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Growth and inequality in Sub-Saharan Africa: insight from a linked abg method and cge modeling

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ABSTRACT

This paper uses survey data from a sample of Sub-Saharan African countries and showsthe heterogeneity in the shape and the structure of inequality between countries and over time.Based on the new Alpha Beta Gamma method (ABG), inequality is considered as an anisotropicdimension along the income scale.In the second part of the paper, we show that the growth-inequality relationship is defined in local domains. Different sector-led growth profiles are found to have heterogeneous effects on inequality at the median, the top and bottom ends of the income distribution.

Keywords: Growth, Inequality, Income, Africa

PAPER

1. Introduction

Africahas the highest poverty rate in the world and is the second most inequitable region after the Latin America. Giving the relation between poverty and inequality, there is timely research question to assess detailed analyses of inequality across and within countries and to find out the growth strategies that lead to more redistribution of wealth.

This paper uses a new representation of inequality developed by (Chauvel, 2014) in order to shed a new light on income distribution in Sub-Africa In this representation, inequality is then considered as anisotropic and varies along the income side. This is contrary to the traditional approachesthat consider inequality as stable and relyingonly onpartial summary statisticslike the Gini coefficient.The study uses survey data from a sample of 10 African countries, especially West African countries[1] to assess the inequality disparities along the income scale, between countries and over time.

The growth realized in the continent did not translate into inequality reduction and an interesting researchquestion could focus on identifying alternative sources of growth that could generate a high poverty reduction and more equal distribution of wealth[2].The second part of the paper tackles this question by using Senegal as a study country. It applies a Quasi-Dynamic Computable General Equilibrium (CGE)model linked to a micro-simulation module to identify the sectors that when driving growth have the highest impact on poverty reduction and inequality. Despite the long debate and the huge literature about growth-inequality linkage no consensus and clear relationship have been found. We contribute to this debate by turning our attention to the possibility that the growth-inequality relationship is defined in local domains along the income scale and by considering the fact that the pattern of growth might be an important factor.We explore the impact on inequality in the different parts of the income distribution in order to better take into account the complex nature of the inequality-growth linkage. This investigation could help to see the conditions in which economic growth impacts on economic inequality and poverty. The analyses of growth-poverty-inequality linkage for Senegal serve as a touchstone for future research including several countries.

Different sector-led growth profiles might have heterogeneous effects on inequality at the median, the top and bottom ends of the income distribution. Moreover, determining the condition under which economic growth impacts inequality requires an in-deep country specific analysis in a general equilibrium framework in order to integrate all the spillover effects in the economy. However, many of the previous studies on poverty-growth-inequality linkage use cross-countries data that often leadto limited and broad conclusions by failing to account for the idiosyncratic factors, and by using samples which include countries at various stages of economic development. A complex and unknown inequality shape combined with an appropriate choice of growth profile might lead to sub-optimal development policies.

The rest of the paper is organized as follows. In section 2, we provide some background knowledge on

[1] Many empirical analyses focused on the Southern African region where we have six countries among the continent's top ten most unequal countries in the world (ADB, 2012).
[2] The GINI coefficient increases from 0.42 to 0.46 over the period 2000 to 2010 (ADB, 2012).

the issue of anisotropic inequality and growth-poverty-inequality linkage.

Section 3 presentsthe methodology we used to address the research questions. Section 4.1 presents the pattern of inequality along the income scale and over time for selected countries in Africa. Section 4.2 identifies the growth profiles that have the highest impacts on poverty and inequality taking into account the heterogeneity along the income scale.

2. Background

2.1 Poverty-inequality-growth linkage

It is widely recognized that Sub-Saharan Africa is one of the most unequal region in the world. The Gini coefficient is estimated at 0.46 and isthe highest, behind Latin America (Table 1). However, beyond this general statistic, there might exist different levels and structures of inequality between countries and between the individuals within each country. This calls for a deep analysis of the structure and the evolution of inequality over the years and along the income scale. Besides, the presented framework allows analyzing how inequality responds to the different economic growth profiles. While there is a consensus that growth is a necessary condition for poverty reduction (Ravaillon and Chen 1997;Deininger and Squire 1997; Fan, Hazell and Thorat,2000; Ravallion, 2004; Fields, 2001; Kraay, 2006), the relationship between inequality and growth was subject to controversial debate in the literaturethat makes the link between the two factors no clear. For instance,a cross-country study by Ravallion (2004) finds that a one percent increase in income level results in a poverty reduction of between 0.6 and 4.3 percent. Likewise, Kraay (2006) found that growth in average incomes can explain 70 and 97 percent of changes in poverty headcounts in developing countries in the short and long-run.

Regarding growth-inequality linkage,Kuznets (1955) identifies an inverted U shape of inequalities over time. However, this relationship was criticized by some authors (Ravallion and Chen 1997; Atkinson, 1999; Arjona, Ladaique and Pearson, 2001) that cast doubt on the direction of the causation and the robustness of the relation.Pardo-Beltran (2002) finds a negative and but non-linear effect of growth on inequality.While Hausman and Gavin (1996) showed that the volatility of growth increases income inequality measured as the ratio of the income received by the richest 20 percent of the population to the income received by the poorest 40 percent.

In contrast to the growth-poverty nexus, the literature review shows that there is little consensus regarding growth-inequality linkage. However, our study investigates whether this relationship might depend on the nature of the growth, the parts of the income distribution that is considered and on the shape of inequality.In fact, different growth sources might have heterogeneous effects on inequality at the different parts of the income distribution because they affect household income differently and are not all growth-neutral. The link between inequality and growth can be multidimensional. However, this paper focuses on one direction of the interaction that is how growth might impact income inequality. There have been many indexes used in the literature to measure inequality at the top and bottom of the distribution, such as the quintile ratios, namely Q5/Q3 and Q3/Q1 and the percentile ratios, namely P90/P50 and P50/P1 or P90/P70 and P10/P30. However, the choice of these indexes might be arbitrary and might lead to various results. The Alpha Beta Gamma method (ABG) defined in section 3 allows a straightforward combination of the information along the income scalewithout losing generality. This paper sheds a light on the difference of structure of inequalities between and within selected sub-Saharan Africancountries by taking into account the heterogeneity in the income distribution.In a second step, this contribution investigates if it is not more the sources of growth that is crucial in determining the effects on inequality. Our framework allows identifying the growth profiles that lead to more egalitarian economies.

