poverty line	Extreme poverty line	Global poverty line
Urban	845	1160	1356
Rural	758	1030	1173

Source: AfDB Statistics Department

Poverty Measures:

Poverty assessment in Sudan is based on the following poverty measures proposed by James Foster, Erik Thorbecke, and Joel Greer in 1984:

1. Incidence of poverty: It estimates the proportion of the population living below the poverty line.
2. Poverty gap (depth of poverty): It provides the mean consumption gap (shortfall) relative to the poverty line. In other words, it indicates how far, on average, individuals' consumption is from the poverty line, expressed in percentage.
3. Squared poverty gap (severity of poverty). It estimates the average gap relative to the poverty line giving greater weight to those who are further below the poverty line.

Formal definitions of these poverty measures are given in appendix A.

Consumption level and structure across regions

Table 6 presents the average per capita expenditures at national and regional levels.
For simplicity, the 18 states are grouped into 6 regions namely: Northern, Eastern, Khartoum, Central, Kordofan, and Darfur[2]. The Khartoum and Northern regions have the highest per capita expenditure levels in Sudan, respectively of 7799 and 6888 SDG per year. The lowest expenditure levels are observed in Darfur (4912 SDG)

[2] Northern region: Northern River Nile. Eastern region: Red Sea, Kassala, Gadarif. Khartoum region: Khartoum. Central region: Gezira, White Nile, Sinnar, Blue Nile. Kordofun region: North, South, and West Kordofan. Darfur region: North, West, South, Central, and East Darfur.

and Kordofan (5259 SDG), significantly below the national average (6082 SDG).

Regardless the region of residence, the largest share of expenditures is devoted to foods, which represent about 60% of total expenditures. Unsurprisingly, the poorest region spends relatively more on foods than the richest one. The main expenditure categories, other than food are: health care, transport & communication, energy and housing with respective share at the national level of: 6%, 6.3%, 3.6%, and 3.2%.

Table 6: per capita consumption by region (SDG)

Region	Food	Education	Health care	Clothing	Utilities	Transport commu	Personal care	Housing	Recreation	Other	Energy	Total
Northern	4026	103	450	213	41	447	219	262	38	28	261	6888
Eastern	3808	53	295	168	171	326	149	168	41	58	278	6054
Khartoum	3900	249	444	146	56	734	217	319	55	73	224	7799
Central	3899	81	447	149	90	328	175	184	51	24	271	6238
Kordofan	3322	61	304	137	146	267	154	150	44	28	188	5259
Darfur	3134	96	272	181	93	281	168	143	62	29	139	4912
Total	**3638**	**108**	**365**	**161**	**102**	**386**	**177**	**196**	**51**	**39**	**221**	**6082**

Source: AfDB Statistics Department

Table 7 shows that the national average per capita consumption in urban areas is 7149 SDG, clearly higher than the rural average, estimated at 5509 SDG. The consumption level in urban areas is 30% higher than the rural average. When we look at regional statistics, the average consumption is always higher in urban areas compared to rural ones. Data from Table 7 shows that the rural areas in Kordofan and Darfur seem to be the most deprived regions in Sudan with average per capita consumption about 4949 and 4450 SDG, which represent respectively 81% (4949/6082) and 73% (4450/6082) of the national average. Another interesting feature is that the gap between urban and rural areas varies considerably across regions. Indeed the in Northern region it is about 6% (7206/6780) compared to 40% (6264/4450) in the Darfur region.

Under the assumption of normal distribution of per

capita consumption, we expect that the average consumption level in the 3rd quintile should be very close to the global consumption average. Table 7 shows that in all regions, as well as for the whole country, the average consumption is consistently lower than the average consumption of the third quintile. These results suggest that the consumption distribution is positively skewed (skewed to the right) as most of the population (about 60%) report a consumption level below the average. Such patterns are observed both in rural and urban areas.

The results reported in Table 7 give a first look at the distribution of living standards across the Sudanese regions for the different population categories. Overall, the Northern and Khartoum region seems to have by far the highest living standards compared to the rest of the country.

Table 7: Per capita consumption by urban/rural residence

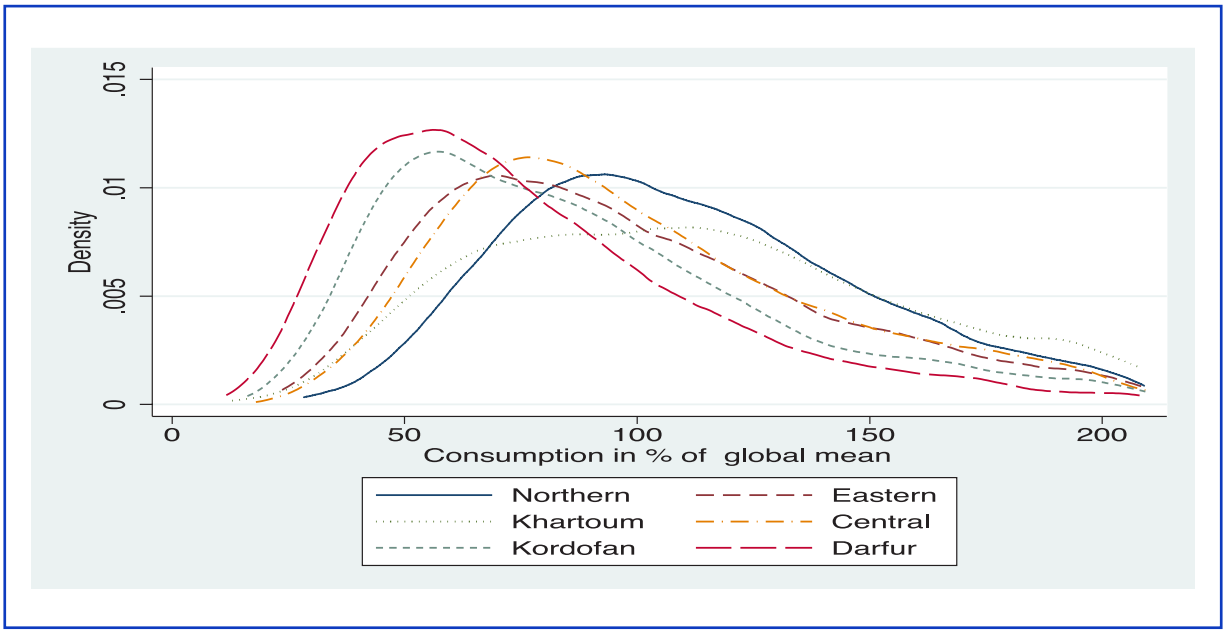
Urban area							
	Northern	Eastern	Khartoum	Central	Kordofan	Darfur	Sudan
Quintile 1	4025	3225	3164	3325	2957	2724	3113
Quintile 2	5397	4360	4871	4780	4437	4140	4610
Quintile 3	6547	5486	6611	5989	5756	5339	6024
Quintile 4	7975	7232	8814	7803	7350	7006	7956
Quintile 5	12239	11768	16545	12688	11877	12174	14054
Total	7206	6404	7993	6906	6452	6264	7149
Rural area							
	Northern	Eastern	Khartoum	Central	Kordofan	Darfur	Sudan
Quintile 1	3568	2871	3367	3176	2418	2122	2594
Quintile 2	4967	3993	4786	4349	3347	3073	3775
Quintile 3	5973	5169	6195	5321	4306	3918	4840
Quintile 4	7575	6577	7846	6708	5570	4988	6198
Quintile 5	11843	10836	12586	10665	9111	8156	10143
Total	6780	5882	6937	6039	4949	4450	5509
Both							
	Northern	Eastern	Khartoum	Central	Kordofan	Darfur	Sudan
Quintile 1	3669	2963	3196	3199	2498	2230	2732
Quintile 2	5054	4130	4843	4435	3488	3258	4018
Quintile 3	6117	5268	6529	5459	4573	4206	5196
Quintile 4	7682	6748	8585	6922	5942	5459	6773
Quintile 5	11952	11180	15853	11186	9814	9413	11695
Total	6888	6054	7799	6238	5259	4912	6082

Source: AfDB Statistics Department

Figure 2 presents the estimated densities of per capita consumption by region. Results show that data rank the different regions clearly by consumption level, except perhaps the difference between Central and Eastern regions. Consumers below the average are clearly ranked by the region of residence from the lowest (Darfur), followed by the Kordofan, Eastern, Central, and Khartoum states and the highest is in Northern state). The same ranking is observed for consumers above the average except that there is no clear difference between Central and Eastern regions, as their respective density curves collapse.

These results indicate that in the absence of significant spatial price variations, comparisons of poverty between these regions will not be very sensitive to the choice of poverty lines. For some poverty thresholds which are moderately low, or close to the standard of living of the first quintile, the incidence of poverty will be higher in Darfur and Kordofan. Below, we will discuss a more detailed analysis across different regions and states.

Figure 3: Densities of per capita consumption by region

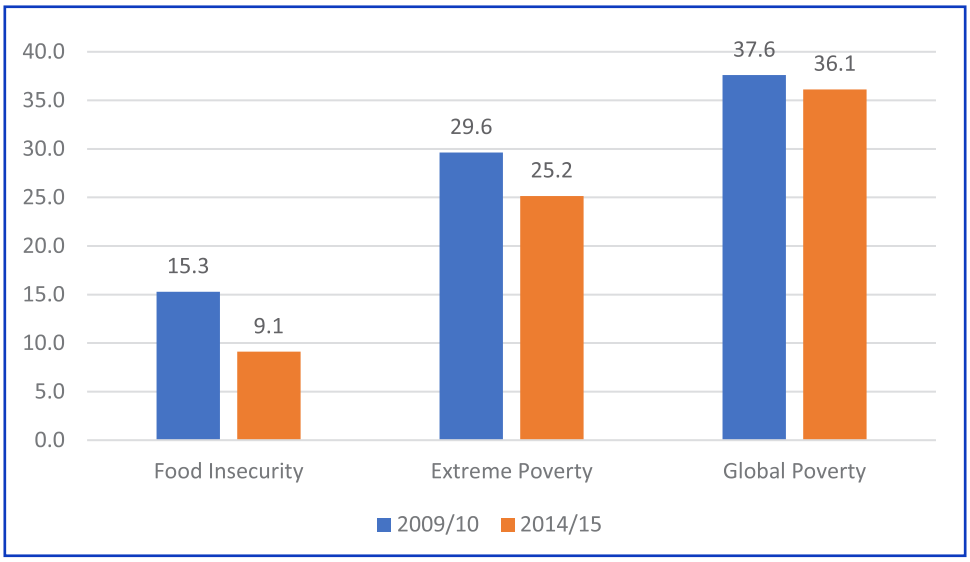


Source: AfDB Statistics Department

2.2. Poverty trend since 2010

Poverty declined slightly by about 1.5 percentage points between 2010 and 2015. When we consider global poverty, here referring to the upper poverty line, Sudan's poverty incidence declined from 37.6 percent in 2010 to 36.1 percent in 2015. About 14 million of the population of Sudan are poor with yearly per capita consumption below the poverty line estimated at 5,110 SDG and 4,044 in urban and rural areas, respectively. While the difference seems very low it is statistically significant at the 95% confidence level.

Figure 4: Poverty indicator trends, 2010-2015

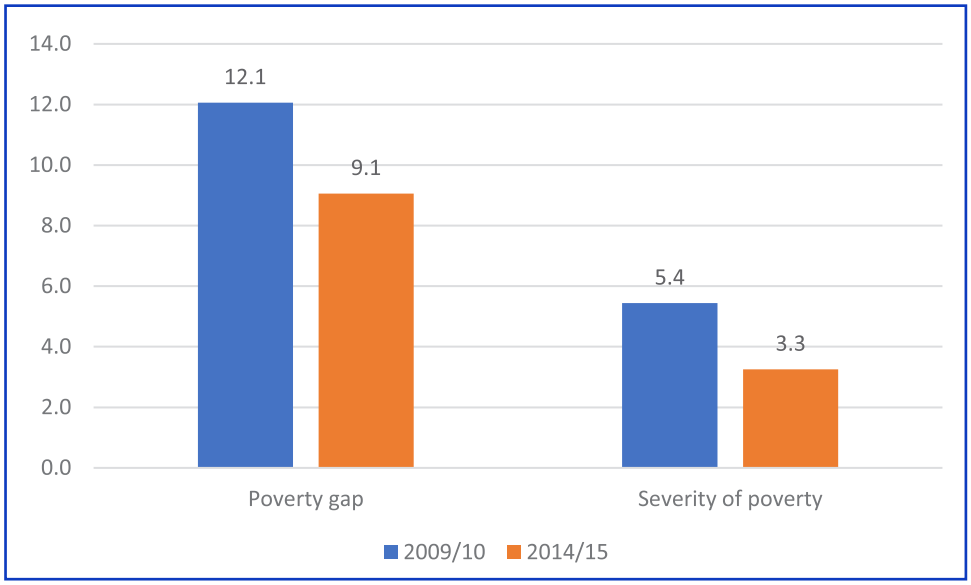


Source: AfDB Statistics Department

Extreme poverty and food insecurity incidence fell sharply between 2010 and 2015. In this report, the food poverty line is used to measure food insecurity, which characterizes households whose per capita consumption level is below the food poverty line. Such deprivation is the most severe form of poverty. Indeed, households living below the food poverty line face a problem of acute food insecurity as they are unable to meet their basic food needs even if they devote all their available resources to purchase foods. As shown in Figure 3, more significant progress has been achieved in reducing food insecurity and extreme poverty. The proportion of the population that cannot afford enough food to meet their minimum nutritional requirements (even if they devote all their available resources to food consumption) declined from 15.3 to 9.1 percent, falling by around 6 percentage points. Extreme poverty was also significantly reduced from 29.6 to 25.2 percent.

Clear improvement of living conditions of the poor. As shown in Figure 4, the depth and severity of poverty declined more sharply than the poverty incidence, suggesting that poor populations were able to improve their living standards relative to the poverty line. The poverty gap (depth of poverty) declined from 12.1% to 9.1% between 2010 and 2015. The same trend is observed for severity of poverty (squared poverty gap) with a significant decrease from 5.4% to 3.3% reflecting an improvement of living conditions among the poorest individuals.

Figure 5: Trends in depth and severity of poverty in Sudan



Source: AfDB Statistics Department

Divergent evolution of poverty in rural and urban areas. Table 9 presents the poverty trend by urban/rural residence. Results show that while the poverty incidence in Sudan is declining, its statistical distribution has dramatically changed between 2010 and 2015. Both extreme and global poverty in rural areas drastically decreased by about 10 percentage points, from 36.8% to 26.5% and 45% to 35.5%. Conversely, urban areas saw their global and extreme poverty rates increase by 13 and 6 percentage points. It is noteworthy that food insecurity has been halved in rural areas compared to a slight increase from 6% to 7% in urban areas. Among the 14 million Sudanese people living below the poverty line, 9 million live in rural areas. In a few respects rural populations are worse off, but the gap between urban and rural areas has been narrowed. One of the burning issues that deserves more attention and analysis is the root causes of the deterioration of the living conditions of urban populations. Is the decline observed due to internal migration from the poor to urban areas; or, the deterioration of labour market conditions and functioning, etc.? Unfortunately, the available cross-sectional data do not allow us to understand the details of these profound changes.

Table 8: Poverty measures by urban/rural residence, 2010-2015

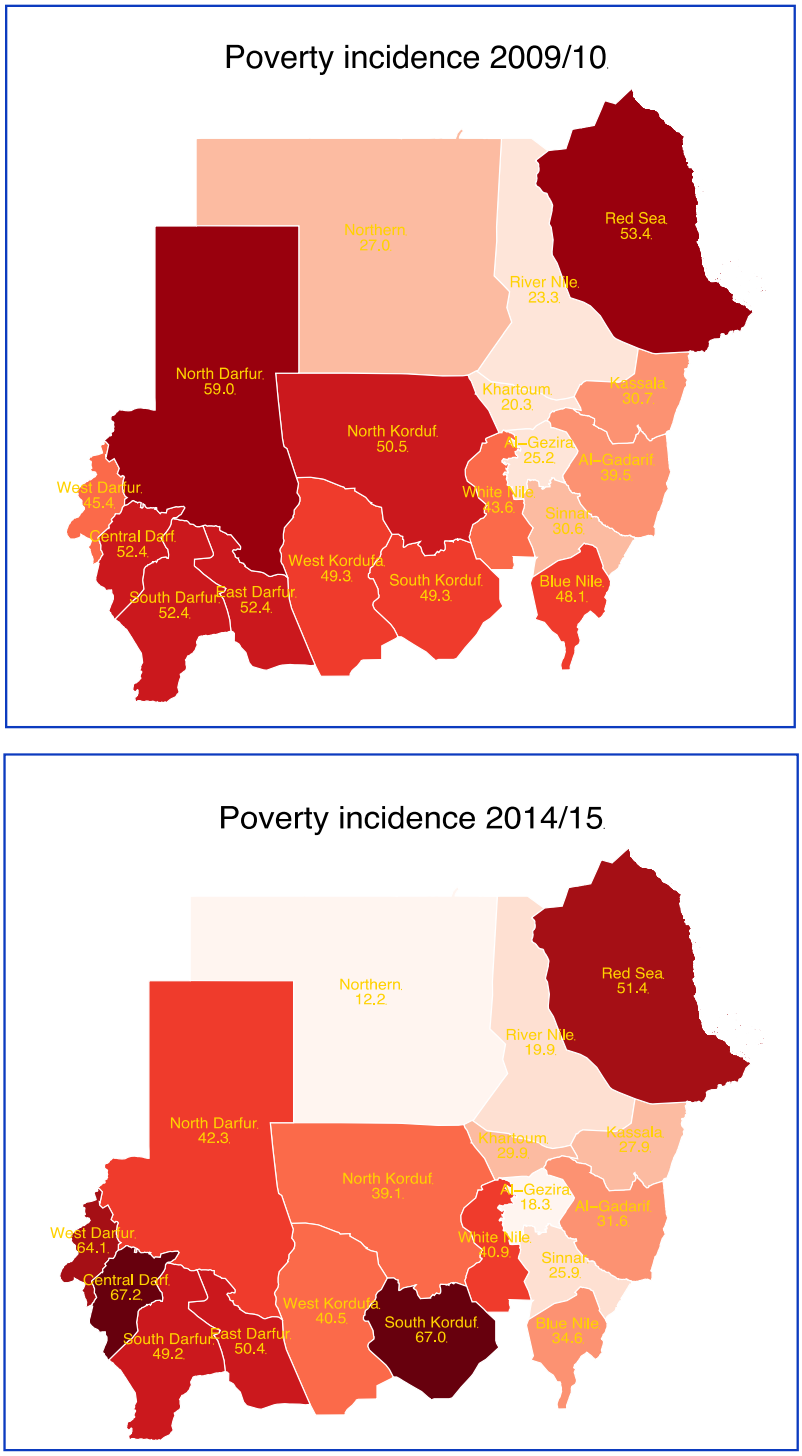
	2009/10			2014/15		
	Rural	Urban	Total	Rural	Urban	Total
Incidence of poverty						
Food poverty	20.4	6.0	15.3	10.2	7.1	9.1
Extreme poverty	36.8	16.7	29.6	26.5	22.6	25.2
Global poverty	45.0	24.3	37.6	35.5	37.3	36.1
Poverty gap						
Food poverty line	5.6	1.1	4.0	1.9	1.3	1.7
Extreme poverty	11.7	3.9	8.9	5.9	5.0	5.6
Global poverty	15.3	6.3	12.1	8.6	9.8	9.1
Severity of poverty						
Food poverty	2.3	0.4	1.6	0.5	0.4	0.5
Extreme poverty	5.3	1.3	3.9	2.0	1.6	1.8
Global poverty	7.2	2.3	5.4	3.0	3.7	3.3

