

# Is Africa On Track to Ending Poverty by 2030?

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# Outline

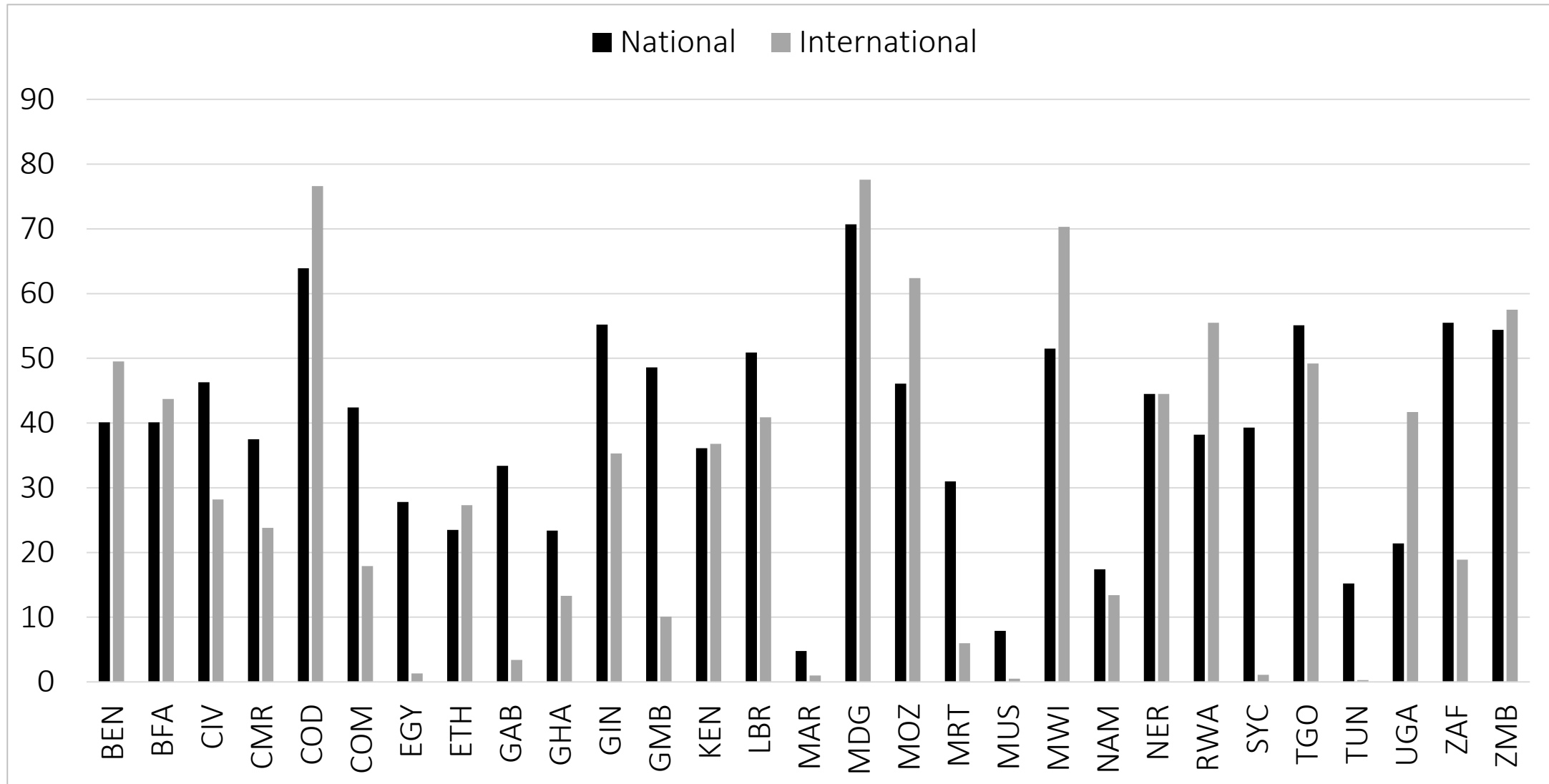
1. Introduction
2. Method and Data
3. Results and Discussions
4. Conclusion

## 1. Introduction

- Poverty reduction is central to Africa's development strategies (PRSP, Africa 2063, CAADP, SDGs, ...)
- Using 29 countries for which recent poverty estimates are available reveals:
  - 14 countries (48 percent of the sample) show a poverty headcount ratio, measured at international poverty line, above 30 percent
  - Number of countries with a poverty headcount index above the threshold of 30 percent reaches 21 (72 percent) when the poverty headcount ratio is measured at the national poverty lines
  - Poverty has declined, but levels are relatively high