Table 1: Income Inequalities in the world

REGIONS	GINI	GE(0)*	90TH/10TH PERCENTILE RATIO
MIDDLE EAST AND NORTH AFRICA	0.37	0.25	5.12
SUB-SAHARAN AFRICA	0.46	0.31	6.63
LATIN AMERICA	0.50	0.50	14.42
SOUTH ASIA	0.33	0.18	4.12
EAST ASIA	0.39	0.25	4.92
EUROPE AND CENTRAL ASIA	0.31	0.16	4.17
HIGH-INCOME OCDE	0.31	0.17	4.09

Note *: Mean log deviation.
Source: World Bank, 2005; AFD, 2007

2.2. Agricultural sector in Senegal

Determining the extent to which different growth profiles affects household welfare and anisotropic inequality can be helpful for designing development policies. We use Senegal as our pioneer work for a better understanding of the potentials for inequality reduction, in addition to poverty reduction, by assessing the complex impacts of each specific sector-led growth on inequality along the income scale. The ABG method is used in order efficiently measure inequality.

In Senegal, as in many sub-Saharan countries, there has not been sufficient work in the sense of investigating the linkages between the several household groups and economic sectors and the various economic mechanisms that are specific to the sectors. The study provides insight on the extent different sector-led growth affect local inequality and household welfare. We will show how these effects vary, in the context of the structural transformation and growth promoted by the Senegalese Emergency Plan (PSE). In fact, the Senegalese government has recently started a new challenge that is the one of rapid progress toward successful economic emergence. This latter is the new reference framework for economic and social policy in the medium and long-term. One of the three axes of the new released PSE is growth and the structural transformation of the economy through the consolidation of the actual growth engines and the development of new sectors that are able to create wealth, employment, and social inclusion. The plan also seeks to promote sectors thathave the strongest export capacity and are attractive for investments (Senegal Emergent Plan, 2014). This new development strategy looking ahead to 2035 comes in addition to the large set of initiatives undertaken by the government like the establishment of the SCA (Accelerated Growth Strategy) at broader level or the implementation of agricultural development initiatives such as the Great Offensive for Food and Abundance (GOANA), the program return to Agriculture (REVA), the agro - Sylvo - Pastoral Orientation Law (LOASP) and more recently the National Program of Agricultural Investment (PNIA), within the Comprehensive African Agricultural Development Program (CAADP).

The implication of an agriculture-led growth is not documented so far, nor has been empirical evidence on the impacts of non-farm sectors on the welfare of both non-agricultural households and agricultural households. On one hand, although occupying a high share of employment, Agriculture in Senegal contributes weakly to the national GDP, contrary to Services sector. On the other hand, it is widely recognized that the Services sector drives growth, but poverty and inequality are still persistent and at the current path of the economy, it is difficult to imagine that figures will change much better over the next decades. Therefore, an interesting research question is to identify the growth profiles that have higher contribution to poverty and inequality reductions. The general equilibrium modelling part wants to shed a light on the heterogeneity on the effects of different growth types on anisotropic inequality and poverty. The characteristics of the economic sectors are not identical and the patterns that ensure their linkages to populations are quite different. Therefore, inequality and poverty impacts of various growth strategies deserve to be analyzed by considering the full range of general equilibrium effects. Further, the analyses of the sector-led growth and inequality linkages will be extended to remaining countries once we have built the appropriate micro-

Table2: The general structure of the economy

Sectors	*GDP share*	*Employment share*	*Export share*	*Import share*
Primary sector	16.1	47.4	11.2	7.0
Agriculture	7.0	26.4	3.2	6.1
Food Ag.	5.6	17.2	1.2	5.7
Industrial Ag.	1.4	9.2	2.0	0.3
Livestock	5.1	16.5	0.0	0.3
Forestry	1.1	2.5	0.1	0.1
Fishing	2.8	2.1	7.9	0.6
Secondary sector	23.9	14.7	64.1	85.3
Mining	2.2	0.9	8.9	9.9
Food processing	5.8	5.2	14.8	17.6
Industry	10.0	3.8	34.8	52.3
Other industries	6.0	4.8	5.6	5.5
Tertiary sector	60.0	37.9	24.7	7.7
Trade	16.7	25.8	0.0	0.0
Telecommunication	7.3	0.2	5.4	1.3
Business services	5.3	3.5	6.2	3.1
Health and Education	4.4	2.8	0.7	1.3
Other services	26.4	5.7	12.4	1.9

Note: GDP, employment, export, and import shares from the SAM are presented

Source: Authors

simulated CGE model for each country.

Beyond the macro-economic models that are based on national accounts, it is important to explore growth-poverty-inequality linkage from household surveys. As pointed out by Bourguignon et al. (2008), linked micro-macro can help to deal with the limitations of single and pure micro (respectively macro model) that when taken solely, only provides partial responses of policies at the macro level (respectively the micro level). The Table 2 presents the structure of the Senegalese economy. Agriculture employs the most of the individuals (47.4%) but account for only 16% of the GDP. The agricultural sector is confronted with many difficulties, including an overall yield decline owing to the soil degradation, the dependence to the precipitation, the successions of sub-optimal government policies, and the difficulties facing the main fertilizer provider, the Chemical Industry of Senegal – ICS, etc. Services account for a large share of the GDP (60%), despite the fact that agriculture is the primary source of employment in rural areas. The country's key export sectors are in the Industry (mainly chemical industry that includes fertilizer and phosphate extraction). Besides, the Food processing with 14.8% and primary sector with 11.2% have a significant part in the national export level (for the primary sector, we have especially the fishing sector, the groundnut and the vegetable sectors).