Source: AfDB Statistics Department

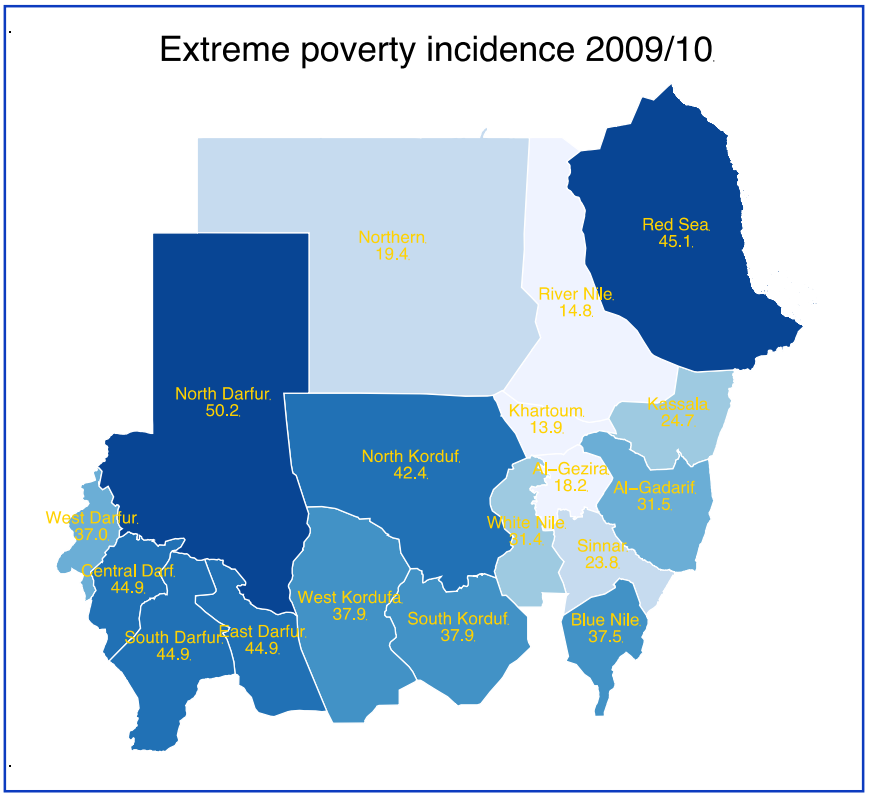
Important regional disparities exist in terms of prevalence and trend of poverty. Overall, western, southern, and Red Sea states are the relatively most deprived regions, compared to northern and eastern states. Figure 5 shows that in South Kordofan, West and Central Darfur about two in three people are poor (more details on regional distribution of poverty below). The most noticeable fact over the period 2010 and 2015 is the spectacular increases in poverty in Central and West Darfur, South Kordofan, and Khartoum states. The poverty incidence in West Kordofan increased from 49.3% in 2010 to 67% in 2015 (about 18 percentage points); the same magnitude of increase was observed in West Darfur state.

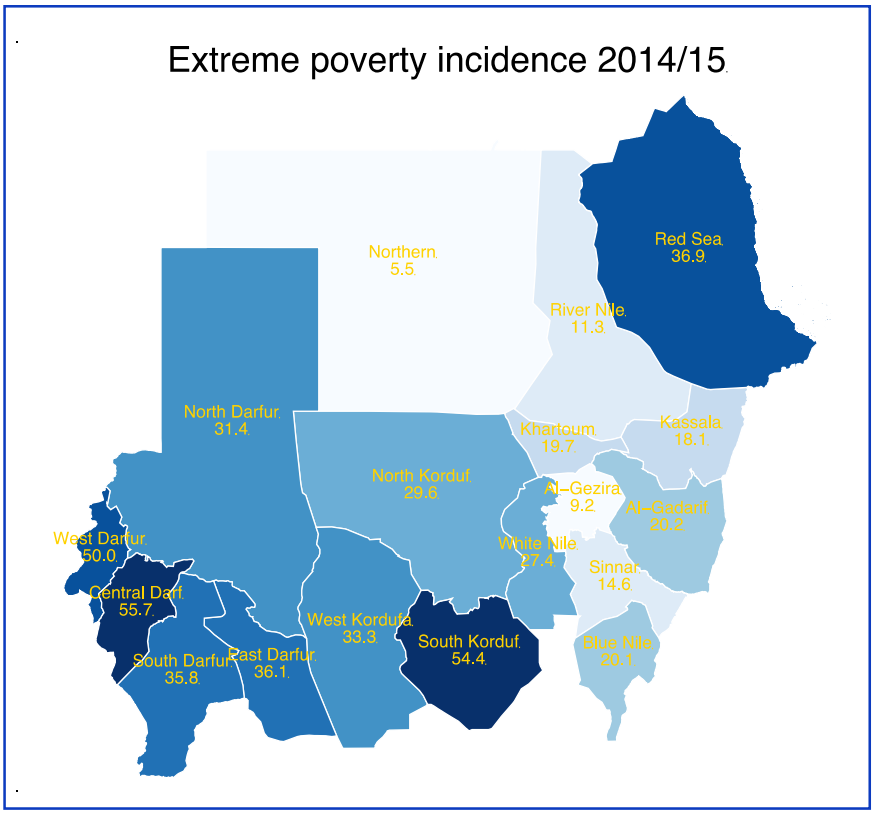
The main message that emerges is that progress in terms of extreme poverty performs better in almost all regions, except in southern regions.

Figure 6: Poverty incidence by state.



Source: AfDB Statistics Department



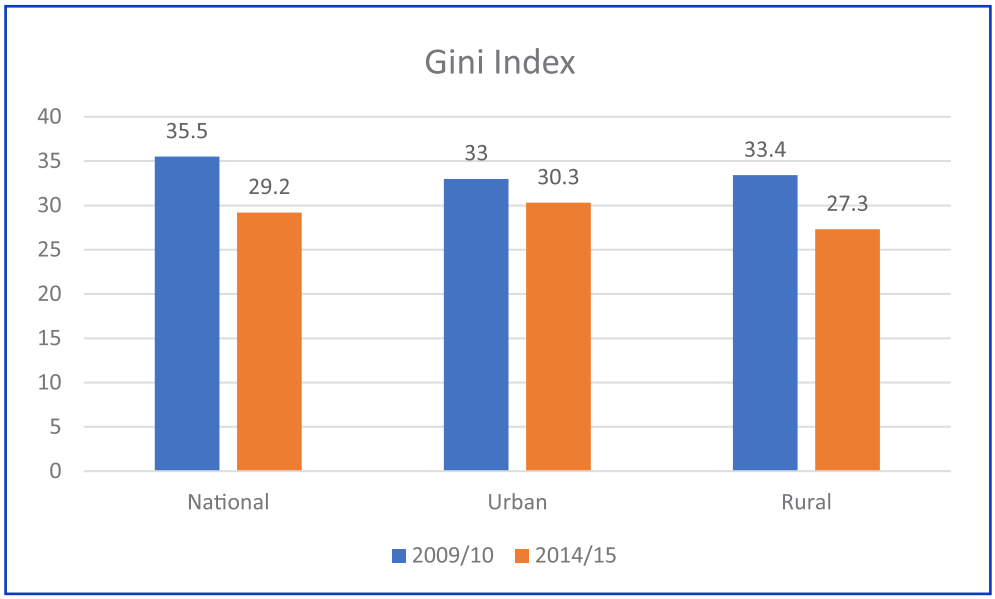


Source: AfDB Statistics Department

2.3. Inequality trend since 2010

Sudan's achievement in reducing inequality and improving the poorest living conditions have been remarkable. In parallel to the decline in poverty incidence (particularly food insecurity and extreme poverty), inequality in Sudan shows a sharp decreasing trend over the 2010-2015 period. The Gini coefficient decreased by 6.3 percentage points from 35.5 to 29.2% (see Figure 6). Inequality improvement was more pronounced in rural than in urban areas. The Gini coefficient[3] decreased from 33.4% to 27.3% in rural areas, compared to an only 3-percentage point decrease from 33% to 30.3% in urban areas.

Figure 7: Gini index 2010-2015



Source: AfDB Statistics Department

It's important to note that such conclusions are insensitive to spatial price variations in both urban and rural areas. Indeed, when using per capita consumption deflated by poverty lines as a welfare indicator to account for the difference of living costs between areas, we observe the same trend of decreasing inequality. Results of Table 9 show the same magnitude of inequality decrease in both rural and urban areas and nationwide.

Table 9: Gini coefficient (deflated welfare indicator by poverty lines)

	2010	2015
Rural	33.4	27.3
Urban	33.0	30.3
Sudan	34.3	28.4

Source: AfDB Statistics Department

[3]The Gini index is the most used indicator for measuring inequality. First, the Gini index is very simple to interpret, since it corresponds to the average distance of all possible pairs of per capita consumption. Secondly, it is derived from the Lorenz curve which measures the cumulative proportion c of consumption held by the poorest proportion p of the population. The Gini index is always between 0 (the case of perfect equality) and 1 (the case of extreme inequality).

The period 2010-2015 witnessed increases of social welfare by about 4%. An additional way to assess the evolution of individual welfare is to rely on a Gini social welfare function. According to the work of Amartya Sen in 1974, social welfare can be assessed by the weighted average of individual income or consumption. The weight of an individual with income x is simply equal to the percentage of persons in the society who are richer than him. Formally, Sen's social welfare function can be written as

$$S = 2\int_0^{\infty} (1 - F(x)xf(x)dx$$

where x denotes the individual's income (consumption) $f(x)$, and $F(x)$ denote respectively the density and cumulative density function of income.
The social welfare function can also be written as

$$W = \mu(1 - G)$$

where μ denotes the the mean income and G is the Gini coefficient which represents the percentage loss of social welfare induced by inequality.

Table 10: Social welfare index, 2010-2015

Year	2010	2015	Relative variation in %
Per capita consumption, current prices	1839.5	6082.1	+230
Per capita consumption, 2015 prices	6420	6082	-5.2
Gini coefficient	35.5	29.2	-17.2
Welfare: W=mu(1-G)	4141	4306	+4

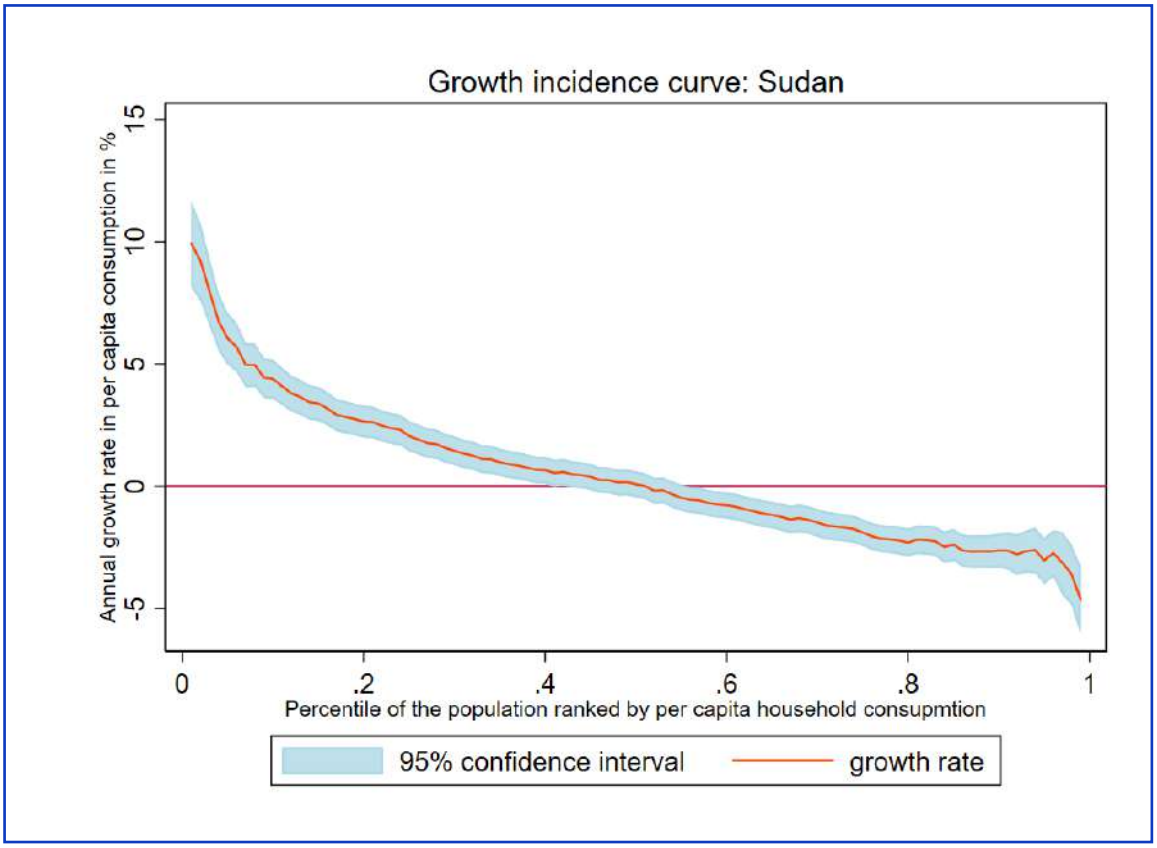
Source: AfDB Statistics Department

Table 10 shows that economic welfare increased by about 4% over the period 2010-2015 despite the decreases in real mean consumption by about 5.2% during the same period. Such a result is due to the improvement in inequality that has offset the consumption decrease.

While the average consumption growth rate has been negative in real terms, averaging -1.07% per year, the poorest population groups have been spared from such a negative trend. Consumption levels improved to some extent for the bottom half of the population, but the improvements were particularly larger among the poorest 10 percent population groups.

As shown in Figure 7, the growth incidence curve (GIC) for 2010-2015, which depicts the annual growth rate in average consumption for each percentile of the distribution, indicates a higher increase in consumption among the poorest 40 percent of the population than among the rest of the population. The curve is also strictly decreasing over all percentiles, implying that inequality fell. The annualized growth rate in per capita consumption is estimated to have been about 10% for the poorest percentile, falling to-4.6% for the richest.

Figure 8: Growth incidence curve 2010-2015

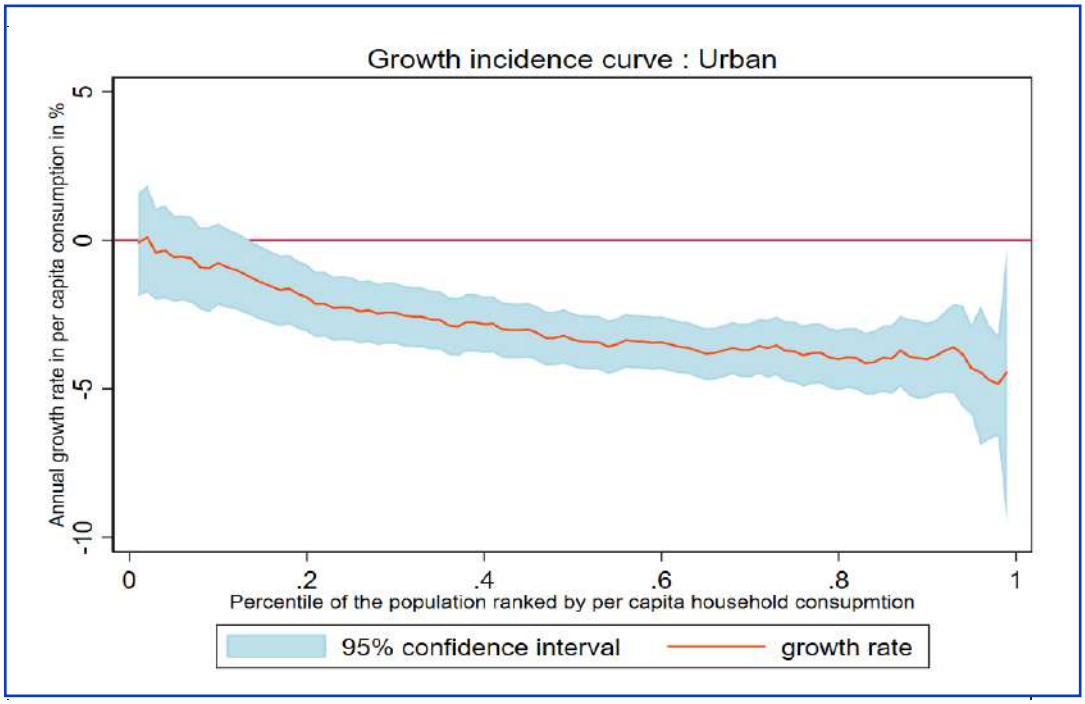


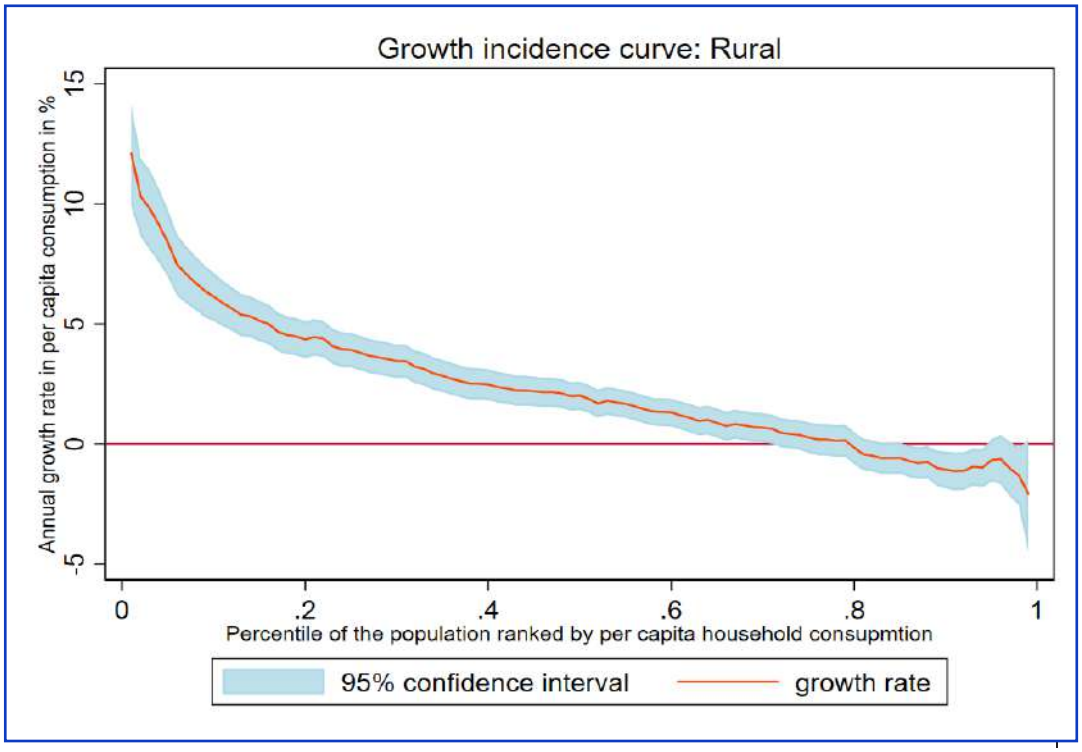
Source: AfDB Statistics Department

While such results suggest that the poor population---estimated to be the 37.6 percent bottom of the population in 2009--- benefited disproportionately more from economic growth, the improvements were not even across all poor individuals. Figure 4 shows that the poorest decile (poorest 10%) saw the most important increase in their consumption with an average annual increase of about 6.2%, while the second decile experienced an increase of only 3.1 percent. Consumption gains among the third and fourth poorest household groups were respectively 1.9 percent and 0.9 percent. The real growth rate for the upper half distribution of consumption was negative.

