On the measurement and use of equality weighted growth

El crecimiento económico ponderado de la igualdad: la medición y el uso

Pacifique D. MONGONGO
pacifique.mongongodosa@outlook.be
Cátedra de Cooperación
Internacional y con Iberoamérica
Universidad de Cantabria

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Resumen

If developing economies keep growing between 4 and 8 %, their current GDP will double between 2025 and 2034. By 2030, they will have already reached incomes above all reasonable poverty thresholds. Does this predict the end of poverty by 2030? By correcting mean income from inequality and comparing its growth to that of the overall GDP, this paper analytically shows that it depends on how such new wealth will be shared. It confirms that it will be the case if growth patterns will be creating jobs and opportunities for the less-well off and hence pull up their revenues. Applying this to sub-Saharan Africa (SSA), empirical results underpin that since 2000 SSA meets such a shared prosperity pattern. However, although forecasted to last and eradicate poverty by 2030, this pattern is not robust to crisis periods because it seems that people with lower incomes bear most of the burdens of recession.

Keywords: economic growth, inequality, MDGs, SDGs, GINI coefficient.

Abstract

Si las economías en desarrollo continúan creciendo entre un 4 y un 8 %, su actual PIB se duplicará entre 2025 y 2034. Para 2030 se habrán alcanzado ingresos por encima de todos los umbrales de pobreza razonables. ¿Predice esto el fin de la pobreza para 2030? Corrigiendo la renta media de la desigualdad y comparando su crecimiento con el del PIB total, este trabajo demuestra analíticamente que depende de cómo se distribuya dicha nueva riqueza. Se confirma que ese será el caso si los modelos de crecimiento se basan en la creación de trabajo y oportunidades para aquellos económicamente menos favorecidos, lo cual, por lo tanto, repercutiría en un aumento de los ingresos. Al aplicarse esto al África subsahariana, los resultados empíricos sostienen que desde 2000 se encuentra con ese patrón de prosperidad distribuida. No obstante, aunque se prevé que durará y se erradicará la pobreza en 2030, este patrón no es sólido para los períodos de crisis ya que parece ser que las personas con menos ingresos llevan la mayor parte de las cargas de recesión.

Palabras clave: crecimiento económico, desigualdad, ODM, ODS, coeficiente de GINI.

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1
Introduction

Ending poverty and fighting inequality has been pinpointed as one of the most desirable extensions of the expired Millennium Development Goals (MDGs): «We resolve, between now and 2030, to end poverty and hunger everywhere; to combat inequalities within and among countries […]» (UN 2015, p. 6). However, while economic growth is consensually recognized as a necessary stage to fight poverty, combating inequality to reduce or eradicate poverty is still controversial in the development literature. For instance, considering too difficult how to measure and determine an optimal level of inequality, Klansen (2012) and Ravallion (2013) argued against the inclusion of an explicit objective to promote equality within the Sustainable Development Goals (SDGs). Conversely, Fuentes-Nieva (2013) counter-argued in favor of including a reference target to the negative features of inequality and he saw in the Palma index a good enough indicator to measure such a goal and track its progress.

Summing up both the literature pointing out the pro-growth and counter-growth characteristics of income inequality,[1] the World Bank's shared prosperity literature takes a nuanced standpoint. While it argues in favor of tracking and stimulating the income of the poorest, it does not advocate for any kind of wealth redistribution from the rich to the poor. It draws attention on stimulating higher and sustainable growth by making sure that its pattern generates income and opportunities for the less-well off. This bears the idea that a high enough economic growth creating jobs and opportunities for poorer people is preferable to wealth redistribution policies discouraging productive efforts and hence generating perverse effects on growth and poverty reduction. Though intuitively irrefutable, one would reasonably wonder whether such policy orientation matches with realities of developing economies.

Considering Sub-Saharan Africa (SSA) as one of the regions with the highest rates of economic growth but, with a relatively higher number of people living in poverty, this paper assesses the extent to which economic prosperity has been shared in that region since the nineties comparing the pre-MDGs to the MDGs era and pinpointing the implication for the SDGs era.

To do so, section 2 starts by spelling out why it is worthwhile relying on economic growth to tackle most development issues. Section 3 complements the latter by raising the limit of the overall growth when analyzing the dynamics of poverty reduction and explores alternative ways out of that shortfall. Section 4 takes SSA as a case study in its empirical application and section 6 concludes this work.