The use of the CGE allows integrating all relevant economic aspects, especially existing spillover effects in the economy and resource re-allocation. The analyses give valuable information on the responsiveness of the inequality and poverty to growth driven by a specific sector, as many policies are formulated by targeting specific sectoral programs.

3. Methodology

3.1 Inequality analyses

To assess inequality we used a new method develop by Chauvel (2014) that relies on the fact that inequality is anisotropic and its intensity is variable along the income scale. This method differs from the traditional one that only considers a constant general inequality index in the population expressed as the Gini index. The Alpha, Beta and Gamma (ABG) method estimates three parameters of inequalities, compatible with the Pareto properties of the tails. These parameters provide the level-specific measures of inequality at the median (alpha), the top (beta) and the bottom (gamma).

Starting from the CF distribution (see Champernowne, 1937; Fisk, 1961; Dagum, 2006), the ABG method is based on the expression of power of income Y_i (measured as the logarithm of the medianized revenue y_i) as a function of the logit of the rank quantile p_i in the distribution, X_i = logit (p_i) = log (p_i/q_i) where q_i is the proportion of individuals $(1 - p_i)$ having income above the income of the individual i.

$$Y_i = ln(y_i) = ISO(X).\ X_i \qquad (1)$$

With $ISO(X)$ expressing the local inequality at level X_i through the divergence between the median and log-income y_i and is defined as follows

$$\mathrm{ISO(X)} = \mathrm{alpha} + \mathrm{beta\ B(X)} + \mathrm{gamma\ G(X)} \qquad (2)$$

$$\text{Where } \mathrm{B(X)} = (\mathrm{theta1(X)} + \mathrm{theta2(X)})/2 \text{ and } \mathrm{G(X)} = (-\mathrm{theta1(X)} + \mathrm{theta2(X)})/2$$

$$\text{And } \mathrm{theta1(X)} = \tanh\ (X/2) = \frac{e^{X/2} - e^{-X/2}}{e^{X/2} + e^{-X/2}} \text{ and } \mathrm{theta2(X)} = \tanh^2(X/2)$$

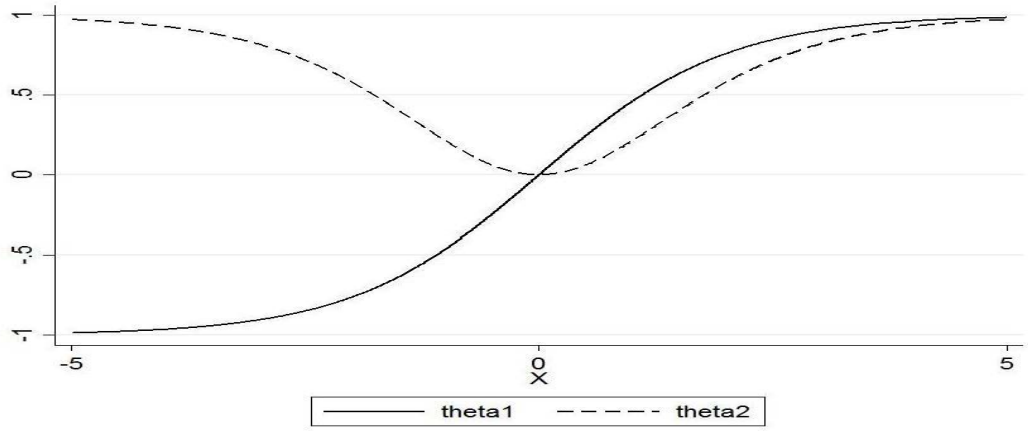
The coefficient alpha of the inequality level near to the median corresponds to the constant term in the equation (2). The uses of the two tangents hyperbolic related functions theta1 and theta2 allow the parameter beta to measure additional inequality at the top and gamma the additional inequality at the bottom. When beta and gamma are equal to zero, the distribution is a CF of coefficient alpha that will correspond to the Gini index. Otherwise the inequality is considered as non-stable along the income scale. The coefficient beta is positive when the rich are richer than in the CF distribution of coefficient alpha and gamma is positive when the poor are poorer than in the CF distribution of coefficient alpha (For more information see Chauvel, 2014).

To assess poverty, the calculated poverty indexes are the Foster-Greer-Thorbecke (FGT) family of poverty measures.

$$FGT = \frac{1}{N}\sum_{i=1}\left(\frac{z-y_i}{z}\right)^{\alpha} .\ I(y_i \le z) \qquad (3)$$

For $\alpha = 0$ the FGT index collapses to the headcount ratio P_0 that quantifies the proportion of the population that is poor, but does not show how poor the poor are. $\alpha = 1$ gives the poverty gap index (P_1) that measures the extent to which individuals fall below the poverty line as a proportion of the poverty line. The poverty line corresponds to the level of expenditure that allows households to meet nutritional needs and essential non-food consumption.

Figure 1: theta1 and theta2 functions



3.2 CGE modeling and micro-simulation

As explained before, we use Senegal as a case study to see how different sources of growth might have different impacts on both poverty and anisotropic inequality. A dynamic extension of the standard model developed by the International Food Policy Research Institute (IFPRI) is used (see Lofgren and Robinson, 2002 and Thurlow, 2004). The model is constructed for Senegal and calibrated using the 2011 agricultural Social Accounting Matrix (SAM) that we build. The simulations are run over a ten year period from 2011 to 2020 at the midterm of the Sustainable Development Goals(SDGs)[3].