Urban and rural areas witnessed different experiences in terms of pro-poor growth. Figure 8 shows that there is clear evidence of "pro-poor" growth in rural areas. The growth incidence curve is downwardly sloped and indicates a positive growth rate for more than three-quarters of the rural population indicating higher growth amongst the poorest who benefitted disproportionately from growth. In contrast with rural areas, the urban population experienced a deterioration in their real standard of living with negative growth in consumption that affected the entire population (see Figure 8). However, it should be noted that the decline in real consumption has been more pronounced for the most affluent categories. This trend deserves further analysis in order to identify the factors that have affected the declining living conditions of the urban population and which has been reflected in an increase in the incidence of poverty discussed above.

Figure 9: Growth incidence curve 2010-2015, by urban/rural residence





Source: AfDB Statistics Department

2.4. Decomposition of change in poverty by growth and redistribution

Table 11: changes in per capita consumption and Gini index 2010-2015

Year	2010	2015	Absolute difference
Average per capita consumption: SDG	6420	6082	-338
Gini index	35.5	29.2	-6.3

Source: AfDB Statistics Department

The observed changes in poverty (under its various measures) over the period 2010-2015 is the result of several factors that impact the living standards. On the one hand, as shown in Table 11, average real per capita consumption (expressed in 2015 constant prices) decreased from 6420 SDG to 6082 SDG. On the other hand, inequalities in consumption have witnessed a significant reduction over the same period from 35.5% to 29.2%. As rightly pointed out by Datt and Ravallion (1992), it is important to assess to what extent changes in poverty are due to variations in the distribution of living standards, as opposed to (real) variations in living standards Poverty changes can be decomposed into a growth component, which represents shifts in the mean of the consumption distribution in the absence of changes in inequality, and a redistribution component, which represents changes in the distribution in the absence of economic growth (see appendix C for a brief presentation of the decomposition method). Table 12 summarizes how observed changes in food insecurity, extreme poverty, and poverty incidences can be decomposed to changes in average level of consumption (growth effect) and changes in inequality of consumption (redistribution effect).

Table 12 confirms that, if inequality had remained unchanged, the actual decrease in real consumption would have increased the incidence of: (i) poverty by 4.6 percentage points, (ii) extreme poverty by 3.4 percentage points, and (iii) food insecurity by 2.1 percentage points. Decreases in inequality would have offset the effect of negative growth. The redistribution effect was particularly stronger in reducing extreme poverty and food insecurity. Indeed, if we assume that mean consumption had remained unchanged, the poverty, extreme poverty, and food insecurity would have fallen by 6, 7.8 and 8.3 percentage points. There is clear evidence that distributional effects are associated with higher rates of poverty reduction. The adverse effect of negative growth in average living standards has not been strong enough to offset the benefit effect of reduced inequality. Overall, it seems that the main driver of poverty decreases is the redistributive measures that benefited the poorest groups more so than economic growth.

Table 12: Growth-redistribution decomposition of the change in poverty

Year			
	2009	2014	Difference
Poverty rate	37.6	36.1	-1.5
Growth effect			4.6
Redistribution effect			-6.0
Year			
	2009	2014	Difference
Extreme poverty rate	29.6	25.2	-4.5
Growth effect			3.4
Redistribution effect			-7.8
Year			
	2009	2014	Difference
Food insecurity	15.3	9.1	-6.2
Growth effect			2.1
Redistribution effect			-8.3

Source: AfDB Statistics Department

III. Poverty Profile and its Main Determinants

The decline in poverty (particularly in extreme poverty) during the period 2010-2015 should not mask the substantial differences in welfare and poverty risk between various types of households or spatial location. This section describes the patterns of the observed poverty levels and analyzes its main determinants. To this end, we rely firstly on the decomposition exercise of poverty by key correlates of poverty such as region and urban/rural residence, as well as by household head's characteristics. The decomposition allows us to better understand the role played by each characteristic in determining the level of global poverty. Then, we perform a multivariate analysis to identify the 'pure' effects of each household characteristic on poverty status, controlling for other factors. Such analysis is essential in formulating effective targeting programs and policies tackling the roots of poverty and social exclusion.

3.1. Decomposing poverty by household characteristics

Table 13 presents the decomposition of food, extreme, and global poverty by state. It gives the population share, poverty estimates, and relative contribution of each state to the observed poverty level. We also calculate a priority ratio defined as the ratio of relative contribution (RC) to population share. It helps to identify priority intervention which may be undertaken by the authorities in different regions. When the ratio exceeds a value of 1 it indicates that the relative contribution of a population group to total poverty is more than proportional to its share in the total population and needs particular attention.

In terms of food insecurity, the highest incidence is observed in Central and West Darfur where around one-third of persons suffer from food insecurity, followed by South Kordofan (22%) and to a lesser extent the rest of the Darfur and Kordofan states as well as the Red Sea and White Nile states. The priority ratio of central Darfur is estimated at 3.5 meaning that the contribution of this region to total food insecurity is 3.5 times its population share.

When we look at extreme or global poverty, the picture remains the same and priority intervention regions are specifically: Darfur region, South Kordofan and Red Sea. Within the framework of the growth and poverty reduction Strategy, It's clear that the highest priority should be given to tackling the problem of food insecurity affecting about 9.1% of the Sudanese population; more than two-thirds of them live in the different Darfur and Kordofan regions. This makes these regions a very high priority region for targeting aid to be deployed.

The identification of priority areas should not, however, obscure the problem of poverty at the country level. Sustained efforts should be made to eradicate this scourge in the different regions.

Table 13: Decomposition of poverty incidence by state

	Population share (1)	Food poverty (P1)	RC in % to P1 (2)	Priority ratio(2)/(1)	Extreme poverty (P2)	RC in % to P2 (3)	Priority ratio (3)/(1)	Global poverty (P3)	RC in % to P3 (4)	Priority ratio (4)/(1)
Northern	2.2	0.3	0.1	0.05	5.5	0.5	0.23	12.2	0.7	0.32
River Nile	3.9	3	1.3	0.33	11.3	1.8	0.46	19.9	2.1	0.54
Red Sea	3.7	11.6	4.7	1.27	36.9	5.4	1.46	51.4	5.3	1.43
Kassala	5.6	3.8	2.4	0.43	18.1	4	0.71	27.9	4.3	0.77
Gadarif	5.1	5.6	3.1	0.61	20.2	4.1	0.80	31.6	4.4	0.86
Khartoum	17.4	5.3	10.2	0.59	19.7	13.6	0.78	29.9	14.4	0.83
Gezira	11.5	0.4	0.6	0.05	9.2	4.2	0.37	18.3	5.8	0.50
White Nile	5.9	11.5	7.5	1.27	27.4	6.5	1.10	40.9	6.7	1.14
Sinnar	4.6	3.5	1.7	0.37	14.6	2.6	0.57	25.9	3.3	0.72
Blue Nile	3.1	4.6	1.6	0.52	20.1	2.5	0.81	34.6	3	0.97
North Kordofan	9.3	11.5	11.8	1.27	29.6	11	1.18	39.1	10.1	1.09
South Kordofan	2.5	22.5	6.2	2.48	54.4	5.4	2.16	67	4.6	1.84
West Kordofan	2.5	11.9	3.2	1.28	33.3	3.3	1.32	40.5	2.8	1.12
North Darfur	6.9	12.7	9.7	1.41	31.4	8.6	1.25	42.3	8.1	1.17
West Darfur	2.6	31.8	9.2	3.54	50	5.2	2.00	64.1	4.7	1.81
South Darfur	7.8	13.6	11.6	1.49	35.8	11	1.41	49.2	10.6	1.36
Central Darfur	3.3	32.1	11.6	3.52	55.7	7.3	2.21	67.2	6.1	1.85
East Darfur	2	16.4	3.7	1.85	36.1	2.9	1.45	50.4	2.8	1.40
Sudan	100	9.1	100		25.2	100		36.1	100	

Source: AfDB Statistics Department

In most developing countries, women are often considered as a vulnerable group as they are more exposed to economic shocks and poverty given their low access to economic opportunities or more productive jobs compared to men. Consequently, women are more likely to fall into poverty than men, and it is therefore crucial that poverty reduction strategies place greater emphasis on the poverty risks of women.

In this context, it is important to check whether Sudanese women are more affected by the three dimensions of poverty (food, extreme, and global) than their male counterparts. Panel A in Table 14 presents the results of the poverty decomposition measured at the national level by the gender of the head of the household. Results show that female-headed households, which represent 11% of households, are not at particularly higher risk of poverty than the male headed households although the prevalence of extreme poverty is 2.4 percentage points higher in female-headed households compared to men.

Table 14: Poverty decomposition by household characteristics

	Population share (1)	Food poverty	RC (2)	Priority ratio (2)/(1)	Extreme poverty	RC (3)	Priority ratio (3)/(1)	Global poverty	RC (3)	Priority ratio (3)/(1)
A. Head's gender										
Female	11.4	10.3	12.8	1.13	27.3	12.3	1.08	37.2	11.7	1.03
Male	88.6	9.0	87.2	0.98	24.9	87.7	0.99	36.0	88.3	1.00
B. Age groups										
Under 29 years	6.2	5.1	3.5	0.56	16.1	4.0	0.64	23.5	4.1	0.65
30-44 years	35.9	10.5	41.3	1.15	26.3	37.6	1.05	36.7	36.5	1.01
45-59 years	35.1	9.5	36.8	1.05	28.1	39.2	1.12	40.6	39.4	1.12
60-73 years	18.9	7.8	16.3	0.86	21.9	16.5	0.87	33.1	17.3	0.92
74 years or more	3.8	5.2	2.2	0.57	18.0	2.7	0.72	25.8	2.7	0.71
C. Household size										
1 or 2 persons	2.8	0.04	0.0	0.00	1.21	0.1	0.05	1.75	0.1	0.05
3 or 4 persons	15.7	1.14	2.0	0.12	4.58	2.9	0.18	8.21	3.6	0.23
5 or 6 persons	28.8	4.27	13.5	0.47	14.84	17.0	0.59	24.25	19.3	0.67
7 or 8 persons	28.5	10.68	33.4	1.17	30.19	34.3	1.20	43.87	34.6	1.21
9 persons or more	24.2	19.23	51.1	2.11	47.56	45.8	1.89	63.19	42.3	1.75
D. Dwelling type										
Tukul	40.0	16.0	70.2	1.8	37.6	59.7	1.5	48.4	53.6	1.3
Apartment / villa	2.0	7.8	1.7	0.9	24.2	2.0	1.0	35.8	2.0	1.0
House: mud/ wood	34.0	5.6	21.0	0.6	20.5	27.8	0.8	33.7	31.7	0.9
House: bricks concrete	23.9	2.7	7.0	0.3	11.1	10.5	0.4	19.2	12.7	0.5

Source: AfDB Statistics Department

Households headed by a relatively young (under 29 years) or elderly (more than 74 years) person face lower risk of poverty than other households. Indeed, panel B of Table 14 shows that prevalence of the three forms of poverty (food, extreme, and global poverty) is clearly higher among households headed by individuals aged between 30-44 and 45-59 years. This pattern is confirmed by the priority ratio for different groups. The contribution to total poverty of the latter groups is higher than their relative share in the total population.

The correlation between the head's age and poverty seems inconsistent with life cycle theory which states that the workers' incomes tend to increase throughout the professional career. Hence, it is expected that poverty should be relatively higher for families headed by a young person compared to families headed by older persons. Also, workers' incomes tend to decline after retirement, which could lead to a relatively high incidence of poverty among their families.

As we will see below, the apparent inconsistency between what is expected according to theory and the results reported in Table 14 is due to the correlation between the head's age and household size, on the one hand, and the correlation between household size and the incidence of poverty, on the other hand. Indeed, panel C in Table 14 shows that people living in large households (with more than 9 members) face higher poverty risks. About 19% of people living in these households suffer from food insecurity compared to .04% in 1 or 2 person households. More generally, the incidence of all forms of poverty is much higher in households with more than 6 members. Global poverty incidence in households with 7-8 and 9 or more members is estimated at 43.8 and 63.2% respectively which is clearly much higher than the national average of 36.1%. Overall the three forms of poverty increase as the size of the household expands. Since young households as well as elderly-supported households tend to be small, this explains at least partly why the incidence of the three forms of poverty reaches its lowest levels for households whose main support is either relatively young or elderly.

As with the characteristics discussed above, the analysis of the correlation between the household type and poverty status can help in identifying the poorest households, if its characteristics are strongly correlated with poverty. The type of housing is easily observable and could thus be used to identify and target the poorest groups.

Panel D in Table 14 shows that, overall, households living in concrete brick houses are relatively less exposed to the risk of poverty than other households. Also, the prevalence of food insecurity is 16% among households living in Tukul compared to a national average of 9%. Regardless of the type of poverty (food, extreme, or global), these households deserve special attention in the context of poverty reduction strategies.

Table 15: Poverty decomposition by household head characteristics

	Population share (1)	Food poverty	RC (2)	Priority ratio (2)/(1)	Extreme poverty	RC (3)	Priority ratio (3)/(1)	Global poverty	RC (3)	Priority ratio (3)/(1)
A. Head's education										
No qualification	40.8	12.1	42.4	1.6	32.3	37.4	1.4	43.2	33.8	1.3
Khalwa	8.8	17.1	16.6	1.9	33.3	11.7	1.3	45.6	11.1	1.3
Primary	26.0	7.5	21.5	0.8	23.9	24.6	0.9	35.3	25.4	1.0
Intermediary	9.3	4.3	4.3	0.5	16.7	6.1	0.7	27.5	7.0	0.8
Secondary	9.4	2.4	2.4	0.3	10.0	3.7	0.4	23.4	6.1	0.6
University	5.8	1.7	1.0	0.2	6.1	1.4	0.2	10.1	1.6	0.3
B. Situation with respect to labour market										
Out of labour market	12.0	6.0	7.9	0.66	19.4	9.3	0.77	27.7	9.2	0.77
Paid employee	41.2	7.9	35.6	0.86	22.3	36.6	0.89	33.7	38.5	0.93
Employer	9.0	6.7	6.6	0.73	23.1	8.3	0.92	33.2	8.3	0.92
own account worker	33.6	10.8	40.0	1.19	28.7	38.4	1.14	40.2	37.4	1.11
Unpaid family worker	3.4	24.0	9.0	2.64	47.5	6.4	1.89	59.5	5.6	1.65
Unemployed	0.7	11.6	1.0	1.28	35.6	1.1	1.41	49.9	1.0	1.38
C. Sector of activity										
Agriculture / fishing	37.9	13.9	57.6	1.52	32.7	49.2	1.30	43.0	45.0	1.19
Industry	3.7	5.2	2.1	0.57	18.7	2.7	0.74	32.1	3.3	0.89
Construction	3.6	4.6	1.8	0.51	22.9	3.3	0.91	35.9	3.6	0.99
Wholesale/trade	8.9	5.2	5.1	0.57	16.1	5.7	0.64	27.4	6.7	0.76
Transportation	4.7	3.2	1.6	0.35	19.1	3.6	0.76	32.2	4.2	0.89
ITC/Finance	1.8	2.0	0.4	0.22	20.0	1.5	0.80	29.7	1.5	0.82
Real estate/other	2.8	3.8	1.2	0.42	14.4	1.6	0.57	28.7	2.2	0.79
Public administration	10.0	3.8	4.2	0.41	14.7	5.9	0.58	25.7	7.1	0.71
Other	26.5	8.9	26.0	0.98	25.2	26.5	1.00	35.8	26.3	0.99

Source: AfDB Statistics Department

Panel A in Table 15 provides a first look of the relationship between the household head's level of education and poverty in its three forms.

The results show that almost half of the Sudanese population live in households headed by individuals with no education or having studied at Khalwa. This segment of the population has the highest level of poverty compared to other groups with an overall incidence of poverty of more than 43%. The positive impact of the household head's education on the risk of poverty is observed from the level of intermediate education, where the incidence of poverty drops significantly for households with relatively better educated heads, who are therefore more able to seize economic opportunities. The priority ratios calculated for the different groups clearly show that public interventions should target low-educated household heads.

These results have implications for future poverty reduction strategies and show the importance of education as a lever for reducing poverty through improving the skills of the population. The return of this investment is certainly not immediate. This investment must therefore be part of a range of measures that must include targeted direct transfers to households experiencing the most severe form of poverty.

When we look at household heads' situation with respect to the labour market, results from panel B in Table 15 show that unemployed and unpaid family workers are the most affected groups by poverty in comparison with employed heads or those out of labour market (mainly retired individuals). Note however that the former groups represent a small share of the total population (less than 5%). Own account workers (self-employed) also seem to be particularly affected by poverty compared to salaried employees or employers. Food, extreme, and global poverty reach respectively 10.8, 28.7, and 40.2 within this group.

Panel C in Figure 15 presents poverty levels by household head's activity sector. The highest poverty incidence under its different measures is among agriculture and fishing workers. About 1 in 7 individuals living in farm households suffer from food insecurity; one-third are in extreme poverty, and more than 4 persons in ten are poor, according to the upper poverty line. Agricultural output is highly volatile and depend on rainfall, which limits the ability of households to effectively use their lands and generate high and stable income. The observed levels of poverty in the rest of sectors are relatively lower than in the agriculture sector and vary slightly across sectors. These results deserve more attention and a deeper analysis of the potential role of this strategic sector protects the population from poverty by offering more productive jobs with higher remuneration and stable income.

3.2. Determinants of poverty

While the breakdown of the incidence of poverty gives a broad picture of the key contribution of regional-level and household characteristics to the observed level of poverty, it does not offer a satisfactory explanation of why some people are poor nor the effect of each characteristic on poverty all things being equal. In addition, the simple decompositions of poverty measures do not measure the net effects of continuous variables (such as age and, to a lesser extent, size); unless there are groupings that inevitably lead to some loss of information.

To overcome such a limitation we rely on regression analysis to identify the effects of each individual characteristic on poverty status. More specifically, we run a probit regression to model a dichotomous outcome variable taking values of 1 for poor and 0 for non-poor individuals respectively. The predictor variables of interest are a set of household socioeconomic and demographic characteristics. The regression technique is a good way to identify the immediate correlates of poverty, but cannot explain the roots of poverty status which is more related to deeper causes such as lack of education, equitable access to economic opportunities…etc.

To simplify the reading of regression results and avoid interpretational difficulties we present in figures below the marginal effects of main explanatory variables on the probability of being poor. Table A1 in appendix E present the regression results (raw coefficients) of the probit model. All the marginal effects should be interpreted ceteris paribus. In other words, the reported effects are the marginal effects when all other variables equal their means; the marginal effects will differ at other values of the explanatory variables.