# 1. Introduction cont'd

Poverty Headcount Ratio at National and International (\$1.90 a day at 2011 Purchasing Power Parity) Poverty Lines, 2012-2017 (Percent)



Growth, inequality and poverty are intricately linked

- Growth is essential to poverty reduction (*Dollar and Kraay 2001, Bourguignon 2003*)
- Inequality important to the transformation of growth into poverty reduction (*Ravallion, 2004; Ravallion and Chen, 1997; Squire, 1993*)
- How much growth reduces poverty depends on (*Adams, 2004; Fosu, 2015; Thorbecke and Ouyang 2017; Berg et al. 2018*):
  - ✓ rate of economic growth
  - ✓ initial level of income (relative to the poverty line)
  - ✓ initial inequality level
  - ✓ change in inequality

## Objective

- An important question is *'what is the optimal growth and inequality mix required for African countries to attain the poverty reduction targets of the Sustainable Development Goals?*
- The literature does not **pronounce on the optimal mix** of growth and inequality required to reduce poverty.
- This can offer valuable information to countries in terms of prioritisation, policy focus and effort to be able to meet the SDG poverty goal.

## Objective

- Contribute to identify strategies SSA countries can follow to address inclusive growth.
- Assisting SSA countries to monitor and develop more effective strategies to speed up poverty reduction.
- Poverty has multiple dimensions, focus on the monetary dimension.

- Existing approaches/models (econometrics)
  - => uses cross country macro data/estimates
  - => “ill posed inverse ” problem
- Exploration of an alternative methodology
  - => Using micro data to allow a direct measurement of poverty
  - => Applying **Cross Entropy** method to **Combinatorial Optimization Problems**



- Our study applied a cross entropy method to a *combinatorial optimization technique* (Rubinstein and Kroese, 2004) to understand what is required to achieve the SDG poverty goal.
  - finding the best combination of some set of inputs to produce a maximum output under a given state and environment
- Growth-inequality-poverty relationship is approached as a combinatorial optimization problem in the sense of a search for the optimum association between income growth and income inequality reduction to meet a desired poverty reduction target

- The Kullback-Leibler cross-entropy allows us to archive this, i.e. to minimize the distance between the survey distribution of income across the population and the optimal distribution of income to achieve the poverty reduction goal (Kullback and Leibler, 1951)

### Kullback-Leibler Cross Entropy (CE)

- **Entropy:** Amount of information produced by a stochastic event

$$H(x) = E [-\log p_x]$$

- **Cross-entropy:** Measure of the distance between two probability distributions
- **Kullback-Leibler:** Commonly used distance measure

$$H(p, q) = \sum_{x=1}^n p_x \cdot \log \frac{p_x}{q_x}$$

## 2. Method and Data (Cont'd)

Kullback-Leibler Cross Entropy problem statement (Golan, Judge and Miller , 1997)

Objective  $\min K = \sum_i p_i \cdot \log_e \frac{p_i}{q_i}$

Subject to  $y_j = \sum_i x_{j,i} \cdot p_i$

Adding up constraints  $\sum_i p_i = 1$

### Combinatorial Optimization (CO)

- ✓ Subset of mathematical programming/optimization
- ✓ Consist of finding the best object from a finite set of objects
- ✓ Search for the best combination of some set of discrete items
- ✓ Applications in several fields
  - artificial intelligence
  - machine learning
  - software engineering
  - Supply chain optimization
  - Development of the best airline network of spokes and destinations
  - Decision on which taxis in a fleet to route to pick up fares
  - Seek for the optimal way to deliver packages

- Implementation Steps

1. We use surveys to determine optimal growth

- learning from African country structures

2. We use all countries (almost all in Africa) against this growth target to gauge where they are at given their specific profiles and if they will meet SDG target of halving poverty

3. We simulate high growth scenario, and check the improvement in countries to meeting SDG poverty target

- 51 survey data of 25 African countries (2000-2017)
- Survey data capture initial conditions and permit direct measurement of poverty
- Income measurement => per capita consumption expenditure
- Income inequality measurement => Gini index