Table A1 and Table A2 in the appendix provide a description of the model, and further explanation can be found in the above-mentioned documents.

Households are disaggregated based on their location, activity, and initial poverty status (Rural agricultural poor, rural agricultural rich, rural non-agricultural poor, rural non-agricultural rich, urban agricultural poor, urban agricultural rich, urban non-agricultural poor, and urban non-agricultural rich). Their consumption levels result from the maximization of a Stone-Geary utility function. The aggregated domestic output is allocated between domestic sales and exports using a constant elasticity of transformation (CET) to reflect the imperfect transformability between these two types of sales. An Armington function (Armington, 1969) is used to model imperfect substitutability between domestic outputs supplied for the domestic market and imports (See Lofgren, 2002 and Thurlow, 2004 for more details on the CGE model)[4]. Labor is disaggregated into four categories: unskilled labor, primary labor, secondary labor, and tertiary labor.

To assess the impact on poverty and inequalities, we use a micro simulation that we calibrated to household survey ESPS II[5]. Endogenous changes in consumption resulting from the CGE model are passed down to the household by mapping each of the household in the micro simulation model to the corresponding household in the CGE[6].

3.3 Data Source

The study relies on data from household surveysavailable forthe different countries. These surveys are representative at the national level and collect detailed information on household characteristics (employment, housing, income, education, health, etc.). The source of these surveys is indicated for each country in Table 3.

4. Results and Discussion

4.1 Inequality and poverty

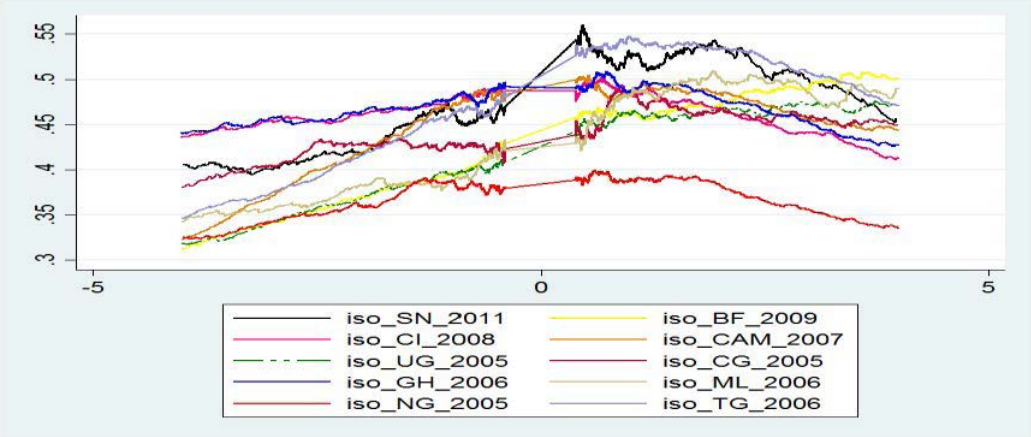
While there are many studies describing poverty, this study primarily focuses on inequality. The analyses of the isographs(Figure 2) and their summary in the ABG parameters (Table 4) show some heterogeneity between countries in both the level and the shape of inequality along the income scale, especially at the top income extremity. The isographs are not flat or constant over the income scale, revealing therefore the existence of local inequality. The difference of the parameters Beta and Gamma from zero indicates the limit of the Gini indicator as pointed out by (Chauvel, 2014).

[3] The new Sustainable Development Goals aim to end poverty by 2030 and are going to replace the Millennium Development Goals from January 2016.
[4] The Armington and CET elasticities are borrowed from the GTAP.
[5] Poverty Monitoring Survey.
[6] See (Colombo, 2010) for explanation of survey data and CGE model linkages.

Table3: Data source for income inequality analyses

Country	Survey Used	Year
Senegal	ESAM I: The Senegalese Household Survey I	1994
	ESPS I : Poverty Monitoring survey I	2005
	ESPS II : Poverty Monitoring survey II	2011
Uganda	UNHS: Uganda National Household Survey	2005
Burkina Faso	EPI: Priority Survey	1994
	ILCS: Integrated Living Conditions Survey	2009
Cameroon	ECAM III : Households Survey	2007
Ghana	GLSS : Living Standards Survey III	1992
	GLSS : Living Standards Survey V	2006
Mali	Household survey	1989
	ELIM: Integrated Household survey	2006
Niger	ECVAM : Vvulnerabilityandhouseholdfood insecurity	2005
Togo	QUIBB	2006
Ivory Coast	Living Standards Survey	1993
	Living Standards Survey	2008
Congo	ECOM: Household poverty monitoring survey	2005

Figure 2: Shape of inequality across the countries



Note: SN = Senegal; BF = Burkina Faso; CI = Ivory Coast; CAM = Cameroon; UG = Uganda; CG= Congo Democratic; GH = Ghana; ML= Mali; NG = Niger; TG = Togo

Source: Authors

Considering the last available household survey, the countries in our study are classified according to the sign of the parameters beta and gamma. Although the years of the different surveys are not the same, it is still insightful to compare the shape of inequality as we believe that inequality structure does not change drastically in the very short term.

All the countries have a negative gamma. However, the coefficient Beta allows the classification of the countries in two groups. Cameroon, Ghana, Niger, and Ivory Coast (Group N) have a negative beta while Senegal, Uganda, Burkina Faso, Mali, Togo, and Congo (Group P) have a positive one. In the first group countries have an isograph in the form of an inverted U with the peak observed around the zero and those in the second group have isograph with a positive slope. A positive Beta reveals more inequality at the top of the income distribution than at the median. The country typology reveals that despite being on the same continent and having similar economic structure, there are significant variations across countries in the structure of the inequality. Senegal and Togo have the highest inequality at the median of the distribution, Ghana and Ivory Coast have the highest inequality among the poor households, while Burkina Faso and Mali tend to have the highest level of inequality whenconsidering the richest households.