For discrete variable X_k the marginal effect is given by:

$$ME_k = \Pr(poor = 1|X, X_k = 1) - \Pr(poor = 1|X, X_k = 0)$$

For continuous variable X_k the marginal effect is given by:

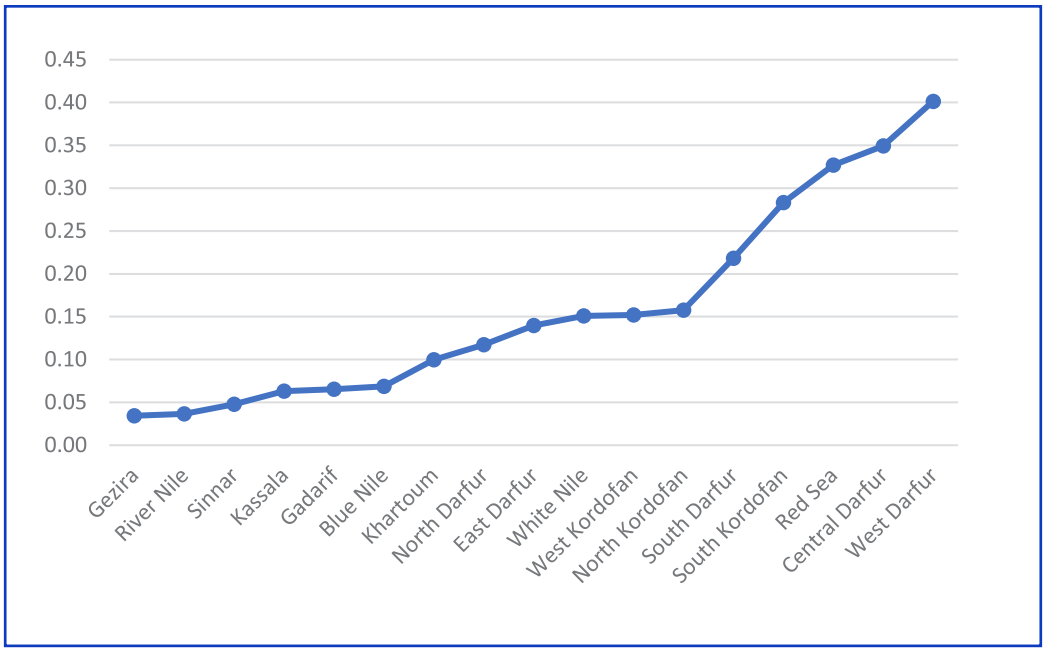
$$ME_k = limit\ \Pr(poor = 1|X, X_k + \Delta) - \Pr(poor = 1|X, X_k/\Delta)$$

as Δ tends to 0.

The effect of region of residence

With respect to the spatial dimensions of poverty, Figure 9 presents the effect of state of residence on the probability of being poor, compared to Northern state. The results confirm the patterns discussed above, and show that, ceteris paribus, residing in West Darfur is associated with a 40% higher risk of poverty. The same effect does not exceed 3% for Gezira state. The risk of poverty rises dramatically from 16% for North Kordofan residents to 22% (South Darfur), 28% (South Kordofan), 33% (Red Sea), 35% (Central Darfur), and 40% (West Darfur).

Figure 10: The effect of the state of residence on the probability of being poor compared to Northern state.

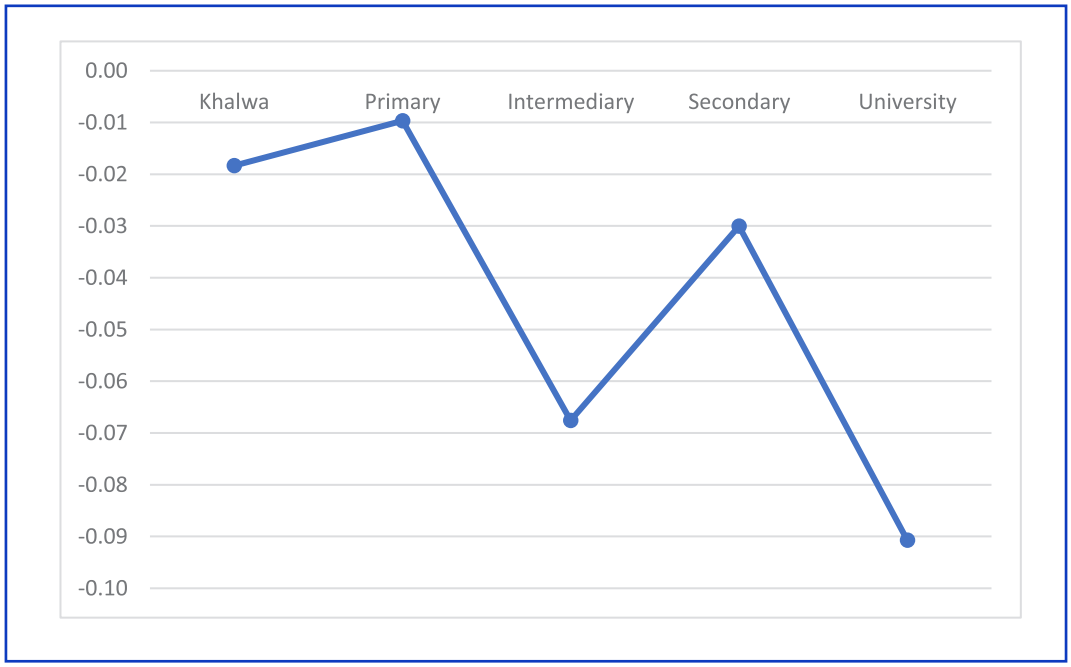


Note: The reference state of residence= Northern state
Source: AfDB Statistics Department

The effect of head's education

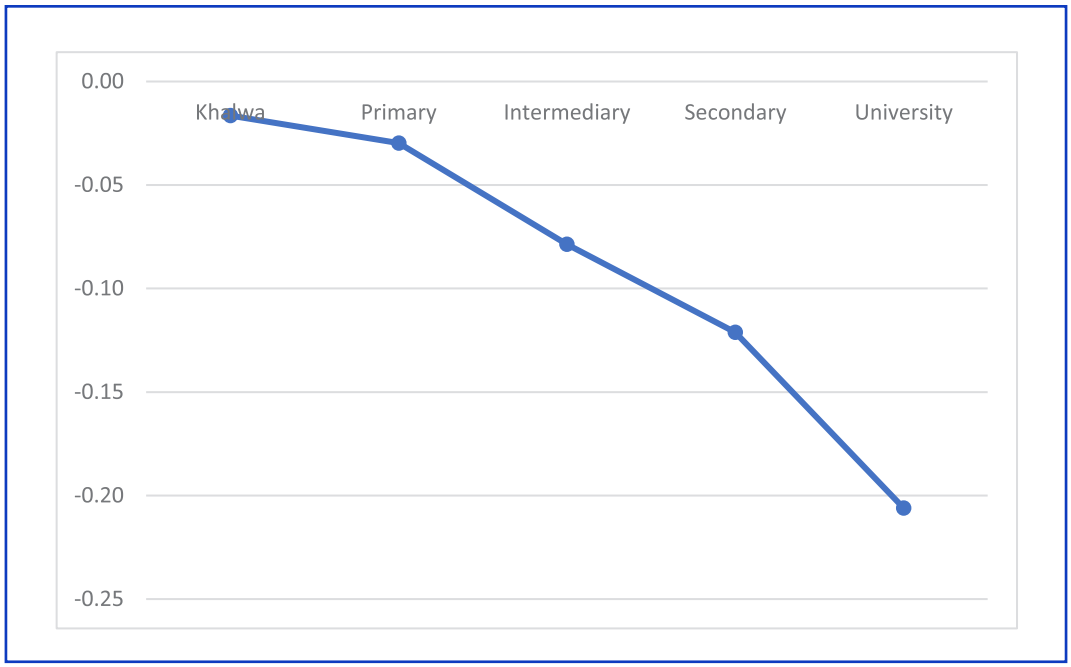
Figures 10 & 11 present the marginal effects of head's education and the highest education level in the household on the poverty status. The risk of poverty is 9% lower in households headed by an individual with a university degree than in households headed by an individual with no education. The same picture emerges when we consider the highest education level in the household.

Figure 11: The effect of the head's education on the probability of being poor compared to no education level.



Note: The reference category=Head with no education
Source: AfDB Statistics Department

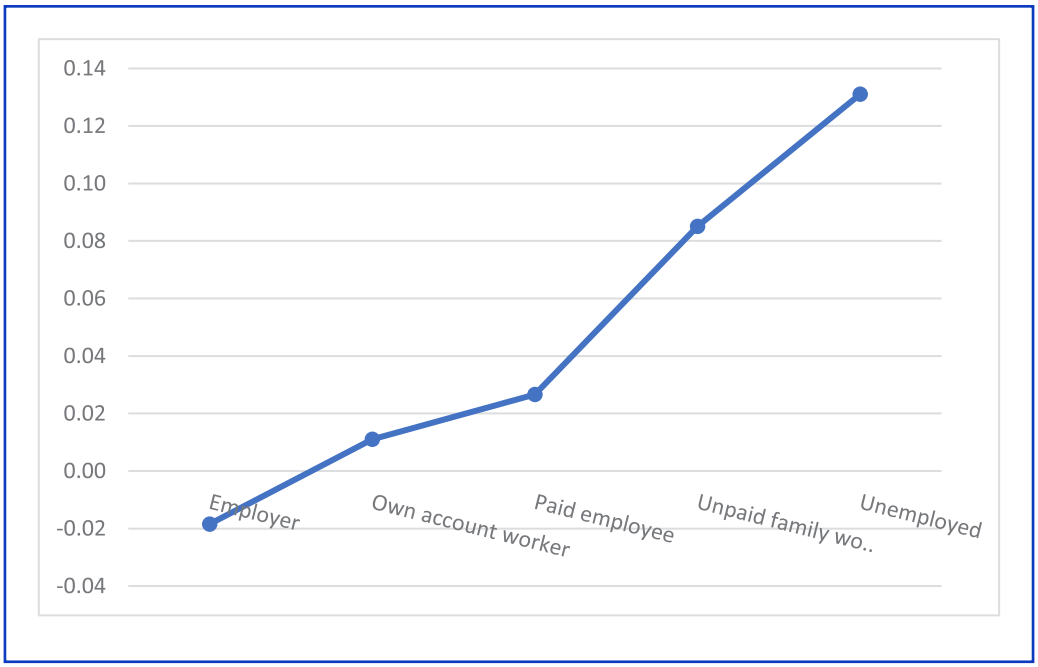
Figure 12: The effect of the highest education on the probability of being poor compared to no education



Note: The reference category= No education is the highest education level in the household
Source: AfDB Statistics Department

The employment status of the household head is significantly related to poverty risk. Compared to the reference category (out of labour market: retired) the households headed by an unemployed person are more likely (by about 13%) to fall into poverty. The same remark applies for unpaid family workers (9% higher risk). We note also that the employers are about 2%less likely to fall into poverty. All in all, the results show that having an income generating activity significantly reduces the poverty risk.

Figure 13: The effect of the head's employment status on the probability of being poor



Note: The reference category=Head out of labour market.
Source: AfDB Statistics Department

Table 16 gives the marginal effects of the rest of the explanatory variables. Urban households are more likely to be poor than rural households by about 8 percentage points. Having a male head reduces the probability of falling into poverty by about 5 percentage points. An increase of the head's age by 10 years increases the poverty risk by about 1%. (recall that this is a total effect of the age and age squared variables.) Unsurprisingly, household size increases poverty risk, as does the presence of children. Each additional child aged 0-4 years increases the poverty risk by 2 percentage points, while children aged 6-14 increase the probability of falling into poverty by 3 percentage points. Each additional member aged 15-24 increases the same probability by 1 percentage point.

Table 16: Marginal effects on the probability of being poor

Variable	Marginal effect
Urban	0.08
Head male	-0.05
Head age	0.001
Log hh size	0.64
# children 0-5	0.02
# children 6-14	0.03
# children 15-24	0.01

Source: AfDB Statistics Department

In summary, the regression analysis of poverty status helps to assess and measure the impact of several factors that significantly correlated with poverty risk. Firstly, our analysis reveals a significant effect of region and rural/urban residence on the probability of falling into poverty, even when controlling for main characteristics of the household. Secondly, household size and the presence of young children tend to significantly increase the poverty risk. Access to income generating activity(ies) remains the strongest influencing factor to reduce household poverty.

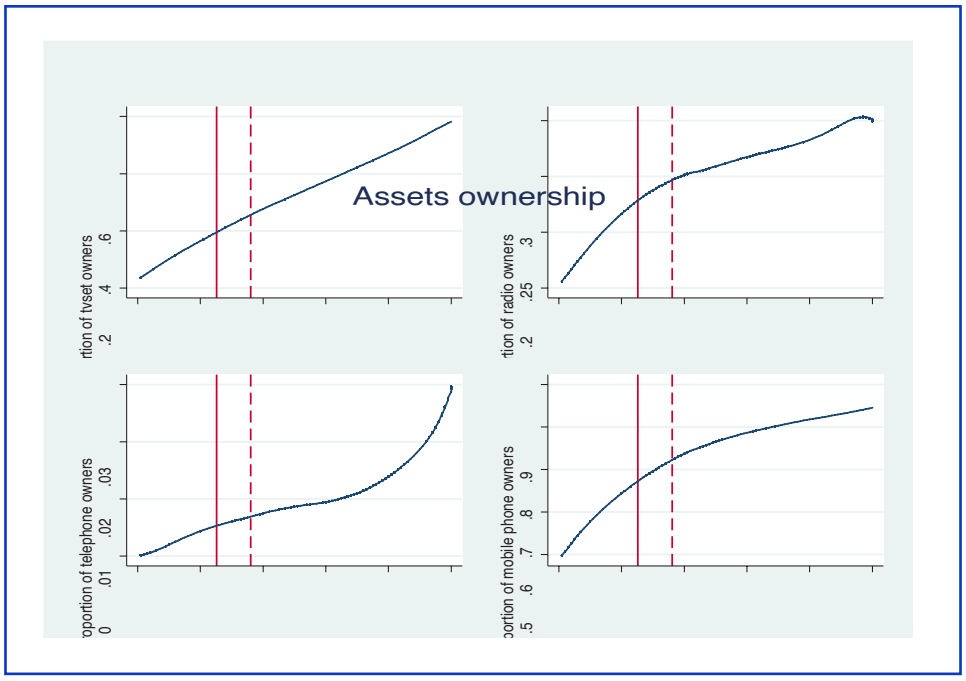
3.3. Assets ownership and living standards

Another way to look at consumer living standards is the availability or ownership of assets or durables goods. Figures 13-15 present the distribution of asset ownership by consumption percentiles. Note that the statistics presented here do not take into account the quantity nor the quality (or the age) of durables owned. The available data do not permit to measure the quality of the durables owned by population group.

Unsurprisingly, asset ownership is highly related to the consumption level. However, access to some durables remains relatively low, in particular information sources such as Television, radio, or mobile phone. At most one-fifth of the extremely poor population own a TV set, and more than one-third of the same population live in a household with no access to a mobile phone (see Figure 13).

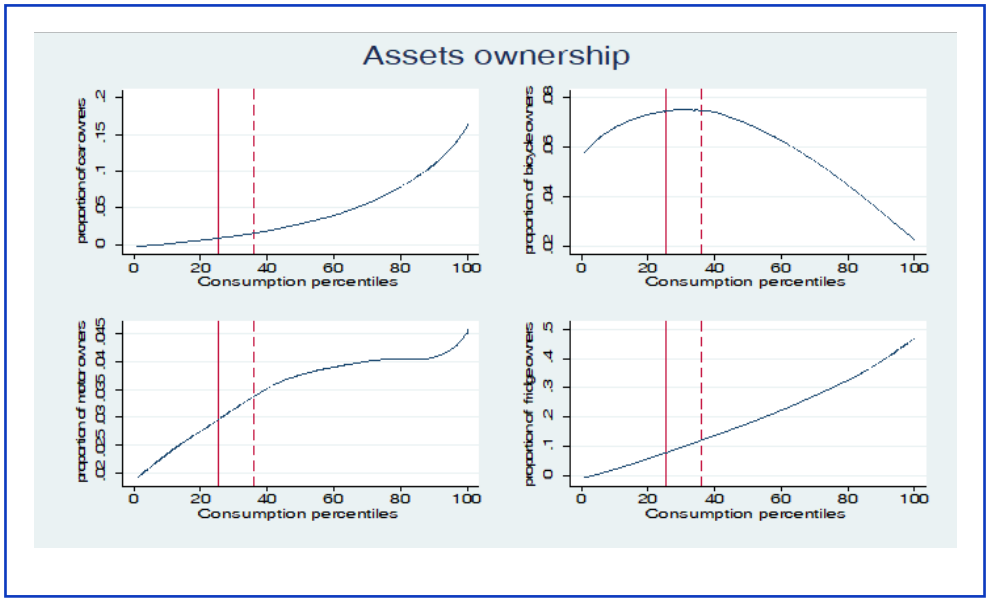
Access to a means of transportation (cars, bicycle, motorcycle) remains globally low at the national level and in particular among the poorest segments of the population. The same remark applies to other durables such as fridge, fan, computers…etc.

Figure 14: Assets ownership by percentile (TV, radio, telephone, mobile phone)



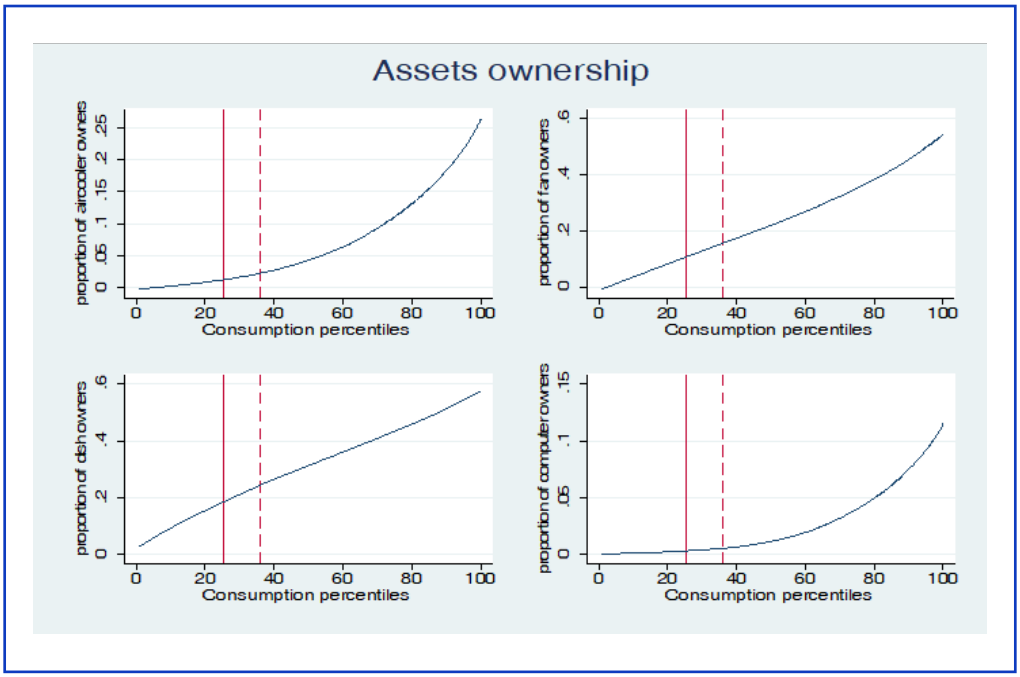
Reference lines respectively denote extreme and global poverty lines.
Source: AfDB Statistics Department

Figure 15: Assets ownership by percentile (cars, bicycle, motorcycle, fridge)



Reference lines respectively denote extreme and global poverty lines.
Source: AfDB Statistics Department

Figure 16: Assets ownership by percentile (air conditioner, fan, dish, computer)



Reference lines denote respectively extreme and global poverty lines.
Source: AfDB Statistics Department

IV. Consumption Inequality in Sudan

We discussed in Section II the evolution of inequality at the country level and we showed the positive impact of the reduction of inequality on the level of poverty. A relevant question is how does the level of inequality vary across various social groups, for example by region of residence, level of education, socio-professional category, etc. It is important to know the extent to which global inequality is due to the prevalence of inequality within each social group as well as across social groups. Indeed, even if the overall level of inequality could be small, excessive disparities between population groups could undermine social cohesion and promote less stable and less efficient economic development.