### 3. Results and Discussions

#### Relationship between Income Growth, Income and Inequality Levels

- The results indicate that the optimal income growth target is closely related to;
  - i) the initial income growth level
  - ii) the initial level of income inequality
- An initial mix of *low* inequality level (Gini index) and *high* income level is associated with *low* optimal income growth
- In contrast, high income growth is required for countries with an initial mix of high inequality and low income growth levels.
  - In line with other empirical findings



## 3. Results and Discussions

### Grouping and clustering countries

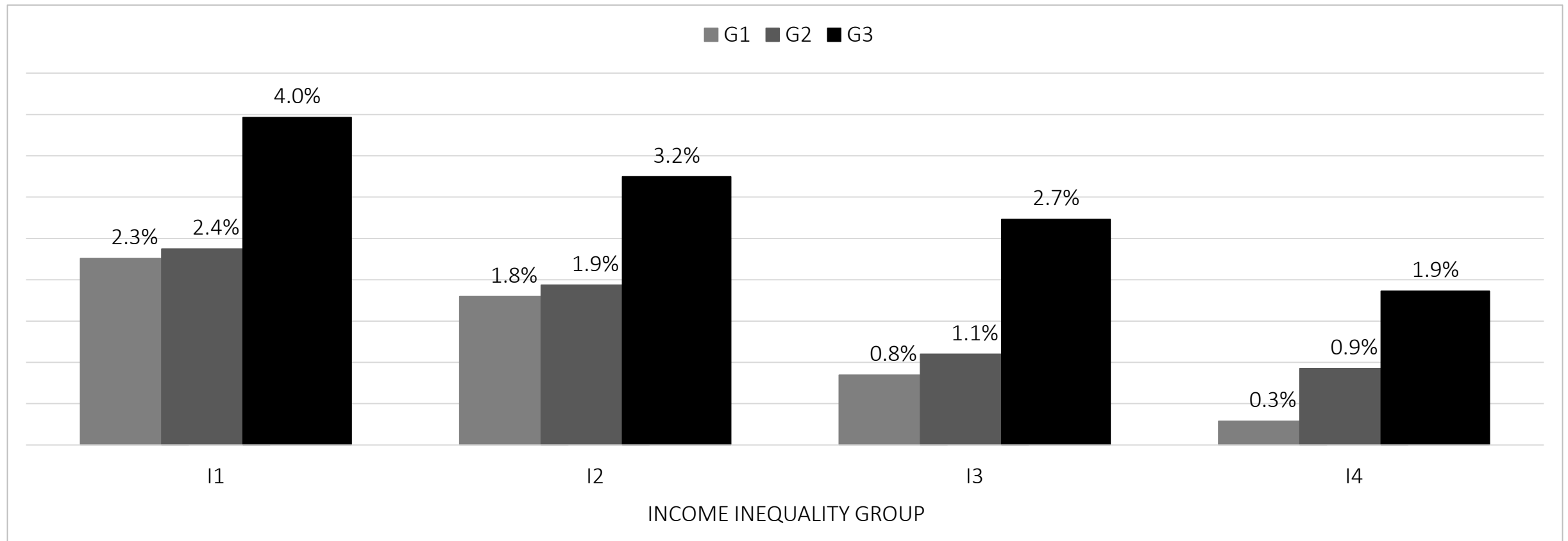
- **First groupings by inequality:**
  - G1: Low inequality countries with Gini index values less than 0.4. (38%)
  - G2: Middle group countries are those with moderate inequality level with Gini index values ranging from 0.4 and 0.5.(43%)
  - G3: High inequality countries with Gini index values more than 0.5 (19%)
- **Second, groupings by income**
  - I1: Low relative income levels, (ratio of average income to poverty line of less than 1)
  - I2 and I3: Value are between 1 and 2, and 2 and 3, respectively
  - I4: High relative income levels of more than 3

### 3. Results and Discussions

#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

- Initial income inequality and (relative) income levels are both strongly related to the income growth requirements and poverty reduction

Relationship between Income Growth, Income and Inequality Levels, Annual Income Growth



Note: I1: Lowest income group; I4: Highest income group; G1: Lowest inequality group; G3: Highest inequality group.

### 3. Results and Discussions

#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

- Thus:
- An annual average per capita income growth of around 0.3 percent is required for countries with low inequality level (below 0.4) and high relative income growth level, i.e. ratio of average income to poverty line (above 3)
- In contrast; an annual average per capita income growth of around 3.9 percent is required for countries with high inequality level (above 0.5) and low income growth level (below 1)

### 3. Results and Discussions

#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

- Countries with high income levels can achieve the poverty reduction goal through income growth only, i.e. without requiring a reduction in income inequality
  - However, the income growth targets should not be pursued at the expense of an increase of income inequality in these countries.
- On the contrary, countries with lower income levels must combine income growth with income inequality reduction to meet the poverty reduction target.