4.2 Dynamic inequalities for selected countries

A description of the temporal variation of the shape of inequality for some countries(two countries selected from each group) would allow seeingin detail potential heterogeneity in the change of the

Table4: Parameter valuesfrom the ABG method

Countries	*Year*	*Alpha*	*Beta*	*Gamma*
Senegal	2011	0.5061	0.0035	-0.1243
		(0.0005)	(0.0022)	(0.0012)
Uganda	2005	0.4289	0.0421	-0.0921
		0.0001)	(0.0003)	(0.0004)
Burkina Faso	2009	0.4401	0.0436	-0.1068
		(0.0001)	(0.0004)	(0.0003)
Cameroon	2007	0.4967	-0.0517	-0.1290
		(0.0002)	(0.0005)	(0.0009)
Ghana	2006	0.4946	-0.0372	-0.0564
		(0.0001)	(0.0006)	(0.0003)
Mali	2006	0.4306	0.0827	-0.0769
		(0.0003)	(0.0011)	(0.0007)
Niger	2005	0.3913	-0.0322	-0.0523
		(0.0002)	(0.0006)	(0.0005)
Togo	2006	0.5101	0.0063	-0.1523
		(0.0002)	(0.0008)	(0.0005)
Ivory Coast	2008	0.4921	-0.0520	-0.0564
		(0.0001)	(0.0005)	(0.0003)
Congo	2005	0.4399	0.0347	-0.0283
		(0.0003)	(0.0008)	(0.0009)

Note: Standard errors in parentheses.

Source: Authors

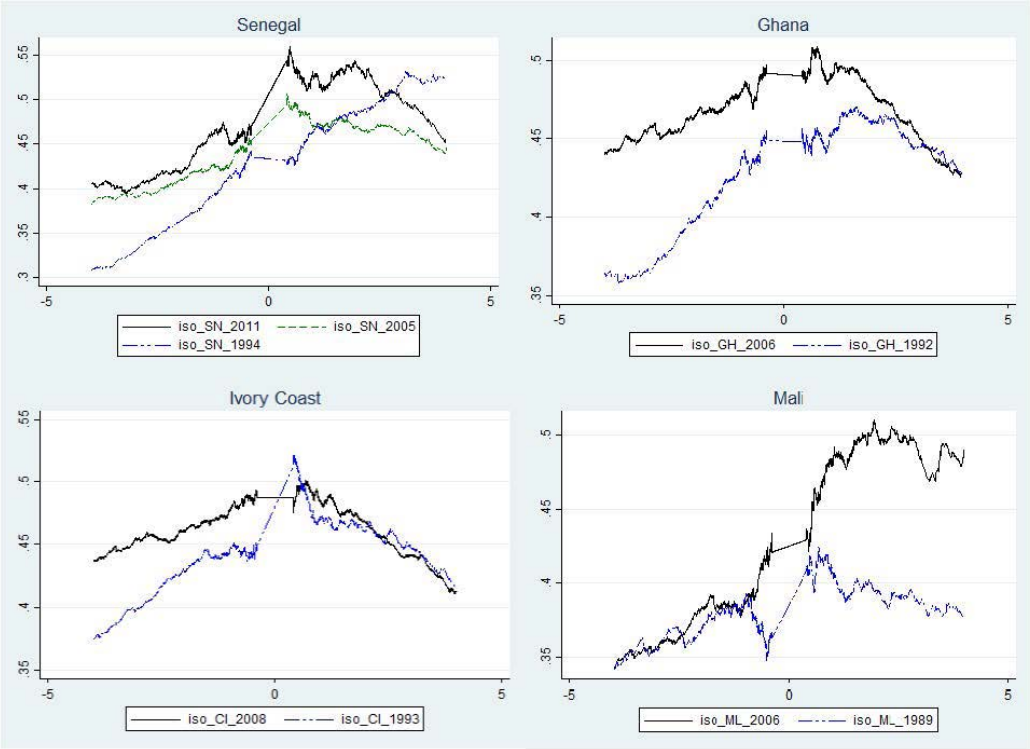
Table5: Classification of the countries following the shape of their isograph

	Beta Negative	**Beta Positive**
Gamma negative	***Group N*** Cameroon Ghana Niger Ivory Cost	**Group P** Senegal Uganda Burkina Faso Mali Togo Congo

Source: Authors

structure of inequality between the two last decades. The figure 3 shows the change and the persistent problem of inequality along the income scale over the years for the selected countries. The shape of inequality has changed less in Ivory Coast between the 1990's and the 2000's. In Senegal the inequality has increased over the years at the lower and middle level of income while the isograph decrease at the top. Senegal has observed a change in its shape of inequality that appears to be increasing throughout the mid-nighties and started charting an inverted U shaped type in the mid-twenties. Ghana and Mali show opposite patterns with either an observed widening or compression of inequality at the ends of the distribution over the years. Income inequality in Ghana has substantially increased at the low level of the income and has not changed much at the top while in Mali only inequality at the upper tail has

Figure 3: Dynamic of inequality



Source: Authors

changed drastically. Therefore, in Mali the increase of overall inequality is due to the diverging effect at the upper tail from the 1900's to the 2000's while in Ghana it comes from the diverging effect at the lower tail between the two periods. The differences of the inequality structures indicate that there should be no blueprints of the development policies' looking at the issue of inequality in Africa, each country deserves to be treated separately.