This section provides a more detailed and in-depth analysis of the distribution of consumption and the evolution of inequalities between different segments of the population. We therefore compare levels of inequality across different population groups using conventional decomposition methods.

The economic literature offers a large number of inequality indices that characterize the level of interindividual and inter-group disparities. In parallel with the Gini index presented above, other measures of inequality, notably those of the Atkinson class (1970), or the Entropy class are often used to test whether differences in inequalities over time or between different social groups are sensitive to the choice of inequality indices.

4.1. Usual inequality measures

Table 17 shows that the nationwide Gini index is around 29.2. With an average consumption of about 6082 SDG, this result means that if we randomly choose two Sudanese people, the average yearly consumption gap between them is expected to be equal to 3552 SDG, which is 2*0.292*6082. Compared to regional standards the inequality level in Sudan seems very low (31.4% in Egypt, 34% in Jordan, 45% Mauritania, 36% in Tunisia).

Table 17 also shows that the level of inequality of non-food consumption is much higher (nearly 12 percentage points), higher than the level of inequality of food consumption, with an index value of 38.9% against 27.1 for food consumption. Disparities in food consumption are clearly less severe in Sudan than other components of consumption. However the low inequality in food consumption should not mask the potential problem and difference in food quality between poor and non-poor groups. Food consumption disparities, especially among children deserve more attention and deeper analysis of the content of food baskets consumed.

Table 17: Gini index by consumption component

	Gini index
Food consumption	27.1
	(0.2)
Non-food consumption	38.9
	(0.5)
Total consumption	29.2
	(0.3)

Note: standard errors in parentheses
Source: AfDB Statistics Department

In Table 18, the first inequality measure is the inter-decile ratio, which gives the ratio of the consumption share of the 2nd decile to the share of consumption of the 9th decile (D2/D9). This ratio is equal to 37.2% for food consumption, 25.4% for non-food consumption, and 35.5% for total consumption. These estimates confirm that consumption of non-food goods is significantly more unequal than consumption of food goods. It should also be noted that the extent of inequality measured by the expression (1- D2/D9) for total consumption is higher than the inequality index of food consumption. This result suggests that the segment of the population with the lowest share of aggregate food consumption probably also has the lowest share of aggregate non-food consumption. In other words, there is a strong correlation between the shares of food and non-food consumption controlled by each segment of the population.

Table 18 also shows that the different inequality indices used confirm the previous results, regardless of their sensitivity to changes in the level of consumption experienced by rich or poor categories.

To better understand the determinants of these results, Figure 16 presents the Lorenz curve of food consumption, non-food, and total per capita consumption. In order to better discern the different curves in Figure 16, Figure 17 shows the deviation, for each percentile of the consumption distribution, of the Lorenz curves (food and non-food) compared to the Lorenz curve of the total consumption.

Figures 16 and 17 reveal that regardless the level of consumption, the concentration curve of food consumption is located above the Lorenz curve of total consumption (although for poor percentiles the two curves are rather the superimposed). At the same time, the concentration curve of non-food consumption is located above the Lorenz curve of total consumption. These results suggest again that regardless of the choice of inequality index, food consumption tends to be less unequal than consumption of non-food goods.

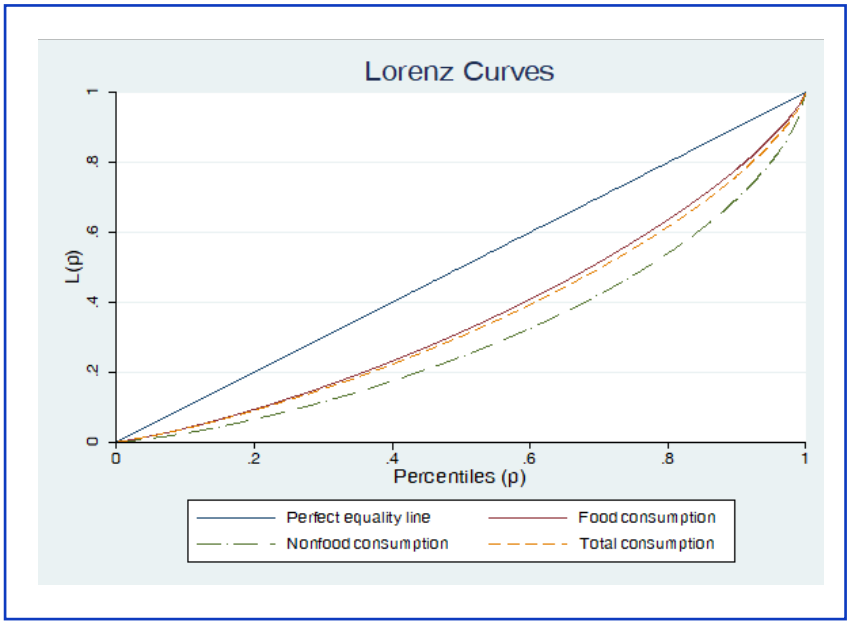
Table 18: Alternative inequality measure

	Food	Non-food	Total
consumption			
D2/D9	37.2	25.4	35.5
	(8.7)	(9.7)	(8.8)
1-D2/D9	62.8	74.6	64.5
	(8.7)	(9.7)	(8.8)
Atkinson (3) pro-poor	30.2	85.7	31.9
	(0.6)	(6.3)	(0.5)
Atkinson (1) middle class	11.3	22.3	13.0
	(0.2)	(0.5)	(0.3)
Atkinson (.5) pro-rich	5.9	12.4	6.9
	(0.1)	(0.4)	(0.2)
Entropy (0) pro-poor	12.0	25.3	13.9
	(0.2)	(0.7)	(0.3)
Entropy (1) middle class	12.3	28.0	14.9
	(0.2)	(1.1)	(0.4)
Entropy (2) pro-rich	14.6	46.2	19.5
	(0.4)	(4.4)	(1.0)

Source: AfDB Statistics Department

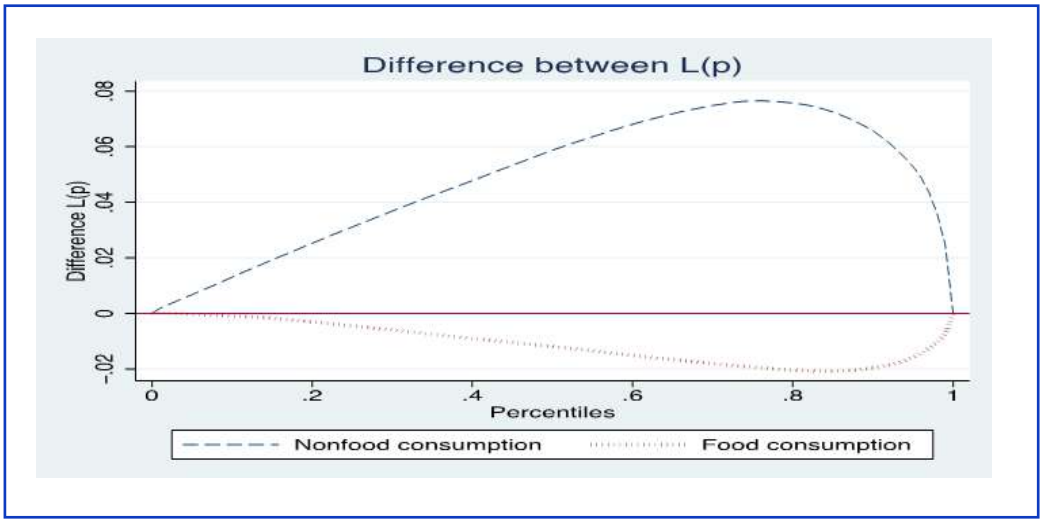
In light of the results of Tables 18 and the curves in Figures 16 and 17, a strategy aimed at reducing poverty could be based on a marginal reform of the indirect taxation system. It would be appropriate to reduce indirect taxes on foodstuffs and increase indirect taxes on certain non-food items (while keeping total revenues constant). This path of reform deserves to be explored further by considering all consumed goods and services in order to identify more precisely the goods whose tax rate should be increased or lowered in order to further reduce inequalities and poverty.

Figure 17: Lorenz curves for consumption components



Source: AfDB Statistics Department

Figure 18: Difference between Lorenz curves



Source: AfDB Statistics Department

4.2. Decomposing consumption inequality (Theil index) by subgroup

This section proposes a decomposition analysis of inequality levels in 2015. As for the decomposition of poverty, inequality decomposition is a useful tool in describing main disparities patterns across key household characteristics such as head's education, age, activity sector, etc. Indeed, if inequality is mainly attributed to differences between population groups, then policies aimed at reducing differences in average income between them would have much prospect to reduce overall inequality.

The approach followed is to express the total inequality in per capita consumption as the sum of an intra-group component that describes the inequality within each group, called the within component, and an inter-group component that describes the extent of inequality between different social groups (as if each group was a member of the population). Intra-group inequality is a weighted sum of inequality within each group. The inter-group inequality is the inequality calculated for the total population when the individual consumption in each group is replaced by the group average. Inter-group inequality thus reflects the inequality of average consumption across groups as if there was perfect equality of consumption within each group. See appendix B for a formal derivation of the decomposition of inequality measures.

Tables 19-25 show how the Theil index varies between different groups of the population. In each table the second column gives the level of inequality by group. Column 3 gives the relative share of the population group in the total population. Column 4 gives the absolute contribution of each group to overall inequality; the sum of these absolute contributions corresponds to the total inequality at the country level. Column 5 gives the relative contribution of each group to the global inequality such that the sum of these shares is equal to 100% of the global inequality. Column 6 gives the average per capita consumption of each group. The last column gives the equalized equivalent consumption (EDC) defined by average consumption (AC, column 6) times 1 minus the Theil index (reported in column 2).

The last column, in each table, combines two indicators of living standards that take into account the average level of consumption that is assumed to be strongly correlated with the level of well-being, and the level of inequality within each group that is assumed to be negatively correlated with individual welfare since individuals are generally averse to inequalities and prefer to belong to a social group with a low level of inequality. The EDC indicator is very important for classifying groups in terms of well-being. In fact, from a purely distributional point of view, the least unequal groups are considered to be the most affluent in terms of well-being. At the same time, individuals also prefer to belong to a social group with a high average standard of living. Thus, the EDC could be considered as a bi-dimensional indicator of well-being that classifies all social groups by inequality and consumption level simultaneously, regardless of their heterogeneity in terms of average living standards.

Urban/rural residence

Table 19 shows that consumption differences between urban and rural areas are quite sharp. The consumption level in urban areas is about 30% higher than in rural areas. At the same time, the level of inequality is lower in the latter group (.159 vs. .128). The two dimensions of well-being (inequality and level of expenditure) thus act in opposite directions, which marginally reduces the welfare gap between the two.

Table 19: Decomposition of the Theil index by urban/rural residence

	Theil index	Population share	Absolute contribution	Relative contribution	Average consumption	Equally distributed equivalent consumption
Rural	**0.1286**	**0.6504**	**0.0758 0**	**.5068**	**5508.9 4**	**800**
	0.0039	*0.0058*	*0.0025*	*0.0174*	*3164.7*	
Urban	**0.1598 0**	**.3496**	**0.0657**	**0.4392**	**7148.6 6**	**006**
	0.0072	*0.0058*	*0.0034*	*0.0144*	*4577.3*	
Within .	**.**	**0**	**.1414**	**0.946**		
	.	*.*	*0.0041*	*.*	*.*	*.*
Between	**0.0081**	**.**	**0.0081**	**0.054**		
	0	*.*	*0*	*.*	*.*	*.*
Population 0	**.1495**	**1**	**0.1495**	**1**	**6082**	
	0.0041	*0*	*0.0041*	*0*	*3801*	

Source: AfDB Statistics Department

Region of residence

Table 20 also shows that the Northern region is the least unequal region. It is also one of the most affluent regions in terms of average standard of living. Compared to Khartoum, the level of equally distributed consumption is higher. The regions of Darfur, particularly West Darfur, are characterized by a fairly low level of consumption and significantly higher inequality than the national average. The two dimensions of wellbeing in Darfur act in the same direction and make the standard of living relatively low in that region.

Regarding between-state inequality, the results show that it contributes to about 11% of total inequalities. The contribution of the between inequality component is generally low, but comparing the case of Sudan with other countries in the region, the extent of between-state inequality seems quite high. These results suggest that regional disparities deserve particular attention, both within and between regions.

Table 20: Decomposition of the Theil index by state

	Theil index	Population share	Absolute contribution	Relative contribution	Average consumption	Equally distributed equivalent consumption
Northern	0.0819	0.0218	0.0021	0.0138	7013	6439
	0.0054	*0.001*	*0.0002*	*0.0012*	*3065*	
River Nile	0.1054	0.0388	0.0046	0.0307	6818	6099
	0.0079	*0.0019*	*0.0004*	*0.0029*	*3404*	
Red Sea	0.1175	0.0371	0.0037	0.0248	5176	4568
	0.0085	*0.0016*	*0.0003*	*0.0023*	*2780*	
Kassala	0.1249	0.0562	0.0074	0.0492	6378	5582
	0.0125	*0.0027*	*0.0009*	*0.006*	*3579*	
Gadarif	0.1218	0.0506	0.0064	0.043	6337	5565
	0.0098	*0.0024*	*0.0006*	*0.0043*	*3451*	
Khartoum	0.1768	0.174	0.0395	0.264	7799	6420
	0.0114	*0.0054*	*0.0031*	*0.0158*	*5258*	
Gezira	0.1003	0.1155	0.0129	0.0861	6762	6084
	0.008	*0.0049*	*0.0012*	*0.0081*	*3354*	
White Nile	0.1263	0.0595	0.0068	0.0452	5471	4780
	0.0112	*0.0024*	*0.0007*	*0.0046*	*3219*	
Sinnar	0.1351	0.0456	0.0065	0.0432	6374	5513
	0.0255	*0.0021*	*0.0013*	*0.0086*	*4502*	
Blue Nile	0.0968	0.0315	0.0028	0.0187	5565	5026
	0.0072	*0.0012*	*0.0002*	*0.0017*	*2748*	
North Kordofan	0.1312	0.0935	0.0113	0.0755	5594	4860
	0.006	*0.0032*	*0.0007*	*0.0049*	*3106*	
South Kordofan	0.1013	0.025	0.0017	0.0115	4125	3707
	0.0079	*0.0012*	*0.0002*	*0.0011*	*2052*	
West Kordofan	0.1074	0.0247	0.0022	0.015	5136	4585
	0.0059	*0.0011*	*0.0002*	*0.0011*	*2551*	
North Darfur	0.1294	0.0691	0.0076	0.0511	5197	4524
	0.0101	*0.0036*	*0.0008*	*0.0052*	*2882*	
West Darfur	0.1881	0.0263	0.0036	0.024	4421	3589
	0.0118	*0.001*	*0.0003*	*0.0021*	*3154*	
South Darfur	0.1471	0.0776	0.0098	0.0656	5222	4454
	0.0123	*0.0034*	*0.001*	*0.0068*	*3261*	
central Darfur	0.1299	0.033	0.0028	0.0187	3964	3449
	0.0081	*0.0012*	*0.0002*	*0.0015*	*2281*	
East Darfur	0.1169	0.0203	0.0019	0.0129	4930	4354
	0.0082	*0.0009*	*0.0002*	*0.0012*	*2604*	
Within	.	.	0.1335	0.8928		
	.	.	*0.0041*	.		
Between	0.016	.	0.016	0.1072		
	0.0002	.	*0.0002*	.		
Population	0.1495	1	0.1495	1	6082	5173
	0.0041	*0*	*0.0041*	*0*	*3801*	

Source: AfDB Statistics Department

The gender of the head of the household

The results in Table 21 show that on average the standard of living in female-headed households is very similar to that of male-headed households. The EDEC is estimated at 5224 for the first group compared to 5167 for the second group (a difference of nearly 1%). This result is explained by the fact that the inequality, measured by the Theil index, is relatively higher in the first group (0.17) compared to the second group, strongly reducing the positive difference by nearly 4% in the average consumption between the two groups (6305 SDG compared to 6053 SDG). Similarities in living standards also explain the almost zero difference in between-group inequalities. Of course, these results should not overshadow the potential problems faced by female-headed households, particularly those related to labour market participation, access to finance or other economic opportunities. All of these problems that go beyond the scope of this study deserve to be examined with the necessary rigor.

Table 21: Decomposition of the Theil index by household head gender

	Theil index	Population share	Absolute contribution	Relative contribution	Average consumption	Equally distributed equivalent consumption
Head female	**0.1715**	**0.1138**	**0.0202**	**0.1354**	**6305.103**	**5224**
	0.015	*0.0036*	*0.0021*	*0.0128*	4283.899	
Head male	**0.1464**	**0.8862**	**0.1292**	**0.8641**	**6053.54**	**5167**
	0.0042	*0.0036*	*0.0038*	*0.0132*	3733.805	
Within	**.**	**.**	**0.1494**	**0.9994**		
	.	.	*0.0041*	.	.	.
Between	**0.0001**	**.**	**0.0001**	**0.0006**		
	0	.	*0*	.	.	.
Population	**0.1495**	**1**	**0.1495**	**1**	**6082**	
	0.0041	*0*	*0.0041*	*0*	*3801*	

Source: AfDB Statistics Department

Unsurprisingly, when we consider education level, which is considered an important factor explaining income level and dispersion, results in Table 22 show that income differences among household groups according to the educational level of their head are quite sharp. The education level of the head of household is strongly and positively correlated with the household's equivalent income, except for the more-heterogeneous group of heads with no particular qualification. Sharp differences in consumption levels appear from some secondary education and beyond. Per capita consumption is 7526 SDG which is one and half times that of households in which the head had a "khalwa" education. This reflects the importance of achieving a decent level of education to better seize economic opportunities.

For inequality within each group, there are not-substantial but significant differences across the households according to their head's education level, in particular between those headed by an individual with "university degree" and the rest of the population. The estimates

of the Theil index show that the highest inequality is among households headed by an individual with a university degree, and the lowest inequality is observed in the groups of households where the head has some or more primary education. The overall contribution of the between-group inequality component is estimated at 12.3%.