### 3. Results and Discussions

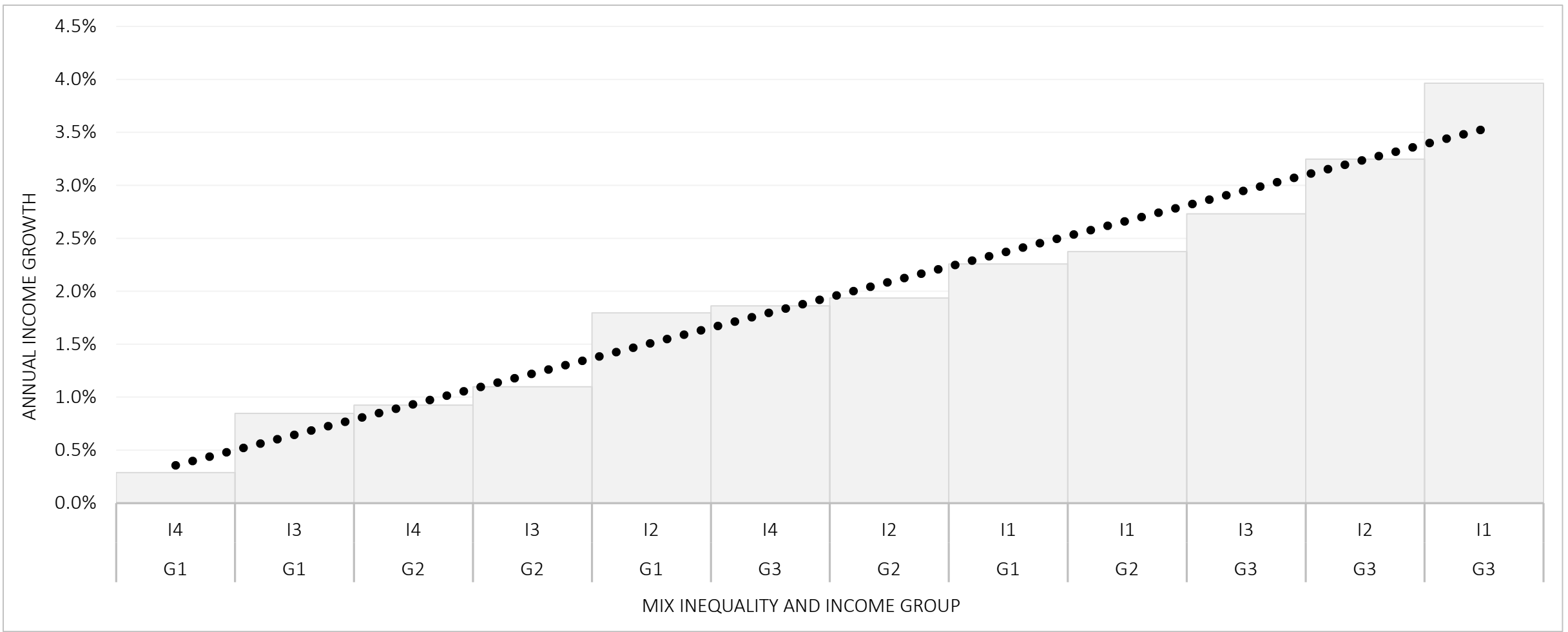
#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

		Initial Gini Index		
		Less than 0.4	Between 0.4 and 0.5	More than 0.5
Initial Relative Income Level	Less than 1	-5.2	-2.7	-4.2
	Between 1 and 2	-1.7	-2.3	-4.0
	Between 2 and 3	-0.6	-0.7	-0.9
	More than 3	-0.1	-0.1	-0.3

# 3. Results and Discussions

## Optimal Income Growth Threshold to Halving Poverty between 2015-2030

Optimal Income Growth Threshold, under Inequality Level (G) and Income Level (I4)