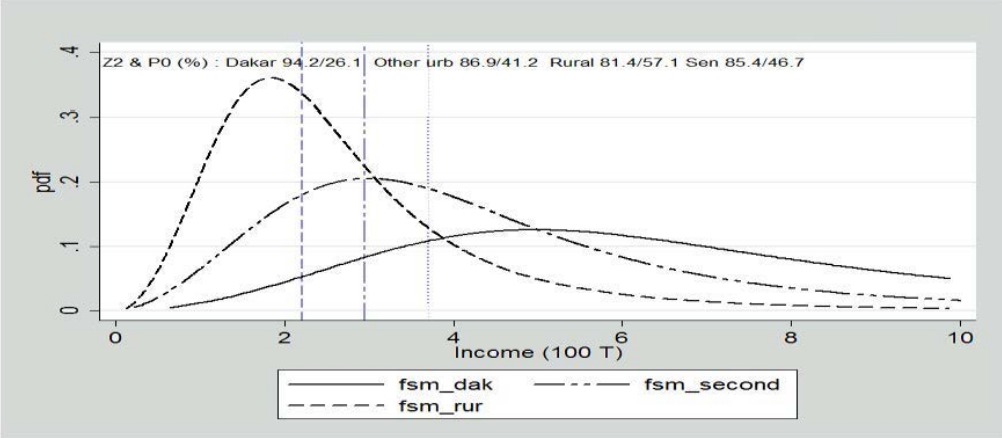
4.3 The engines for poverty and inequality reduction: Application to Senegal

A prominent debate is to identify the sectors and corresponding growth profiles that have the potential to be panaceas for both poverty reduction and income inequalities. This question is discussed in what follows by using Senegal as a case study country. The analysis will be extended to cover other countries in our future research, as there are no universal policy prescriptions and because of idiosyncratic characteristics of the growth-poverty-inequality linkage in each country. Moreover, the previous section has shown significant differences in the structure of inequality between African countries showing potential limitations of cross-countries studies analyzing the issue of inequality in Africa. The evidence from this analysis has the potential to contribute to development policy making and designing an optimal policy strategy in order to realize development targets in terms of poverty alleviation and inclusive growth. Using the quasi-dynamic CGE modeling framework linked to the ABG method, we simulate an additional slight growth of the GDP from the baseline (Business As Usual – BAU) value of 3.7 % to 4% through different scenarios where we assume that this additional growth is led by a specific sector. The size of the simulation here is not crucial as different shifts will generate the same mechanisms in the economy.

The figure 4 shows the initial income distribution in 2011 in Senegal assuming that the income generating process follows a Singh-Maddala distribution. The latter is a generalized Pareto distribution and is considered as providing a better fit for income distribution than distributions like Gamma or Log-normal (Singh and Maddala, 1976; Mac Donald and Ransom, 1979). Poverty headcount is estimated at 46.7% at the national level and is heterogeneous across locations with a widespread rural poverty (57.1%). The capital Dakar shows highest income variance compared to the rural areas and other urban locations. In the rural areas, poverty is not a marginal phenomenon as poor individuals are clustered around the poverty line. This indicates a difficulty in promoting policies that try to directly identify and target these poor individuals due to the concentration of individuals around the poverty line. There are many non-poor individuals that are closer to the poverty line as well as many poor individuals are not severely affected by poverty. These two groups might have the same characteristics.

The impact on poverty and inequality in each sector-led growth depends on the income and price effects. For each household, the significant part of the change in income can be expressed as a weighted sum of the factor earning from different sources. The importance of the direct income effect on poverty and inequality changes for a given household type following a production shift in each single sector *f*, will depend on the propensity of the sector to use a given factor *f* and on the share of this factor income

Figure 4: Income distribution across strata in 2011

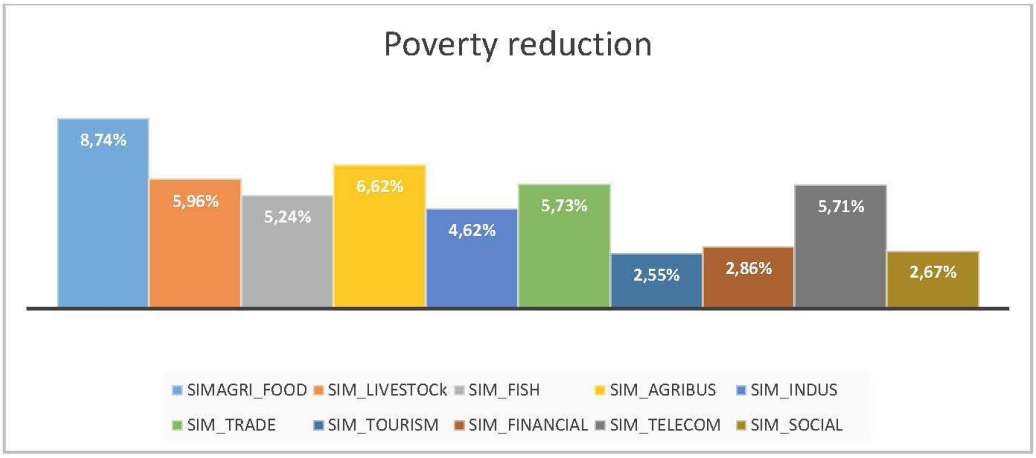


Note: Z2 = 100 – P_1 measures the intensity of poverty reduction.dak = Dakar; rur = rural areas; second = other urban centers.

Source: Authors

distributed to the household. The importance of the price effect for the households depends on the weight of the good that is produced by the sector driving growth in the composition of the household consumption basket. Furthermore, poverty and inequality tend to decrease more if the experienced growth is inclusive and associated with an equitable income distribution in the population. In addition to these effects that are directly related to the sector that is assumed to be affected by growth generated through sectoral productivity improvement, we have indirect effects that will determine the final size of the changes. These indirect effects depend on both production and consumption linkages between the targeted sector and the rest of the economy. A sector with important backward and forward linkage might have larger spillover effects.Agriculture-led growth has the largest impact on poverty with 8.74% reduction of the poverty rate in 2020 compared to its initial level. Agribusiness and Livestock follow with (respectively) poverty change of 6.62% and 5.96%. However, simulations where growth is led by non-agricultural sectors show also significant impacts on poverty reduction, especially for trade and telecommunication.