Table 22: Decomposition of the Theil index by household head education level

	Theil index	Population share	Absolute contribution	Relative contribution	Average consumption	Equally distributed equivalent consumption
No qualification	**0.1314**	**0.4081**	**0.0466**	**0.3119**	**5626.437**	**4887**
	0.0057	*0.0058*	*0.0022*	*0.0146*	*3069.105*	
Khalwa	**0.1201**	**0.0882**	**0.0089**	**0.0593**	**5087.237**	**4476**
	0.0066	*0.0033*	*0.0006*	*0.0043*	*2716.624*	
Primary	**0.1388**	**0.2596**	**0.0361**	**0.2416**	**6095.903**	**5250**
	0.0089	*0.0053*	*0.0026*	*0.0153*	*3669.094*	
Intermediary	**0.1138**	**0.0925**	**0.0112**	**0.075**	**6475.907**	**5739**
	0.0094	*0.0038*	*0.0011*	*0.0074*	*3423.887*	
Secondary	**0.1168**	**0.0939**	**0.0136**	**0.0908**	**7526.795**	**6648**
	0.0064	*0.0036*	*0.001*	*0.0065*	*3902.468*	
University	**0.1523**	**0.0577**	**0.0147**	**0.0984**	**10177.88**	**8628**
	0.0138	*0.003*	*0.0017*	*0.0102*	*6147.556*	
Within	**.**	**.**	**0.1311**	**0.8769**		
	.	*.*	*0.004*	*.*		
Between	**0.0184**	**.**	**0.0184**	**0.1231**		
	0.0005	*.*	*0.0005*	*.*	*.*	*.*
Population	**0.1495**	**1**	**0.1495**	**1**	**6082**	
	0.0041	*0*	*0.0041*	*0*	*3801*	

Source: AfDB Statistics Department

Table 23 shows a negative relationship between the household size and the average consumption. Any additional member was found to have a negative impact on the per capita consumption level. That is, any additional member increases the average household consumption but reduces the per capita consumption level. This suggests that the most deprived population lives in large families. The per capita consumption of a family of 3 to 4 people is twice that of a family of 9 or more people. The between component of inequality is particularly high across households of different sizes. Almost 30% of the total inequality is explained by differences in average living standards between households of different sizes. This suggests that large families, particularly those with 6 or more people, deserve special attention in terms of public intervention. These families represent more than half of the Sudanese population.

Table 23: Decomposition of the Theil index by household size

	Theil index	Population share	Absolute contribution	Relative contribution	Average consumption	Equally distributed equivalent consumption
1 or 2 persons	**0.1224**	**0.0276**	**0.0074**	**0.0496**	**13337**	**11705**
	0.0145	*0.0011*	*0.001*	*0.0063*	*7606*	
3 or 4 persons	**0.1068**	**0.1569**	**0.024**	**0.1606**	**8712**	**7782**
	0.0069	*0.0035*	*0.0018*	*0.0106*	*4391*	
5 or 6 persons	**0.1105**	**0.2881**	**0.0338**	**0.226**	**6454**	**5741**
	0.008	*0.0052*	*0.0027*	*0.0157*	*3423*	
7 or 8 persons	**0.1048**	**0.2853**	**0.0252**	**0.1686**	**5124**	**4587**
	0.0066	*0.0056*	*0.0019*	*0.0123*	*2593*	
9 persons or more	**0.0876**	**0.242**	**0.0148**	**0.0987**	**4234**	**3863**
	0.0053	*0.0059*	*0.0011*	*0.0076*	*1890*	
Within	**.**	**.**	**0.1052**	**0.7035**		
	.	*.*	*0.004*	*.*		
Between	**0.0443**	**.**	**0.0443**	**0.2965**		
	0.0006	*.*	*0.0006*	*.*		
Population	**0.1495**	**1**	**0.1495**	**1**	**6082**	
	0.0041	*0*	*0.0041*	*0*	*3801*	

Source: AfDB Statistics Department

Finally, we consider the head's occupational status which is often used as the main indicator in defining the social status of the household. Results in Table 24 show that per capita consumption is highest among heads working in the IT/finance (7961 SDG), public administration (7254 SDG), and real estate (7193 SDG) sectors. The lowest living standard is observed among heads working in the agricultural/fishing sector (5115 SDG) which represents 37.8% of the total population, and to a lesser extent the construction sector (6110 SDG). These results are in line with the idea that construction and agriculture offer instable and low-productivity jobs, and hence volatile and low incomes. The inequality within each group seems fairly comparable, with the exception of the IT/finance sector, where the Theil index reaches 0.18. The ranking of the different groups in terms of EDEC thus remains unchanged. The between component of inequality is quite low and does not exceed 6%.

Table 24: Decomposition of the Theil index by household head activity sector

	Theil index	Population share	Absolute contribution	Relative contribution	Average consumption	Equally distributed equivalent consumption
Agriculture/fishing	**0.1319**	**0.3788**	**0.042**	**0.2812**	**5115**	**4440**
	0.0059	*0.0057*	*0.0021*	*0.0137*	*3085*	
Industry	**0.1369**	**0.0367**	**0.0055**	**0.0369**	**6677**	**5763**
	0.0129	*0.0024*	*0.0007*	*0.0047*	*3825*	
Construction	**0.1151**	**0.0364**	**0.0042**	**0.0282**	**6110**	**5407**
	0.0108	*0.0024*	*0.0005*	*0.0035*	*3204*	
wholesale/trade	**0.1246**	**0.0888**	**0.0122**	**0.0815**	**6693**	**5859**
	0.0081	*0.0035*	*0.001*	*0.0068*	*3639*	
Transportation	**0.1077**	**0.0471**	**0.0053**	**0.0358**	**6410**	**5720**
	0.0089	*0.0026*	*0.0005*	*0.0036*	*3237*	
IT/Finance	**0.1884**	**0.0183**	**0.0045**	**0.0302**	**7961**	**6461**
	0.03	*0.0017*	*0.001*	*0.0066*	*5584*	
Real Estate/other service	**0.1441**	**0.0282**	**0.0048**	**0.0321**	**7193**	**6156**
	0.0173	*0.0021*	*0.0007*	*0.0049*	*4350*	
Public administration	**0.1398**	**0.1004**	**0.0167**	**0.112**	**7254**	**6240**
	0.0096	*0.0037*	*0.0015*	*0.0094*	*4250*	
Other	**0.1607**	**0.2652**	**0.045**	**0.3011**	**6424**	**5392**
	0.0099	*0.0054*	*0.0032*	*0.0169*	*4202*	
Within	**.**	**.**	**0.1403**	**0.9388**		
	.	*.*	*0.0041*	*.*		
Between	**0.0091**	**.**	**0.0091**	**0.0612**		
	0.0001	*.*	*0.0001*	*.*		
Population	**0.1495**	**1**	**0.1495**	**1**	**6082**	
	0.0041	*0*	*0.0041*	*0*	*3801*	

Source: AfDB Statistics Department

4.3. Consumption polarization in Sudan

Another policy concern related to consumption or income distribution is the extent of geographic or spatial clustering of living standards around distinct and divergent population groups. In fact, people within each group (by region, place of residence, or socio-professional group) have homogeneous lifestyles but are very different from the rest of the population. They could probably develop a strong sense (feeling) of identification because they share almost the same standard of living. At the same time, the identification felt could be accompanied by a feeling of repulsion (alienation) towards other groups of the population. Both of these feelings could have very detrimental effects on social cohesion and peace. They can even distort the choice of certain public policies or investments by favouring a particular group to the detriment of other groups. This form of grouping reflects the polarization of society. An immediate measure of the level of divergence between groups would be the differences in consumption or average income for each group. However, inequality within each group should also be taken into account, which could reduce differences between groups. Indeed, suppose that average consumption in rural areas is lower than in urban areas. In parallel suppose that inequality in rural areas is very high, such that the consumption of the richest in the rural areas could substantially exceed those living in urban areas. Such overlap in the level of consumption can significantly reduce the measure of divergence between the two groups (urban vs. rural).

An immediate measure that takes these two effects into account would be to define a polarization measure P equal to the ratio of between and within components of an exactly decomposable measure of inequality.

Thus, we have $P=B/W$, where B and W denote respectively the between and within components of an exactly decomposable inequality index I that could be written as $I=B+W$. See appendix B for the decomposition of inequality measures.

For a constant level of inequality within the groups, an increase in the average gap between the groups induces more polarization in the society. An increase of inequality within groups lowers the polarization. In what follows we consider two dimensions of the polarization: the first is based on state of residence and the second is based on urban-rural clustering. The evolution of the polarization between the groups between 2010 and 2015 is shown. All results are derived from the decomposition of Theil index which is among General Entropy measures of inequality.

Table 25: Polarization indices 2010-2015

Dimension	Inequality 2010	Between	Within	Polarization 2010	Inequality 2015	Between	Within	Polarization 2015
State	21.88	2.26	19.62	0.12	14.95	1.60	13.35	0.12
Urban/ Rural	21.88	2.91	18.97	0.15	14.95	0.81	14.14	0.06

When we consider the geographical dimension, two features emerge from Table 26. While there was a significant decrease in inequality during the period 2010-2015, consumption clustering around state of residence remained unchanged as can be seen by the constant polarization measure of around 0.12. Second, the between component (mean divergences across states) remained constant with a relative contribution of the between component to global inequality of around 10% in each period. The main driver of inequality decreases was the within component (consumption disparities within each state of residence) which fell by about 32% from 19.62 to 13.35. Disparities across states deserve more attention in order to narrow and improve gaps in living standards. Such results confirm earlier concerns that geographical disparities are indeed an issue to be investigated.

Urban-rural polarization declined significantly by about 60%, falling from 0.15 to 0.06 in 2015. The level of polarization represents about the half of polarization observed across states. The main driver of the decline of polarization is the sharp reduction of the living standards gap between urban and rural areas. As shown in Table 27, the between component decreased from 2.91 in 2010 to 0.81 in 2015. In other words the share of disparities in total inequality between urban and rural areas fell from 13.3% to 5.4%. Recall however that the substantial reduction in the urban-rural gap is partly explained by the negative growth of consumption in urban areas (see discussions above) and such issues should be considered to add nuance to such results.

V. Income Inequality in Sudan: A Gender and Regional Perspectives

It's widely accepted that households would choose a smooth consumption levels which are closely related to their 'lifetime' or 'permanent' incomes, rather than a more volatile 'current' income. Such hypothesis explains, at least partly, why economists often rely on consumption as a welfare measure to analyze the distribution of living standards across population subgroups. The households' ability to smooth their consumption levels depends on the tools they have to move resources over time and the structure (or sources) of their incomes. Access to credit markets, savings, and interfamily and government transfers are generally used to smooth consumption and absorb income shocks.

Hence consumption may be below or exceed current income because a household is saving, borrowing or benefiting from any other form of transfers, which is especially relevant for poorer households. Several studies[4] show that some consumption smoothing would still occur in the household decision making process. These considerations suggest that the smoothing degree depends on the nature of income changes. Also, the extent of the effect of income shocks, and hence household vulnerability, depends closely on the structure of household income and its different sources and whether it's based on permanent/accumulated endowments such as human capital skills or non-permanent or transitory sources (government interfamily transfers,…etc.).

The study of the nature of the income distribution and its various sources has important policy implications. Policies aimed at reducing inequality depend on the share of different sources of household income and the extent to which they are permanent or transitory. This section explores the structure and distribution patterns of household income from gender and regional perspectives.

5.1. The household income in 2015:

The household income is defined as the sum of earnings from the following sources.

[4]See for example Browning and Crossley (2001) and Attanasio and Weber (2010).

Table 26: Income sources

Agriculture activities	- crop sales - horticulture products sales - livestock sales - livestock products sales - poultry and poultry products sales - fish and fish products sales - forest products sales - other agricultural activities sales
Wages incomes	- wages and salaries
Enterprises and self-employment	- industrial activities - commerce - transport and communications
Assets	- rented estates - other rents
Transfers	- transfers from abroad - domestic transfers - other types of support - other sources
Social protection transfers and charity	- cash and in-kind transfers government program - charity, zakat, CSO (cash and in kind)

Table 27: Basic descriptive statistics of per capita household income

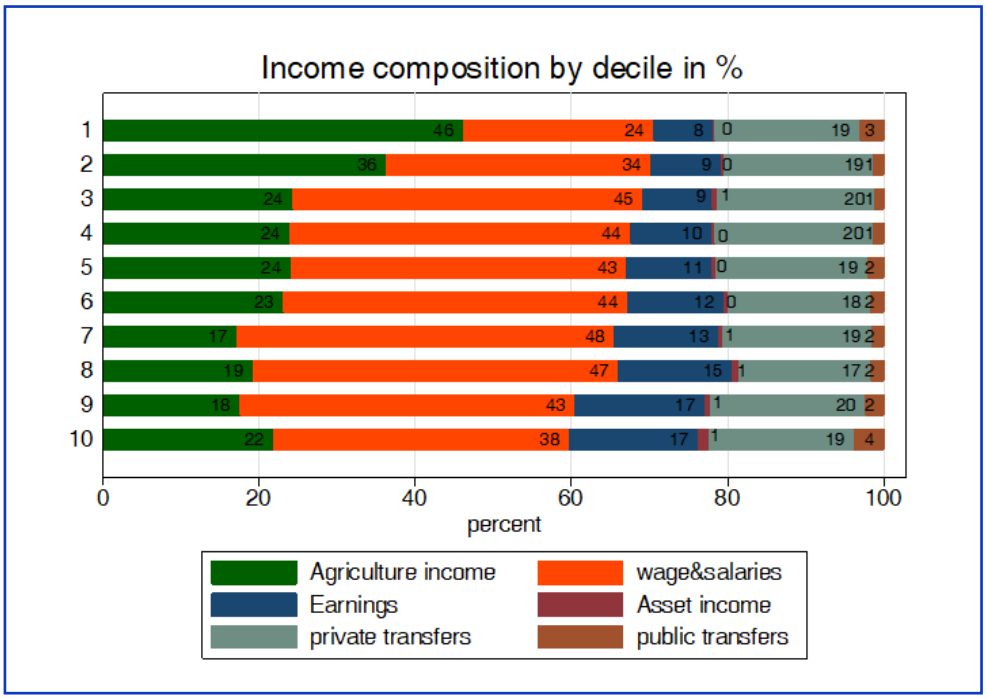
Variable	p5	p25	p50	mean	p75	p95
Per capita income (1)	432	1340	2333	3705	4000	10200
Per capita expenditure (2)	2191	3439	4728	5443	6485	11161
Ratio (1)/(2) in %	19.7	39.0	49.4	68.1	61.7	91.4
Per capita consumption (3)	2393	3741	5187	6082	7253	12879
Ratio (1)/(3)	18.1	35.8	45.0	60.9	55.2	79.2

Source: AfDB Statistics Department

As shown in Table 27, on average per capita income represents 68.1% of the expenditure and 60.9% of the total consumption. The result is not surprising given that expenditure and consumption include own production and consumption as well as imputed rent.

For the population with low consumption levels, the usual and identifiable sources of income represent only a relatively small share of the observed consumption. The poorest 5% report an income that does not exceed 19.7% of their expenditure. The first quartile (the poorest 25%) reports an income equal to 39% of their expenditure. On the one hand, this figure reflects a high volatility and irregularity in the incomes of the poor, which pushes the poor to under-report the different sources of income. On the other hand, the large gap between income and expenditure reflects the importance of inter-family transfers.

Figure 19: Income composition by decile

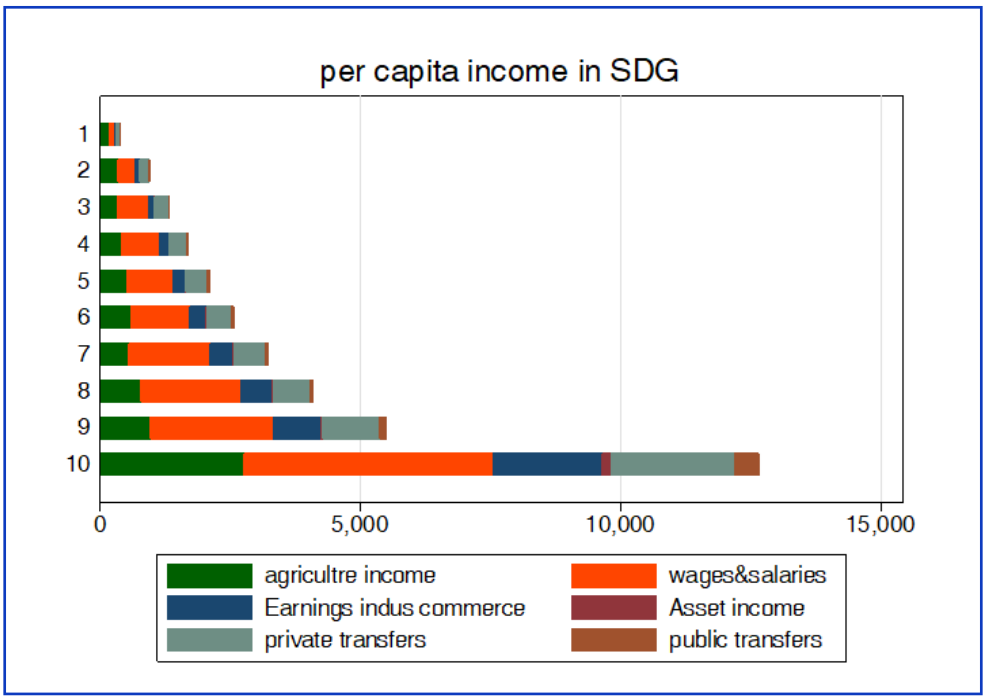


Source: AfDB Statistics Department

Figure 18 shows the income composition by decile. Poor groups derive their income from agricultural activities and to a lesser extent from wage activities, unlike wealthier groups, for which data shows an opposite trend with only 22% of income from agriculture, compared to 46% for the poorest decile. Earnings from other non-wage activities account for a larger share for the richest groups (17% for the tenth decile compared to only 8% for the first decile). The relative share of private transfers, which is around 20%, is constant for all deciles. The same applies to public transfers. Not surprisingly, working income for the poorest is almost nil, while it is around 1% for the wealthiest categories.

The same disparities and patterns of the total income composition appear when we consider the level of per capita income (see Figure 19). Even when the difference in household sizes is taken into account, it is clear that the return on agricultural activities is much lower for the poor.

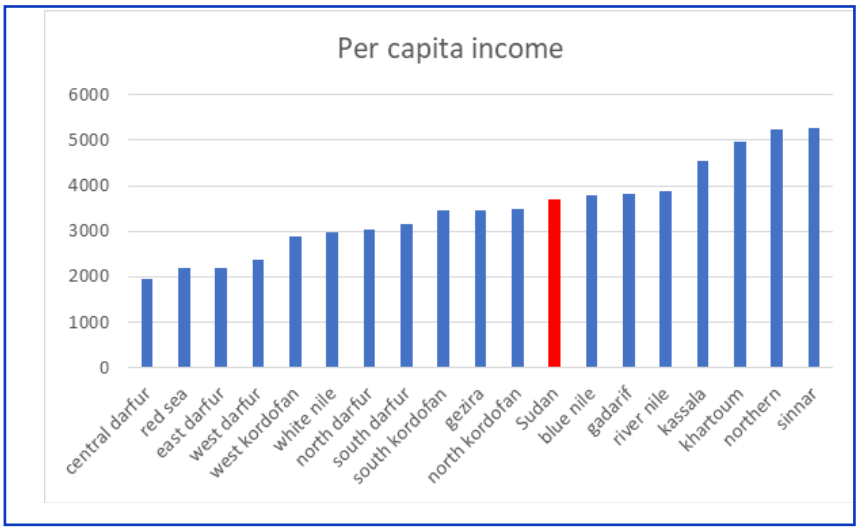
Figure 20: Income Level by Decile and Source



Source: AfDB Statistics Department

Figure 20 shows the distribution of income by state. The same characteristics and disparities discussed above for consumption are confirmed when we adopt income as an indicator of household well-being. The regions of Darfur, the Red Sea, and Kordofan have incomes below the national average. The highest incomes are observed in the Northern and Sinnar regions.