1. Though there is a huge literature on good and bad inequality, considering as good the inequality reflecting differences in productive efforts and as negative otherwise, matches with the main idea expressed here. Subsequently, in this paper, the optimal level of inequality would be the one resulting from policies compensating other forms of disadvantages except differences in the above-mentioned productive efforts.

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2
Exponential and persistent nature of growth

Policy makers, aid practitioners and researchers rely on high rates of economic growth in developing countries to eradicate the extreme poverty (Sachs 2005a; UN 2006; Narayan *et al.* 2009; Cameron *et al.* 2013; ODI 2015; UN 2015). This is underpinned by an economic and a statistic argument, namely the capital accumulation process (Ramsey 1928; Solow 1956; Galor and Moav 2004) and the exponential feature of growth.

Considering as relatively low the levels of capital in developing countries, the law of diminishing marginal returns is expected to keep the rates of economic growth high for a considerable period of time. In addition to this, we know that growth is self-reinforcing. Economists have already noticed that growth is persistent and hence —once reached— difficult to leave (Solow 2007). On this basis, one would reasonably expect two or more decades of high growth rates in developing economies. More importantly, as it is the case with any incrementally growing process, such rates have exponential effects. For instance, an economy with y_t as an initial GDP growing at a rate g between 4 and 8% as is the case of most developing countries doubles its income after a period of time *n* lying between 18 and 9 years:

$$y_{t+1} = y_t * (1 + g)$$
$$y_{t+2} = y_{t+1} * (1 + g) = y_t * (1 + g)^2$$
$$y_{t+3} = y_{t+2} * (1 + g) = y_t * (1 + g)^3$$
$$y_{t+n} = y_{(t+n-1)} * (1 + g) = y_t * (1 + g)^n$$

Subsequently, the doubling time is:

$$y_{t+n} = y_t * (1 + g)^n = 2 * y_t \Leftrightarrow n * ln(1 + g) = ln(2) \Rightarrow n = \frac{ln(2)}{ln(1 + g)}$$

Hence, if $n = 9$, $g = 8\%$ and $n = 18$ for $g = 4\%$. Applying this to current annual GDP per capita which are above 1000 USD in all developing regions and their growth rates above 4% (WB-WDI 2016), it is more likely that most of us will not die before income per person in poor regions exceeds all reasonable poverty thresholds. Even the poorest countries within those regions which currently have more than 250 USD as average GDP per capita, with their current growth rates should soon reach the extreme poverty threshold.

Does this predict the end of poverty with our generation? It depends on how that new wealth will be distributed within countries. As we know, both economic growth and income per capita give no information about wealth distribution. Considering high inequalities

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within developing countries, it might be possible that, instead of predicting the end of poverty, such growth pace and the subsequent fast excess of the average income per capita on poverty threshold indicate more of absolute or/and relative poverty. This would be the case if —within developing countries— income of the poorest is not growing or/and is growing slower than the income of the richest. Subsequently, current economic analyzes and development policies should incorporate the dynamics of inequality to pinpoint actual impacts of growth on poverty reduction in those countries.

It is in this perspective that, section 2 below selects an appropriate inequality measure and transforms it in an equality index weighting GDP growth to account for inequality dynamics. Section 3 provides an application assessing the MDGs era for sub-Saharan Africa before drawing the implications for the SDGs. Section 4 makes an external validity check and section 5 concludes this work.

3
Measuring equality weighted GDP

As equality is the opposite side of inequality, measures of the latter are valuable for measuring the former. A lot of inequality measures exist. The most frequent are range, range ratio, McLoon index, coefficient of variation, Theil's T Statistic, income percentiles and Gini Coefficient. Though each one has its strengths and weaknesses, GINI coefficient has more potential in decomposing GDP and GDP growth with respect to inequality.

Unlike the rest, it entirely includes income distribution data and allows direct comparison among economies with different population sizes (Kakwani 1977). These advantages make GINI ratio a benchmark of this investigation. For clarity and methodological reasons, I introduce the GINI adjustment by percentiles based procedures.