### 3. Results and Discussions

#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

- 55 percent of African countries are off-track to halving poverty between 2015 and 2030, i.e. to attaining SDG 1. (e.g. Guinea Bissau, Central African Republic and Mozambique)
  - These countries show low average income growth, measured by GDP per capita over the period 2015-2024
  - This growth performance is not sufficient to meet SDG poverty goals because of the countries' prerequisites,
    - i.e. high income inequality and low income level, on the one hand, and the historical trend in income inequality reduction, on the other hand
- However, countries with strong prerequisites such as Tunisia and Botswana are on track

### 3. Results and Discussions

#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

- An accelerated growth scenario was built based upon the best historical income growth performances; i.e. performances above the average annual growth value between 2015 and 2024 (trend and projection)
- It shows that some countries move from below to above the target line i.e. for them the accelerated growth scenario may be enough to be on track to achieving the SDG 1
- Under the accelerated growth scenario, 74 percent of the African countries will be on track to achieving the SDG1 (as opposed to 45 percent)



### 3. Results and Discussions

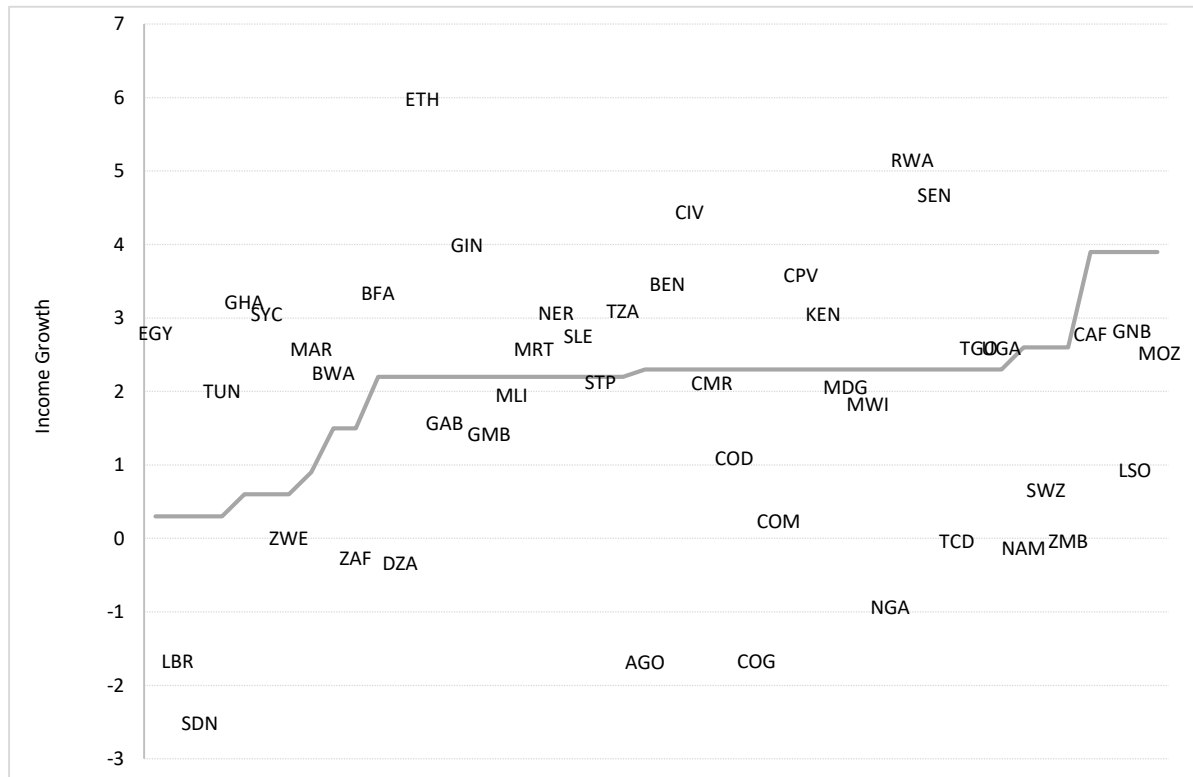
#### Relationship between Income Growth, Income and Inequality Levels (cont'd)

- The accelerated growth scenario is enough to improve the performances of 23% of African countries and put them on track to achieving the SDG 1
- For the remaining countries, the accelerated growth may not be enough to put the countries on track to achieving SDG1
- Thus, it is necessary to combine accelerated growth strategy with income inequality reduction strategy to achieving SDG1