Figure 21: Per Capita Income by State, 2015



Source: AfDB Statistics Department

Figure 20 shows the distribution of income by state. The same characteristics and disparities discussed above for consumption are confirmed when we adopt income as an indicator of household well-being. The regions of Darfur, the Red Sea, and Kordofan have incomes below the national average. The highest incomes are found in the Northern and Sinnar regions. The income distribution also confirms the distribution of the incidence of poverty between the different states.

Table 28: Average income by head's gender in SDG

Per capita income			
	Rural	Urban	Both
Female (1)	2968	5122	3853
Male (2)	3331	4371	3686
Ratio (1)/(2)	89	117	105
Total	**3293**	**4471**	**3705**

Source: AfDB Statistics Department

When we consider income by gender of the head of household, the results in Table 28 show that at the national level the differences are not significant. However, in urban areas, the average income of female-headed households is 17% higher than that of male-headed households. The opposite picture is observed in rural areas where the average income of the first group is 11% lower than the second group of households.

5.2. Income inequality

Table 29: Gini index by urban/rural residence and head's gender

	Estimate	Standard error
Rural areas	50.2	1.0
Urban areas	52.7	1.6
Female-headed households	55.1	3.7
Male-headed households	51.2	0.9
Sudan	51.7	0.9

Source: AfDB Statistics Department

It is not surprising that the level of income inequality is much higher than that of consumption, given that the latter is often much smoother than income. That is to say that, even in the absence of a regular income, households are able to finance their consumption through borrowing, inter-family transfers, etc. Table 29 provides an estimate of the Gini coefficient that measures the level of income inequality. At the national scale, the Gini coefficient is estimated to be 0.517. The same table shows that inequalities are relatively higher in urban areas, which have a Gini coefficient of 0.527 compared to 0.502 in rural areas. The same applies when we distinguish households by gender of the head of the household. Households managed by women have a much higher level of inequality than households managed by men (0.551 against 0.512).

5.3. Income inequality decomposition by source

Table 30 presents the breakdown of total inequality by source of income. We consider six sources, namely: agricultural income, wages, earnings, asset income, private transfers, and public transfers (see Appendix B for a brief presentation of the decomposition methodology). The results show the contribution of each income source on total Sudanese inequality. Such decomposition helps to understand how change in a given income source impacts total inequality. All in all, the contribution of each source of income is very close to its share of household income, with the exception of wages, whose contribution to inequality is less proportional to its share, and public transfers, which contribute more than proportionally to their share of income.

Table 30: Inequality decomposition by source of income

Sources	Income share	Absolute contribution	Relative contribution
Agriculture	21.5	10.8	20.9
Wages	40.1	19.0	36.8
Earnings	15.7	9.4	18.2
Assets	0.8	0.5	1.0
Private transfers	19.4	10.3	20.0
Public transfers	2.4	1.6	3.1
Total income	**100**	**51.7**	**100**

Source: AfDB Statistics Department

5.4. Decomposition of differences in income distributions by head's gender using quantile regression

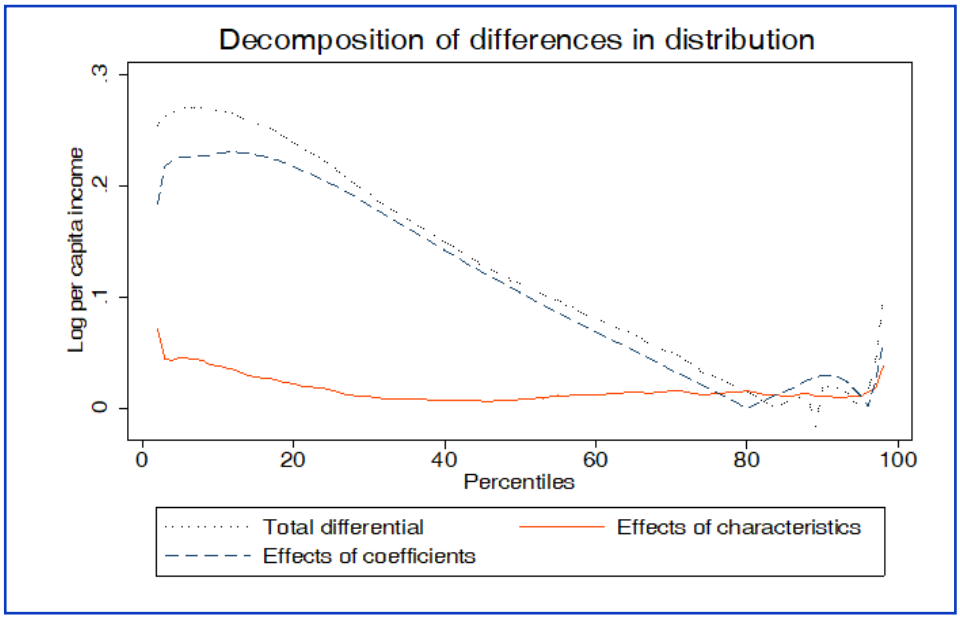
In this section we decompose differences in income distribution by gender of household head using quantile regression. This decomposition is very similar to the Machado and Mata (2005) decomposition.

In the first step, the distribution of log of per capita income conditional on a set of explanatory variables (see Appendix F for the regression specification and results) is estimated using linear quantile regression (see appendix D for a complete description of the estimator). The conditional distribution is approximated by 99 quantile regressions. The conditional distribution of the log of per capita income is then integrated across the explanatory variables to obtain the unconditional distribution.

The first step permits a more precise estimation of the unconditional income distribution by using the information contained in control (explanatory) variables. In other words, this step estimates counterfactual unconditional distributions - when we take the characteristics distribution for female-headed households and the coefficients estimated using the observations with male-headed household, we estimate the counterfactual distribution that we would observe if group 1(female) had the same income generating process as group 0.

This counterfactual distribution can be used to decompose the differences in distribution, for each of the 99 quantiles. The difference between the observed unconditional quantile of income for female-headed households and the same quantile for male headed households is decomposed into a part explained by the distribution of different characteristics and a part explained by the different coefficients. Note that the procedure followed here is a generalization of the famous Oaxaca/Blinder decomposition in the mean of the distribution.

Figure 22 : Decomposition of income differential



Source: AfDB Statistics Department

The observed median income gender gap is 11%. About 1% is explained by differences in the distribution of household characteristics and 10% is due to differing coefficients between both groups and can be interpreted as discrimination Indeed, the gap observed, particularly at the bottom of the income distribution, is largely explained by the performance of household characteristics, rather than by household endowments. For example, two households whose heads have the same level of education do not have the same capacity to generate income. This is why these gaps can be interpreted as a form of discrimination.

The observed gap is decreasing in relative terms when we move up the income distribution. In fact, female-headed households are negatively discriminated against at the bottom of the distribution. Both the distribution of household characteristics and the coefficients are responsible for this fact.

All in all, the main message that emerges from this decomposition exercise is that, the return to characteristics is more important than the household endowments. These results suggest that the discrimination decreases as we move up through the income distribution.

VI. Main findings

Big decline in food insecurity and extreme poverty. Over the period 2010-2015 the Sudan experienced a significant decline in food insecurity and extreme poverty, which fell by 6 and 4 percentage points respectively. In relative terms, these declines are equivalent to 40 and 15 per cent, respectively. However, the poverty rate based on the upper poverty line remains high, falling by only 1.5 percentage points.

Divergent evolution of poverty across areas. While the poverty incidence decreased in rural area from 45% to 35.5%, urban area experienced an increase of poverty rate by 6 percentage points.

Important regional disparities exist on poverty incidence. Overall, western, southern, and Red Sea states are the relatively most deprived. The poverty rate varies considerably from 12% in Northern state to about 67% in South Kordofan and Central Darfur. While food insecurity is almost non-existent in Northern and Gezira states, it affects almost a third of the population of West Darfur and Central Darfur states.

Sudan has succeeded in reducing inequality in a remarkable way. Between 2010 and 2015 inequality, as measured by the Gini index, fell from 35.5 to 29.2%, while average income fell by 5% over the same period from 6420 to 6082 (at 2015 prices). In other words, the average income gap between two randomly selected Sudanese in 2010 was about 4558 SDG (2*0.355*6420), while the same gap decreased in 2015 to only 3552 SDG (2*0.292*6082).

The decline in food insecurity and poverty is mainly due to redistributive policies and not to income growth. The observed change in the different measures of poverty is explained by a redistributive effect and not by a growth-income effect. In other words, if Sudan would have achieved higher growth the reduction in poverty would have been greater.

Per capita consumption growth over the period 2010-2015 was clearly pro-poor. This explains the decrease in poverty and also the improvement in the living conditions of the poorest, even if they did not manage to get out of poverty. The average poverty gap decreased from 12.1 to 9.1%, i.e. a decrease of 25%.

Appendix A: Poverty measures

The aggregation problem consists in describing individuals' multidimensional well-being by a single measure of poverty.

The literature offers a large number of aggregate measures of poverty. The most widely used measure is the headcount index, which measures the incidence of poverty by the percentage of poor individuals. Let *H* be the total number of households, z the poverty line, $\mathbf{n}_h$ the number of people in each household, $\mathbf{w}_h$ the sample weight and $\mathbf{y}_h$ per capita consumption. Let N also be the estimation of the population size, given by

$N = \sum_{h=1}^{H} w_h\, n_h.$

The Headcount index (P_0) can be expressed as follows:

$$P_0(y;\, z) = \sum_{h=1}^{H} \frac{n_h w_h I(y_h<z)}{N} \qquad \text{(A1)}$$

where: *I*(.) is an indicator function that takes a value of 1 if the bracketed expression is true, and 0 otherwise. The numerator corresponds to the estimated size of the poor population (i.e., living below the poverty line) while the denominator corresponds to the estimated size of the total population. This measure is simple to construct and easy to interpret. However, the measure suffers from a few weaknesses. The headcount index does not take the intensity of poverty into account. Indeed, it does not differentiate between extremely low incomes and incomes just below the poverty line.

If we assume that the gap between poor households' income and the poverty threshold reflects the poverty intensity of poor households, then the average of these gaps can be considered as a second aggregate measure of poverty. This is known as the poverty gap ratio and can be expressed as:

$$P_1(y;\, z) = \frac{1}{N}\sum_{h=1}^{H} n_h w_h \left(\frac{z-y_h}{z}\right) I(y_h < z) \quad \text{(A2)}$$

The poverty gap ratio is insensitive to the distribution of well-being among the poor population: any (marginal) transfer from one poor individual to another, even if less poor, has no impact on this measure of poverty.

The first two measures of poverty are part of the FGT class of poverty measures proposed by Foster, Greer, and Thorbecke (1984). The general analytic form of this class takes the following form:

$$P_\alpha(y;\, z) = \frac{1}{N}\sum_{h=1}^{H} n_h w_h \left(\frac{z-y_h}{z}\right)^{\alpha} I(y_h < z) \qquad \text{(A3)}$$

Where α is a measure of the sensitivity of the index with respect to poverty. The higher the value of α, the greater the aversion to poverty. When α=0, the FGT measure is simply the headcount index. When α=1, the index is the poverty gap. The transfer principle, which requires that a marginal transfer (of a monetary unit, for example) from one poor individual to another who is even poorer, reduces poverty, is respected for values of α > 1. The poverty severity index given by α = 2, P_2 (y; z), is one of the poverty measures that satisfies sensitivity to transfers.

Appendix B: Inequality measures

It is common to use consumption distributions to compute an inequality index without taking into account inter-regional price variation. In the case of data on price index at the regional level do not exist, thus, not permitting the assessment of the extent of spatial price variation and its effects on inequalities. However, for a given year, difference in poverty thresholds specific to the four regions could reflect the difference in the cost of living across these regions. We therefore used the region-specific absolute poverty line as an indicator of a price index to correct per capita consumption distributions (food, non-food, and total). Here:

$$Y_c^R = \frac{z_c^R}{\bar{z}_c} y_c^R, \quad \text{(B1)}$$

where the index c designates the consumption component (food, non-food, or total), the index R designates the region of residence; y is the unadjusted welfare (per capita) indicator of spatial price variation; Y is the (per capita) well-being indicator adjusted for spatial price variation; z designates the poverty line; $\dot{z}$ is the average of the poverty line at the national level.

Our approach is therefore to use distributions Y_c^R in addition to or in place of y_c^R to be able to appreciate the extent of the inequalities. The analysis in Section 5 shows that this correction does not have a very significant effect on inequalities.

Inequality indices

Inequality analysis complements poverty comparisons. In order to characterize the level and changes of inequality, the literature offers a large number of inequality indices.

The Gini coefficient

The most widely used measure of inequality is the Gini coefficient that can be calculated as follows:

$$Gini(Y) = \frac{1}{2N(N-1)} \sum_{i=1}^{N} \sum_{k=1}^{N} \frac{|Y_i - Y_k|}{\bar{Y}} \quad \text{(B2)}$$

where Y_i is wealth or income of person i, $\bar{Y}$ is the mean income (or expenditure per capita), and N is the population size.

The popularity of the Gini inequality index is mainly due to its popularity with international organizations, its intuitive interpretation and its graphic representation through Lorenz curves. First, it is the most calculated index by international organizations. Secondly, this popularity is due to its intuitive interpretation as being the average distance between all possible consumption pairs expressed as a proportion of average consumption. Third, this index can be inferred from the Lorenz curve, which indicates the cumulative proportion of consumption of the poorest proportion of the population.

The Atkinson class can be defined as:

$$CA(Y;\varepsilon) = 1 - \left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{Y_i}{\bar{Y}}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \quad \text{(B3)}$$

where ε is a weighting parameter, which measures aversion to inequality. The higher ε is, the more weight is attached to income at the bottom of the distribution relative to those at the top.

Generalized Entropy measures

The general formula of Generalized Entropy inequality measures is given by:

$$CE(Y^t;\theta) = \frac{1}{N^t}\sum_i \log\left(\frac{\bar{Y}^t}{Y_i^t}\right) \qquad si \ \ \theta = 0$$

$$= \frac{1}{N^t}\sum_i \left(\frac{Y_i^t}{\bar{Y}^t}\right)\log\left(\frac{Y_i^t}{\bar{Y}^t}\right) \qquad si \ \ \theta = 1$$

$$= \frac{1}{\theta(\theta-1)}\left[\frac{1}{N^t}\sum_i \left(\frac{Y_i^t}{\bar{Y}^t}\right)^{\theta} - 1\right] \qquad si \ \ \theta > 1$$

For lower values of θ, Generalized Entropy measures are more sensitive to changes at the lower tail of the distribution, and for higher values, Generalized Entropy measures are more sensitive to changes that affect the upper tail. The Theil inequality measure is part of this class and corresponds to the case where θ=1.

Robustness analysis: Are changes in inequality sensitive to the choice of the inequality index?

The robustness analysis makes it possible to determine whether the inequality comparisons are sensitive to the choice of the inequality index. It is done by graphically representing the Lorenz curve of the consumption

distributions. The latter is the graphical representation of the function, which is associated with the proportion of the poorest individuals p, and the proportion of the total consumption that they receive $L(p)$:

$$L(p) = \frac{1}{\bar{Y}} \int_0^p Y(p)dp$$

where $Y(p)$ denotes the consumption of the pth percentile of the consumption distribution, $\bar{Y}$ is the average consumption, and $L(p)$ is the Lorenz curve which indicates the cumulative % of total consumption held by a cumulative proportion p of the population. The line of perfect equality is defined by $L(p) = p$, i.e. by the first bisector.

Second-order dominance

Suppose we do not know whether comparisons of inequality depend on the choice of the inequality index, but we know that the inequality index must decrease as a result of an equalizing (i.e., downward) transfer between two poor individuals. It is then possible to demonstrate that the inequality clearly decreases from distribution B to distribution A if the Lorenz curve of B lies nowhere above and at least somewhere below that of A. In other words, the least unequal distribution must have the Lorenz curve closest to the line of perfect equality. This condition is known as second-order dominance.

Inequality decomposition by population subgroup

One of the most interesting features of the Entropy inequality measures is that they are decomposable by subgroup of the population. This decomposes the inequality measure into two components. The first term represents the within-group inequality and the second term represents the between-group inequality.

$$CE(Y;\theta) = \left[\sum_j f_j \log\left(\frac{\bar{Y}}{\bar{Y}_j}\right)\right] + \sum_j f_j CE_j(0) \qquad si\ \theta = 0$$

$$= \left[\sum_j f_j \left(\frac{\bar{Y}_j}{\bar{Y}}\right) \log\left(\frac{\bar{Y}_j}{\bar{Y}}\right)\right] + \sum_j f_j \left(\frac{\bar{Y}_j}{\bar{Y}}\right) CE_j(1) \qquad si\ \theta = 1$$

$$= \frac{1}{\theta(\theta-1)}\left[1 - \sum_j f_j \left(\frac{\bar{Y}_j}{\bar{Y}}\right)^\theta\right] + \sum_j f_j \left(\frac{\bar{Y}_j}{\bar{Y}}\right)^\theta CE_j(\theta) \qquad si\ \theta > 1$$

Here, f_j is the population share of group j and $CEj(\theta)$ is the level of inequality within group j. Thus, the between-group inequality is measured by the first component of each equation while the within-group inequality is measured by the second component of each equation. $\frac{\bar{Y}_j}{\bar{Y}}$ is the ratio of the group average living standards and the average national standard of living. This is equal to:

$$WL = \frac{Y_j}{\bar{Y}}\left[1 - CE_j(\theta)\right]$$

Note that other measures of inequality are decomposable only when the level of consumption does not overlap across different groups. On the other hand, all inequality measures can be decomposed by factors (income source, source of expenditure, etc.) as we will show in the following section.

Inequality decomposition by income source

Suppose that the indicator of well-being Y^i of an individual i can be expressed as the sum of all income components as follows:

$$Y^i = Y_1^i + \ldots + Y_j^i + \ldots + Y_J^i$$

where Y_j^i represents the different sources of income or expenditure or components of a measure of well-being. It can include wages, profits, dividends, transfers, etc. for income sources while expenditures include food, clothing, housing, transportation, recreation, etc. The idea is to decompose global inequality $IG(Y)$ by factors $IG(Y_j)$ in order to assess the major contributors.

$$IG(Y) = IG(Y_1) + \ldots + IG(Y_j) + \ldots + IG(Y_J)$$

Shorrocks (1999) proposed a general analytical framework based on the Shapley value that estimates the simultaneous contribution of a set of factors to the value of any measure of inequality. The idea is to start from an initial (hypothetical) distribution in which all Y^i are assumed to be zero, which implies an initial level of inequality equal to 0. Suppose we order the J factors in a certain way; the first factor Y_1^i is then given to all individuals, assuming that the resulting increase in inequality is the contribution of this source to the rise in inequality. The second factor Y_2^i is then added to all

individuals, assuming that the increase (or decrease) in inequality that results is the contribution of this second factor to overall inequality:

$$IG(Y_2) = IG(Y_1 - Y_2) + IG(Y_1)$$

Such an allocation is also called a distribution according to «incremental» benefits; it depends on a given order of the various considered factors. The Shapley value offers a simple and elegant solution to this problem: the solution is to make the calculations described above on all the possible orders of the various factors, and to take, as a final estimate of the contribution of each of them, the average of the impact calculated for all these orders. The various factors considered are thus treated symmetrically. Another advantage of factor decomposition is that this decomposition can be done on any measure of inequality, and not only on measures of the Entropy class, as is the case for the decomposition of inequality by subgroup.