3.1. Percentiles based inequality adjustment

Percentiles based procedures adjust both GDP and GDP growth by excluding incomes which are above a given threshold. For instance, Tezanos *et al.* (2013) exclude incomes beyond the ninetieth percentile as follows:

$$y_{i,t}^{ia} = \sum_{k=1}^{9} d_{i,t}^{k} \frac{y_{i,t}}{0.9 * n_{i,t}} \quad (1)$$

Where $d_{i,t}^{k}$ is the income share of the deciles of the kth population of country i in year t, $y_{i,t}$ is the overall GDP, and $n_{i,t}$ is the population of country i in year t. Finally, levels of inequality adjusted GDP ($y_{i,t}^{ia}$) are used to compute average growth rates. Even though the

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authors found a big enough sample of income percentiles for Caribbean countries, this is not the case in most developing economies.

The word Bank's PovcalNet dataset, one of the most comprehensive databases of percentile distributions of income, still misses data of many years for considerable number of Sub-Saharan African countries. Indeed, most publically available databases summarize income distribution with GINI coefficient. In the following section, I show that a derivative of the latter is a good alternative of $d_{i,\,t}^{k}$ not only for data availability but also for its better analytical and intuitive features when the focus is not merely on having an inequality index but particularly on using it to deflate economic growth from inequality.

It is noteworthy that if the focus of this paper was only tracking inequality and no aggregation of equality and growth, the choice between Palma index and GINI coefficient would be a bit tricky. It would be more of an empirical issue than mere theoretical choice. Indeed, to make such a choice, one has to be in a position to figure out the extent to which its sample confirms the stability assumption of the middle of income distribution which intuitively underpins following the dynamics of inequality through tails as captured by the Palma $\dfrac{d_{i,\,t}^{10}}{d_{i,\,t}^{40}}$ ratio (Cobham and Sumner 2013).

3.2. GINI based adjustment

(1 – *GINI coefficient* $_{i,\,t}$) is a good alternative of $d_{i,\,t}^{k}$ to deflate both GDP and its growth from inequality. (1 – *GINI coefficient* $_{i,\,t}$) can even be preferred to $d_{i,\,t}^{k}$. Besides being available, (1 – *GINI coefficient* $_{i,\,t}$) gives a much more intuitive indicator keeping properties of percentiles based adjustments. It provides a better measurement of relative poverty hidden in overall growth. This is understandable in light of GINI coefficient construction (Figure 1).

Figure 1
GINI components

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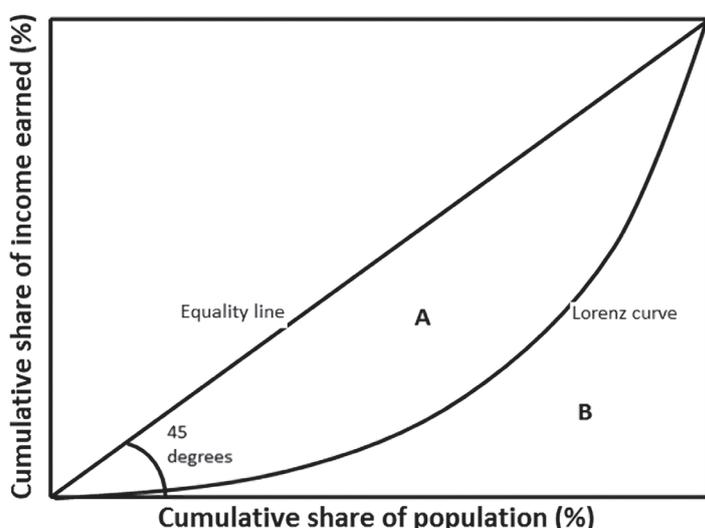
In reference to Figure 1, *GINI coefficient* $_{i,t}$ = $\frac{A}{A+B}$. The bigger *A* is, the farther the Lorenz curve is from the equality line and hence the higher are both *GINI coefficient* $_{i,t}$ and the level of inequality.

To get a GINI based inequality adjusted indicator —let say equality weighted GDP ($y_{i,t}^{ew}$)— increasing with overall GDP ($y_{i,t}$) and decreasing with inequality as in Equation 1, I have two plausible options: either I divide $y_{i,t}$ by *GINI coefficient* $_{i,t}$ or I multiply it by (1 – *GINI coefficient* $_{i,t}$) in Equation 1. As I will detail later in this paper, the second option is much more intuitive and has better features in terms of considering inequality dimensions in growth diagnosis. It gives the following expression of $y_{i,t}^{ew}$:

$$y_{i,t}^{ew} = (1 - GINI\ coefficient\ _{i,t}) * y_{i,t}\ (2)$$

In light of Figure 1, it is worth noting that:

- Lorenz curve gives the actual distribution of income among the population: $\int_{0\%}^{100\%}$ (*Lorenz Curve*)dp = 100% *of population* = 1 = $\frac{A}{A+B}$ + $\frac{B}{A+B}$ (3)

- In Equation 3, *A* and *B* areas measure mean income lags respectively from perfect equality and inequality. They provide retention percentages of incomes below the average from two opposite perspectives: while the first captures inequality, the second shows equality.