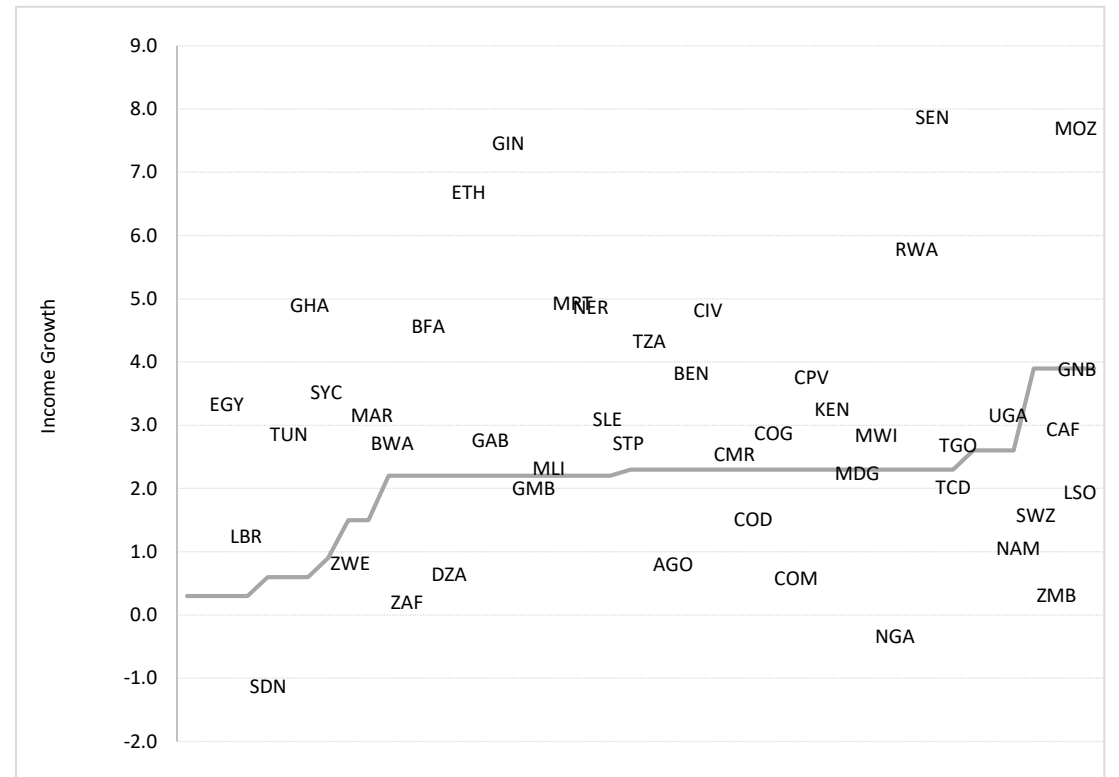
### 3. Results and Discussions

#### BAU Scenario and Accelerated Growth Scenario

**Income Growth Performances in Africa under BAU Scenario**



**Income Growth Performances in Africa under Accelerated Growth Scenario**



## Selected Countries off track, Optimal Income Growth (Percent)

Conutries	Target	Current Growth Performance 2015-2024	Accelerated Growth Performance 2015-2024, Optimal Income Growth Per Capita	Minimal Inequality Reduction, Target
Mozambique	3.9	2.6	<b>7.7</b>	-4.2
Malawi	2.3	1.8	<b>2.9</b>	-2.7
Eswatini	2.6	0.7	<b>1.6</b>	-0.9
Lesotho	3.9	0.9	<b>1.9</b>	-4.2
Namibia	2.6	-0.1	<b>1.1</b>	-0.9
South Africa	1.5	-0.3	<b>0.2</b>	-0.3
Angola	2.3	-1.7	<b>0.8</b>	-2.7
Zambia	2.6	0.0	<b>0.3</b>	-0.9
Zimbabwe	0.6	0.0	<b>0.8</b>	-0.1

**Source:** Simulation Results.

**Note:** Current Growth Performance: Ten-year (2015 to 2024) annual average growth rate; Accelerated Gowth Performance: Performances above the average annual growth value between 2015 and 2024 (trend and projection).

## 4. Conclusion

- Paper provides the optimal income growth and inequality reduction targets African countries must pursue to be on track to achieving the SDG goal on poverty
- Along current trajectory, only 55 percent of the countries will be able to halve poverty by 2030
- If countries however accelerate growth, then this number increases to 74 percent
- The remaining countries will need to not only accelerate growth, but also substantially reduce inequality
- These results are important for policy makers

Is Africa On Track to Ending Poverty by 2030?

**Thank You**