Figure 5: Change in poverty across the sector specific led growth $(P_{0_{2020}}^{SIM} - P_{0_{2011}})/\ P_{0_{2011}}$



Source: Authors

Likewise, the evolution of the inequality in 2020 is displayed in Figure A1 in the appendix. Inequality achieved in 2020 and resulting from each sector-led growth can be compared to the initial inequality level. Figure A1 shows that agriculture-led growth (green line) generate the highest reduction of the inequality level compared to the case where growth is led by non-agricultural sectors. While some non-agricultural sectors might increase the level of inequality. The observed poverty reduction effects of the different sources of growth are partly related to the resulting income distribution. Figure 6 summarizes quantitatively the results by giving the change in the inequality level in the median, upper tail and bottom side of the income distribution. For the different simulations (SIM), the reduction of inequality along the income scale is calculated as follows:

- Reduction of inequality at the median: $(alpha\ ^{SIM}_{2020} - alpha\ _{2011})/\ alpha\ _{2011}$
- Reduction of inequality at the top: $[(alpha + beta)\ ^{SIM}_{2020} - (alpha + beta)_{2011}]/\ (alpha\ + beta)\ _{2011}$
- Reduction of inequality at the bottom: $[(alpha + gamma)\ ^{SIM}_{2020} - (alpha +$ $,gamma2011]/\ (alpha+,gamma)\ 2011$

Considering inequality at the median, only growth led by the primary sector (namely Agriculture, Livestock, Fish), Agribusiness and Trade have reducing effects. Promoting growth profile led by these sectors can help to remedy inequalities instead of empowering relatively a certain class of individuals and impoverishing the weaker population. For the remaining sectors, the simulations show the potential trade-off between growth and inequality. Results also show that only agriculture and agribusiness tend to overcome inequality along all the income scale (median, upper tail and lower tail). The livestock, fishing sector, industry andfinancial sectorstend to reduce inequality at the top of the income distribution, but increase the one at the bottom while trade, tourism, telecommunication, and social services have the opposite effect by reducing inequality at the bottom and increasing the one among the richest households. The difference observed in inequality reduction between the growth profiles is due to the difference in income source between households and on the extent to which some sectors are linked to the household groups and to the poorest within each household group.

The simulations assume the same level of government payments to household compared to the baseline simulation. Therefore, the changes in household income will come from other sources. Household income is affected following the changes in wage and quantity of the different labor categories, on agricultural and non-agricultural capital, on land, the variation of intra-household transfers, and the

Table 6: Distribution of the household labor income across the labor categories (%)

Households	*Unskilled labor*	*Primary labor*	*Secondary labor*	*Tertiary labor*
Rural agricultural poor	70.1	9.8	5.8	14.3
Rural agricultural rich	76.4	5.2	2.7	15.8
Rural non-agricultural poor	50.0	17.2	4.8	28.0
Rural non-agricultural rich	55.2	7.6	6.1	31.1
Urban agricultural poor	45.7	15.5	4.8	34.0
Urban agricultural rich	41.8	14.4	3.3	40.5
Urban non-agricultural poor	25.5	19.4	12.7	42.3
Urban non-agricultural rich	13.6	11.6	16.4	58.4

Source: Authors

variation of transfer from the rest of the word. Wage and employment variation in the productive sector induces changes in the salaries of the workers associated with the concerned sectors and in turn change of household income. For example professionals are more represented in the urban non-agricultural households, while unskilled labor is predominant in the other household groups, especially for in rural and agricultural households (see Table 6). Secondary labor is the second more represented in the urban non-agricultural household. Thus, variation in the quantity and wage of this type of labor tends to have repercussions on the income of urban non-agricultural household compared to the other household groups andcompared to unskilled and primary labor.

For a better understanding of these linkages between sectors and households we compute an interdependence index through the different factors č These relationships help to understand the direct effects of sector-led growth scenarios. To take into account the heterogeneity with the agriculture sector, we consider the disaggregation into different crops which are further subdivided into 14 regions to cover heterogeneity in resource endowments, crop patterns, and farming activities.

$$Inter(h,s,f) = Inter(h,f).Inter(f,s)$$

Where $Inter(h,f) = \frac{YIF_{h\,f}}{\sum_{f\,\epsilon\,F} YIF_{h\,f}}$

$Inter(h,f)$Indicates the extent to which the household groups are linked to the factors. This index evaluates the importance of the income from factor f in the total factor income of the householdh.

And $Inter(f,s)=\frac{WF_f\overline{WFDIST}_{f\,a}QF_{f\,a}}{\sum_{a\,\epsilon\,A} WF_f\overline{WFDIST}_{f\,a}QF_{f\,a}}$

$Inter(f,s)$considers the intensity of the sector in the use of f.

The calculated interdependence coefficients show the interdependence coefficients between households and sectors that occur through factors. In general, rural agricultural households are linked to agricultural sector and the degree of this relationship is higher for the poor households. Unskilled labor and agricultural capital are mainly at the base of this relation and allow the differentiation from the other sectors. Particularly through the capital factor, the rural and agricultural households are more linked to the fishing sector and through unskilled labor to the livestock sector. Rural and non-agricultural households are linked to the Agriculture sector through income from unskilled workers and slightly to services through professional labor and capital with a weaker linkage for the poor. Urban and non-agricultural households are more linked to the services mainly through professional workers and capital. This latter is more related to the richest than to the poor. The interdependence metrics also show that the non-agricultural and the richest households in urban areas are less linked to agriculture than the poor ones. In both urban and rural area rich households are more associated with land. Trade that is associated with transaction costs is linked to rural households and urban poor households, mainly through unskilled labor. For urban and rich households this occurs through professional labor and capital. These various linkages will determine the way growth profiles affect poverty reduction and inequality along the income scale. Growth in labor intensive sectors has more impact on poverty and inequality than growth in the capital intensive sectors. Results show that to reduce inequality along the income scale, future growth should be driven by Agriculture and Agribusiness. In addition, productivity growth in Staple crop and Livestock sub-sectors might lead to the highest impacts on poverty and

Figure 6: Reduction of inequality at the median, the top and the bottom

Source: Authors

inequality given theirrelative strong linkages with the poorest households, as shown by the calculated interdependence metrics.