- Drawing on the same expression 3,

$$\frac{B}{A+B} = 1 - \frac{B}{A+B} \Leftrightarrow \frac{B}{A+B} = (1 - GINI\ coefficient_{i,t})\quad(4)$$

Together, Equations 2 and 4 give:

$$y_{i,t}^{ew} = \frac{B}{A+B}\ y_{i,t}\quad(5)$$

In fact, $\frac{B}{A+B}$ is an inequality deflator. It corrects the mean income ($y_{i,t}$) for inequality.

- Finally, $y_{i,t}^{ew}$ is in terms of intuition and effect equivalent to (Sen 1976)'s income gap Correcting term ($P_1(1 - G^p)$) of his poverty index which can be re-written as: ($P_s = P_0G^p + P_1(1 - G^p)$) (Haughton and Khandker 2009).

This validates $y_{i,t}^{ew}$ ability to account for GDP dynamics and inequality using *GINI coefficient* and considering average income as a benchmark.

Indeed, on the left extreme where *GINI coefficient* $_{i,t}$ is 1, $y_{i,t}^{ew}$ is 0. This means that $y_{i,t}$ is disregarded in poverty reduction analysis since it fully excludes almost everybody from the economic prosperity. On the right extreme where *GINI coefficient* $_{i,t}$ is 0, $y_{i,t}^{ew}$ equals $y_{i,t}$. In this case $y_{i,t}$ is entirely considered since it is perfectly

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inclusive and fully cancels out all relative poverty. The remaining cases lie between the two. For instance, at the median case where *GINI coefficient* $_{i,\,t}$ is 0.5, half $y_{i,\,t}$ is taken into account and hence: $y_{i,\,t}^{ew} = \frac{1}{2}\,y_{i,\,t}$. The remainder of this paper applies $y_{i,\,t}^{ew}$ on Sub-Saharan Africa (SSA) data and draws the implication of its dynamics for the post-2015 development agenda.

4
Dynamics of equality weighted GDP in SSA

4.1. From 1991 up to date

The black and dashed plots on Figure 2 depict GDP and equality weighted GDP. The left hand side (2-A) shows their values and the right hand side (2-B) compares the corresponding growth.
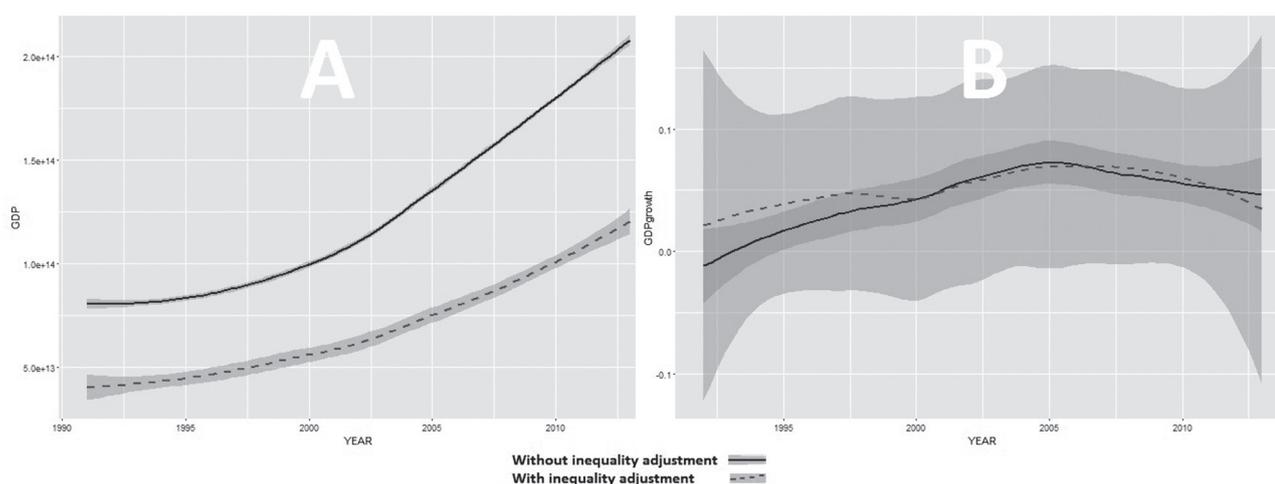