In order to deepen our understanding of the determinants of inequality, we propose to decompose inequality by factors that are derived from an econometric regression model. This model relates the logarithm of consumption per capita to the household characteristics (area of residence, age, household size, education, employment status, etc.):

$$\ln(Y^i) = \delta_0 + \delta_1 x_1^i + ... + \delta_j x_j^i + ... + \delta_1 x_J^i + u_i$$

Note that variables relating to housing conditions are omitted to reduce the risk of simultaneity bias. In addition, the semi-logarithmic model is chosen for two reasons. The first is that it provides a better-fit observation and thus increases the share of the variance explained by the model. The second reason will become clearer once we proceed to the decomposition of global inequality by factor.

Appendix C: Decomposition of the variation of poverty into growth and redistribution components (Datt & Ravallion, 1992)

Let $F(x)$ be the cumulative distribution of income x, $L(F;p)$ the equation of the Lorenz curve given the income share owned by the p^{th} fraction of the population, and $L'(p)$ the slope of the Lorenz curve. According to Kakwani, (1980) we can write:

$$x = F^{-1}(p) = \mu L'(p) \qquad \text{(C1)}$$

where μ denotes the mean income. The distribution function evaluated at the poverty line is simply the poverty incidence (the headcount ratio P_0). Thus, from equation (C1) we can write:

$$L'(P_0) = {}^{z}/_{\mu} \qquad \text{(C2)}$$

where z denotes the poverty line.

Any change in the poverty is clearly related to change in income distribution as seen through Lorenz curve and the mean income. An aggregate additive poverty measure can be expressed as

$$P(F;z) = p\left(L_F, {}^{z}/_{\mu_F}\right) \qquad \text{(C3)}$$

Datt and Ravallion (1992) show that poverty changes between two periods (t=1,2) can be decomposed on a growth component (ΔP^G), redistribution component (ΔP^R), and residual or error term (e).

$$\begin{aligned}\Delta P &= p\left(L_2, {}^{z}/_{\mu_2}\right) - p\left(L_1, {}^{z}/_{\mu_1}\right) \\ &= \left[p\left(L_1, {}^{z}/_{\mu_2}\right) - p\left(L_1, {}^{z}/_{\mu_1}\right)\right] + \left[p\left(L_2, {}^{z}/_{\mu_1}\right) - p\left(L_1, {}^{z}/_{\mu_1}\right)\right] + Residual \\ &= \Delta P^G + \Delta P^G + r \qquad \text{(C4)}\end{aligned}$$

The residual r denotes the difference between the growth (redistribution) components evaluated with respect to the final and initial Lorenz curves (mean incomes).

The Datt and Ravallion decomposition is sensitive to the choice of the reference period (1 or 2), and produces a residual that can be interpreted as the mis-specified components in the decomposition. One way to overcome such a limitation is to rely on the Shapley decomposition and write the poverty change as:

$$\Delta P = \tfrac{1}{2}[G(1,2,r_1) + G(1,2,r_2)] + \tfrac{1}{2}[R(1,2,r_1) + R(1,2,r_2)] = \Delta P^G + \Delta P^G \qquad \text{(C5)}$$

Appendix D: Decomposing gender consumption gap

Estimation of gender consumption differentials using Oaxaca-Blinder

The equation identifies the determinants of the living standard differences between male and female-headed households.

$$Y_G = X_G\beta_G + u_G, G = Male\ (M), Female\ (F) \quad \text{(D1)}$$

where G is the gender of the household head, Y_G denotes a vector that includes the per capita consumption level adjusted by the change in spatial prices, X_G is a matrix that includes household characteristics of each group G, and u_G is a residual term that may also include omitted and unobservable variables.

It is well known that the Ordinary Least Squares regression line passes through sample average points such that:

$$\bar{Y}_G = \bar{X}_G\hat{\beta}_G, G = M, F \quad \text{(D2)}$$

where $\bar{Y}_G$ is the group's average per capita consumption, $\hat{\beta}_G$ is a vector of estimated parameters specific to group G, and $\dot{X}_G$ is the group's average household characteristics.

Therefore, the living standard differences between male and female-headed households can be expressed as:

$$\bar{Y}_M - \bar{Y}_F = \bar{X}_M\hat{\beta}_M - \bar{X}_F\hat{\beta}_F \quad \text{(D3)}$$

When the male-headed household is used as a reference group, equation (D3) can be rewritten as follows:

$$\begin{aligned}\bar{Y}_M - \bar{Y}_F &= \left(\bar{X}_M\hat{\beta}_M - \bar{X}_F\hat{\beta}_M\right) + \left(\bar{X}_F\hat{\beta}_M - \bar{X}_F\hat{\beta}_F\right) \\ &= (\bar{X}_M - \bar{X}_F)\hat{\beta}_M + \bar{X}_F\left(\hat{\beta}_M - \hat{\beta}_F\right) \\ &= CE_{M,F} + CI_{M,F}\end{aligned} \quad \text{(D4)}$$

where $CE_{H,F}$ represents the explained component of the living standard differences between groups and $CI_{H,F}$ represents the unexplained component.

Omitted variables bias: Quantile regression

The Ordinary Least Squares (OLS) method used above results in estimates of the conditional mean of the household's standard living given the value of the characteristics used as exogenous variables. However, the exclusion or omission of relevant variables makes the quality of adjustment of the model quite low (around 50% in the best cases). This means that the results from OLS regressions can give incomplete information about gender discrimination. In contrast, quantile regressions can provide estimates that are more robust to outliers than OLS regressions and are more efficient when the distribution of the error process is not normally distributed.

Unlike the OLS method, the quantile regression aims at estimating either the conditional median (q50) or other quantiles (q1, q2,..., q99) of the endogenous variables (household consumption per capita).

As part of this approach, five steps are followed to construct the counterfactual consumption distribution of female-headed households and to estimate head's unobservable abilities. These steps are represented as follows:

Step 1

It consists of estimating 99 quantile regressions ((**Q**=1,2,...,99) for each group: male and female-headed households.

$$Y_G = X_G\beta_G(Q) + u_G;\ G = M, F; Q = 1,2, \dots, 99 \quad \text{(D5)}$$

Step 2

It consists in predicting for each household 99 possible values of its per capita consumption. Each of these values corresponds to a possible point on the conditional distribution of per capita consumption.

$$\begin{aligned}\hat{Y}_M(Q) &= X_M\hat{\beta}_M(Q);\ Q = 1,2, \dots, 99 \\ \hat{Y}_F(Q) &= X_F\hat{\beta}_F(Q);\ Q = 1,2, \dots, 99\end{aligned} \quad \text{(D6)}$$

Step 3

It consists in determining for each household the absolute value of the difference between the predicted and observed value of per capita consumption.

$$\begin{aligned}Diff_M(Q) &= \left|\hat{Y}_M(Q) - Y_M\right|;\ Q = 1,2, \dots, 99 \\ Diff_F(Q) &= \left|\hat{Y}_F(Q) - Y_F\right|;\ Q = 1,2, \dots, 99\end{aligned} \quad \text{(D7)}$$

Step 4

It consists in determining for each household the value of its quantile $\hat{Q}$ which corresponds to the minimum value of $\mathrm{Diff}_G(Q)$:

$$Diff_M(\hat{Q}) = Min.\left(Diff_M(1), Diff_M(2), \dots, Diff_M(99)\right)$$
$$Diff_F(\hat{Q}) = Min.\left(Diff_F(1), Diff_F(2), \dots, Diff_F(99)\right) \quad \text{(D8)}$$

The value of $\hat{Q}$ is therefore considered as a measure of the unobservable abilities of the head of household.

Step 5

This step is to calculate the counterfactual consumption distribution of female-headed households.

Unlike the previous case where a single regression equation (OLS) is used for each household group, this calculation takes into account the position of each household $\hat{Q}$ on the conditional distribution of the subgroup to which it belongs:

$$\hat{Y}_F(\hat{Q}) = X_F\hat{\beta}_M(\hat{Q}) \quad \text{(D9)}$$

The counterfactual consumption given by equation (D9) therefore corresponds to the per capita consumption level without discrimination. After this step, it becomes easy to evaluate the explained component ($\mathrm{CE}_{M,F}$) and the unexplained component ($\mathrm{CI}_{M,F}$) of the difference in standard of living between the two groups of households. These two components are respectively given by:

$$CE_{M,F} = \frac{1}{N_M}\sum_{i=1}^{i=N_M} n_M^i w_M^i Y_M^i - \frac{1}{N_F}\sum_{i=1}^{i=N_F} n_F^i w_F^i \hat{Y}_F^i(\hat{Q})$$
$$CI_{M,F} = \frac{1}{N_F}\sum_{i=1}^{i=N_F} n_F^i w_F^i (\hat{Y}_F^i(\hat{Q}) - Y_F^i) \quad \text{(D10)}$$

where N_G denotes the size of the population of the subgroup G, n_F^i denotes the size of household *i* belonging to group G, and w_F^i denotes the weight of household *i* of group G. To determine the explained component (CE_{HF}) and the unexplained component ($\mathrm{CI}_{H,F}$), we can alternatively re-estimate equation ( ) with the OLS method but adding as an explanatory variable the new variable which approximates the unobserved abilities of the head of household ($\hat{Q}^i$)

Appendix E : Probit regression of poverty correlates

Table A 1: probit regression results

Outcome variable	Poor 0/1		Head: paid employee	0.106	*
River Nile	0.183			(0.057)	
	(0.120)		Head: employer	-0.076	
Red Sea	1.284			(0.072)	
	(0.106)	***	Head: self employed	0.044	
Kassala	0.303	***		(0.056)	
	(0.116)		Head: family worker	0.332	***
Al-gadarif	0.313	***		(0.079)	
	(0.114)		Head: unemployed	0.503	***
Khartoum	0.459	***		(0.147)	
	(0.106)		eduHead:khalwa	-0.072	
Al-gezira	0.172			(0.057)	
	(0.117)		eduHead:primary	-0.038	
White Nile	0.659	***		(0.040)	
	(0.105)		eduHead:intermediary	-0.275	***
Sinnar	0.235	**		(0.073)	
	(0.114)		eduHead:secondary	-0.119	*
Blue Nile	0.327	***		(0.070)	
	(0.104)		eduHead:University	-0.376	***
North Kordufan	0.684	***		(0.110)	
	(0.102)		Ln size	1.824	***
South Kordufan	1.133	***		(0.248)	
	(0.108)		Ln size sqr	-0.107	
West Kordufan	0.663	***		(0.082)	
	(0.106)		# children 0-5	0.099	***
North Darfur	0.530	***		(0.022)	
	(0.115)		# children 6-14	0.109	***
West Darfur	1.544	***		(0.019)	
	(0.103)		# children 15-24	0.039	**
South Darfur	0.906	***		(0.019)	
	(0.107)		Highesteduc: khalwa	-0.061	
Central Darfur	1.362	***		(0.091)	
	(0.105)		Highesteduc: Primary	-0.111	**
East Darfur	0.616	***		(0.047)	
	(0.107)		Highesteduc: Interm	-0.299	***
Urban	0.330	***		(0.080)	
	(0.035)		Highesteduc: Second	-0.472	***
Age of head	-0.002			(0.065)	
	(0.006)		Highesteduc: University	-0.861	***
Age of head squared	0.000			(0.081)	
	(0.000)		# employed	0.003	
Head is male	-0.208	***		(0.013)	
	(0.046)		Constant	-4.155	***
# Observations	11,953			(0.266)	

Source: AfDB Statistics Department

Appendix F: Estimated difference in the income distribution between female and male headed household

percentile	Characteris-tics effect	Std-err	Coefficient effect	Std-err	Total effect	Std-err
1	0.182439	0.22383	0.065794	0.266031	0.248233	0.092738
2	0.071079	0.145928	0.183274	0.143906	0.254353	0.044967
3	0.04415	0.116404	0.21812	0.095723	0.26227	0.032159
4	0.042989	0.099369	0.222646	0.075156	0.265635	0.02651
5	0.045684	0.086502	0.225892	0.064643	0.271576	0.02384
6	0.044679	0.076452	0.225984	0.056024	0.270663	0.022535
7	0.043718	0.068337	0.227023	0.051302	0.270742	0.021834
8	0.042969	0.06196	0.227348	0.047115	0.270317	0.020841
9	0.038805	0.056698	0.227864	0.043764	0.266669	0.020214
10	0.038133	0.052812	0.229765	0.041176	0.267898	0.019487
11	0.03617	0.04971	0.230218	0.038243	0.266388	0.018677
12	0.034945	0.047389	0.230851	0.036711	0.265797	0.018027
13	0.032122	0.045284	0.229463	0.035371	0.261586	0.017317
14	0.02911	0.043742	0.229678	0.033423	0.258788	0.016701
15	0.02779	0.042539	0.227861	0.031814	0.255651	0.01603
16	0.027003	0.041463	0.227009	0.031125	0.254012	0.015538
17	0.026623	0.040386	0.224716	0.030747	0.251339	0.015112
18	0.024697	0.039428	0.223018	0.030198	0.247715	0.014561
19	0.022679	0.038491	0.220471	0.02983	0.243151	0.014176
20	0.02211	0.037721	0.217282	0.029563	0.239392	0.013913
21	0.019628	0.036936	0.214145	0.029098	0.233773	0.013648
22	0.019636	0.036408	0.211731	0.028499	0.231366	0.013385
23	0.018212	0.035737	0.208601	0.028388	0.226812	0.013037
24	0.017975	0.035269	0.205088	0.028256	0.223062	0.012817
25	0.016146	0.034783	0.201827	0.028072	0.217973	0.012532
26	0.014327	0.034306	0.198424	0.028046	0.21275	0.01227
27	0.011968	0.033913	0.194791	0.027491	0.20676	0.012072
28	0.011299	0.033579	0.190967	0.027614	0.202266	0.011856
29	0.010138	0.033366	0.186663	0.027439	0.196801	0.011677
30	0.010302	0.033193	0.182645	0.027373	0.192947	0.011531
31	0.008992	0.033067	0.178552	0.027059	0.187544	0.011415
32	0.008554	0.032833	0.17437	0.026811	0.182924	0.011193

33	0.007934	0.032626	0.170479	0.026331	0.178413	0.01105
34	0.007782	0.032501	0.166183	0.026084	0.173965	0.010905
35	0.007492	0.032418	0.162286	0.025659	0.169777	0.010734
36	0.00774	0.03247	0.158447	0.025601	0.166187	0.010627
37	0.008016	0.032491	0.154193	0.02541	0.162209	0.010525
38	0.00725	0.032523	0.150333	0.025357	0.157583	0.010399
39	0.006735	0.032662	0.146355	0.025147	0.15309	0.010299
40	0.007491	0.032755	0.142081	0.02491	0.149573	0.010216
41	0.007085	0.032888	0.138457	0.02456	0.145542	0.010116
42	0.007211	0.032949	0.134093	0.024374	0.141304	0.010039
43	0.0072	0.033087	0.129619	0.024448	0.136819	0.01001
44	0.007212	0.033137	0.125968	0.024478	0.13318	0.00998
45	0.005926	0.033349	0.122289	0.024122	0.128215	0.009992
46	0.005974	0.033536	0.118646	0.024014	0.12462	0.009969
47	0.00675	0.033705	0.115151	0.023805	0.121901	0.009951
48	0.006775	0.03381	0.111543	0.02349	0.118318	0.009897
49	0.006693	0.033942	0.107689	0.023315	0.114382	0.009895
50	0.008088	0.034114	0.103877	0.023278	0.111964	0.009933
51	0.008562	0.034317	0.100063	0.023349	0.108624	0.009883
52	0.008722	0.034558	0.09632	0.023084	0.105043	0.009899
53	0.008824	0.034824	0.092744	0.022826	0.101567	0.009836
54	0.010246	0.035216	0.089038	0.022845	0.099284	0.009882
55	0.011146	0.03552	0.085589	0.023062	0.096735	0.009931
56	0.011224	0.035844	0.082119	0.023226	0.093344	0.009993
57	0.011353	0.03603	0.078738	0.023395	0.090091	0.009992
58	0.011354	0.036189	0.075132	0.023504	0.086487	0.010044
59	0.011605	0.036417	0.072151	0.023523	0.083756	0.010029
60	0.011744	0.036596	0.068413	0.02341	0.080157	0.0101
61	0.012212	0.036864	0.065123	0.02345	0.077335	0.010121
62	0.01308	0.037092	0.061738	0.023633	0.074818	0.010133
63	0.013438	0.03742	0.058495	0.023924	0.071932	0.010129
64	0.013911	0.037744	0.055078	0.024198	0.068988	0.010153
65	0.013879	0.038073	0.052131	0.02467	0.06601	0.010135
66	0.013956	0.03843	0.048516	0.024943	0.062472	0.010157
67	0.013259	0.038692	0.045252	0.025211	0.058511	0.010209

68	0.01417	0.03904	0.041445	0.025501	0.055615	0.010249
69	0.014665	0.039294	0.037924	0.025597	0.052589	0.010288
70	0.015498	0.039552	0.034112	0.025927	0.04961	0.010381
71	0.015727	0.039782	0.03098	0.026363	0.046707	0.010392
72	0.014518	0.040033	0.027751	0.026399	0.042269	0.010409
73	0.01279	0.040317	0.024463	0.026384	0.037252	0.010529
74	0.012161	0.040597	0.020825	0.026674	0.032987	0.010571
75	0.012259	0.040934	0.01753	0.026892	0.02979	0.010631
76	0.012961	0.041299	0.014071	0.027107	0.027032	0.010657
77	0.013547	0.041614	0.010548	0.027337	0.024095	0.010682
78	0.014347	0.041842	0.006745	0.027629	0.021093	0.010728
79	0.014526	0.042245	0.003331	0.027973	0.017857	0.010795
80	0.015244	0.042599	-0.0007	0.028457	0.014544	0.010852
81	0.014343	0.042902	0.002993	0.02909	0.01135	0.010988
82	0.012477	0.043211	0.005792	0.029882	0.006686	0.011082
83	0.011705	0.043346	0.009545	0.03024	0.00216	0.011087
84	0.011798	0.043586	0.012803	0.030491	0.001005	0.011363
85	0.010245	0.043787	0.014666	0.030708	0.004421	0.011531
86	0.010656	0.044076	0.017902	0.031063	0.007245	0.011829
87	0.012539	0.044133	0.021636	0.03176	0.009096	0.01216
88	0.012948	0.044378	0.024956	0.033141	0.012008	0.012411
89	0.010684	0.044819	0.027734	0.033996	-0.01705	0.012878
90	0.010153	0.044771	0.029378	0.034596	0.019224	0.013304
91	0.010524	0.045153	0.029256	0.035822	0.018732	0.01395
92	0.009366	0.045524	0.027753	0.037143	0.018387	0.014692
93	0.009373	0.046158	0.024643	0.037623	0.015269	0.015314
94	0.011262	0.047379	0.018585	0.039013	0.007323	0.016204
95	0.010404	0.049533	0.010485	0.039994	0.000081	0.016835
96	0.014432	0.052787	0.001416	0.041588	0.015848	0.018968
97	0.018181	0.059315	0.024306	0.046688	0.042487	0.022588
98	0.037464	0.076722	0.058408	0.058766	0.095872	0.03199
99	0.098233	0.136506	0.021523	0.104823	0.119755	0.055954