Besides, we calculate a difference in difference indexes to see how the gap between inequalitie at the top (respectively inequality at the bottom) is reduced between the additional growtl scenarios and the initial situation. These differences are expressed as follows:

- Reduction in the difference between inequality at the top and inequality at the median:

$$(beta\ {}^{SIM}_{2020} - beta\ {}_{2011})/\ beta\ {}_{2011}$$

- Reduction in the difference between inequality at the bottom and inequality at the mediar

$$(gamma\ {}^{SIM}_{2020} - gamma\ {}_{2011})/\ gamma\ {}_{2011}$$

Agriculture is likely to create more homogenous and constant inequality profile along the income as agriculture-led growth close the gap between inequality at the top and bottom ends and the inequality

Figure 7: Reduction in the difference between inequality at the top (respectively at the bottom) and inequality at the median

Source: Author

level evaluated at the median. It is insightful to identify how the different growth profiles impact on inequality by controlling for all the scale of income. Effort to reach a specific level of targeted growth within formulated policy goals might be insufficient if they do not consider income asymmetries. The findings suggest that examining the level of growth and not its profile, and conducting analyses by using a single non-elastic measurement of inequality might be inappropriate when capturing the effect of growth on inequality. The majority of the results shows evidence that policies that aim to boost agricultural policies are the most egalitarian.

5. Conclusion

Africa's remarkable economic growth in recent years did not automatically translate into considerable welfare improvement andnegatively affected the equal distribution of wealth. This poor performanceleads inequality at the forefront of public debate.Yet there is still much to be learned about inequality in Africa and the complex relationship between growth-poverty-inequality. The paper uses a sample on Sub-African countries and show heterogeneity in the temporal change of the structure of inequality and in the shape with strong variations at the different level of the income scale. The use of the Alpha Beta Gamma method shows that there is a limitation to focus on the summary statistics. Policies that attempt to reduce inequality should not only lies on broad measurement indexes generally expressed at the median of the income distribution, but should also look atthe income distribution at the extremes. Based on the pattern of the isographs and structure of inequality we classify the countries in two different groups. Further, using Senegal as a case study the paper identifies Agriculture and Agribusiness-led growth as having reducing effect on poverty and on inequality along the income scale. Growth driven by these key sectors can make the majority of the people not be disconnected from income growth. As for Senegal, similar study will be conducted in other countries based on the same anisotropic concepts of inequality.

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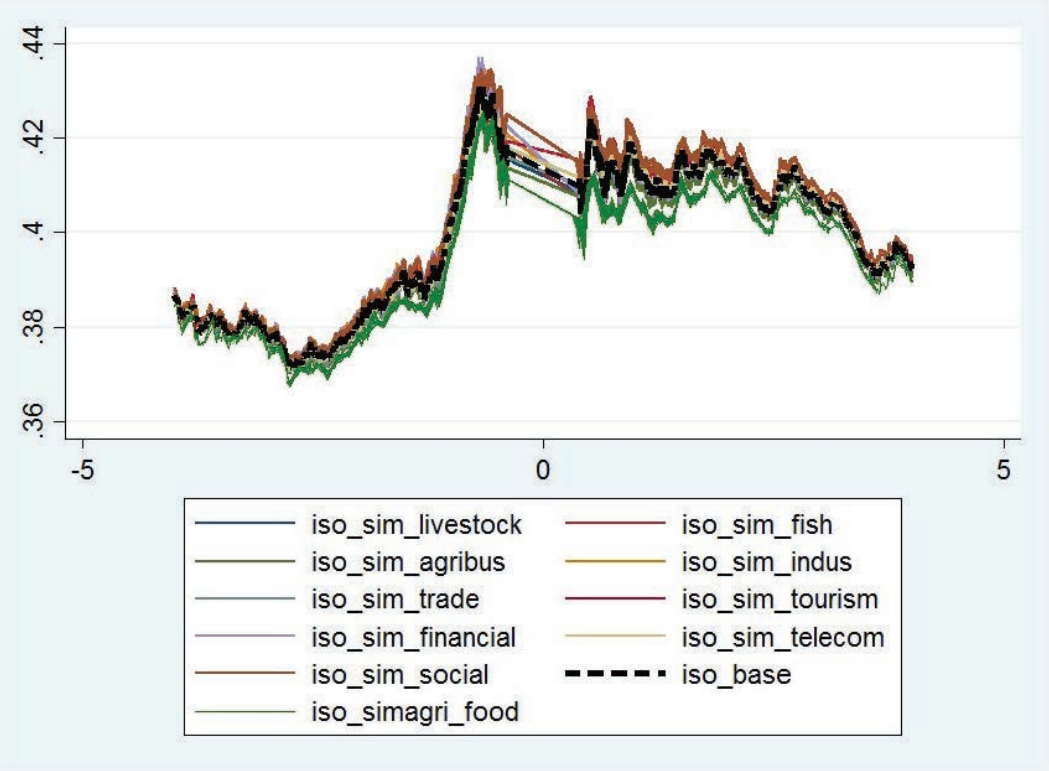
Figure A1 - Shift in the inequality level across growth scenarios



Source: Authors