Figure 2
GDP and equality weighted GDP. Author's based on WDI-2016

As expected, both GDP and equality weighted GDP are increasing but at different paces. While such a co-movement is due to the positive impact of the first on the second, differences in paces are attributable to inequality adjustment. Effects of the latter become clearer on their respective growth on Figure 2-B. This figure describes three critical periods. From 1991 up to 2000, the increasing pace of equality weighted GDP growth was slower than that of overall GDP growth. This means that good effects of growth were not primarily on the advantage of the poor. From 2000 up to 2007, the opposite was observed. The increasing pace of equality weighted GDP growth became faster than that of overall GDP growth. As a result, initial equality weighted GDP growth is lower than overall GDP growth, but the opposite occurred in the courses of their dynamics (Table 1).

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Variable Min.	1st Qu.	Mean	3rd Qu.	Max.
GINI coefficient in % 37.73	43.07	45.13	46.98	53.44
GDP const. 2005 USD 7.989e + 13	8.863e + 13	1.249e + 14	1.585e + 14	0.13370
EWGDP const. 2005 USD 3.719e + 13	4.987e + 13	6.908e + 13	8.767e + 13	1.236e + 14
GDP growth −0.01859	0.03443	0.04383	0.05797	2.087e + 14
EWGDP growth −0.18150	−0.01187	0.05228	0.11420	0.16060

Table 1
Main statistics: 1991-2013. World Bank (2016)

This means that a higher share of growth was on the side of the poor. It is not surprising that the turning point is year 2000. The latter corresponds to the launching period of most domestic and international commitments for the poor. While they have been domestically formalized in poverty reduction plans, at international level they were framed within the millennium developments goals (MDGs) and the subsequent development assistance agenda. Since 2007, the trend of the two growth dimensions made a temporary shift to the detriment of disadvantaged people.

That would be one of the consequences of the global economic crisis that we are facing since 2007 (2008) and which would have relatively frozen pro-poor commitments. This implies that crisis burden was more on the poor.

4.2. One step-ahead prediction to 2030 horizon

Even though Figure 2-B shows that in both the pre-2000 period and the post-2007 era EWGDP growth is slower than GDP growth, the situation through the first period is worse than that of the second. One would expect the latter to disappear with the ongoing economic recovery from the global crisis. To shed light on this, I make comparison of forecast values up to 2030 horizon. GDP growth and equality weighted GDP growth are stationary and match with AR (1) and MA (1) features. The corresponding ARIMA forecasts give similar results in both cases. On average, point forecasts for equality weighted GDP growth are roughly 1 % higher than those of overall GDP growth.

While predictions of the first are slightly higher than 5 % of annual growth, those of the second are spread between 4 and 4.5 %. This shows that the post-2007 opposite situation is disappearing with the ongoing economic recovery and is leaving place to the pro-poor growth observed since 2000. However, it is worth noting that the post-2007 temporary shift of growth pattern against the poor suggests that the latter carry bigger burdens of poor economic conditions. This is confirmed by the lower bounds ARIMA forecasts predicting roughly a 1 % difference in favor of overall growth. Considering the initial 1 % difference in favor of equality weighted growth, this corresponds to 2 % growth redistribution from the poor to the rich. Confirming this from another angle, upper bounds predict the opposite.

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5
External validity check

The application of the procedure I propose in this paper to sub-Saharan Africa shows that the average poverty is diminishing as the overall GDP is increasing. Furthermore, it shows that inequality is diminishing since the equality weighted GDP is growing faster than the overall GDP. Subsequently, both the absolute and relative poverty are diminishing in that region. I resort to the conclusion of existing studies analyzing the dynamics of growth and inequality in Sub-Saharan Africa to externally check the validity of the above mentioned conclusion drawn from my investigation procedure.

5.1. Theoretical analyses

Drawing on descriptive statistics and economic theories, some development economists claim that the situation in sub-Saharan Africa is worsening. For instance, Moyo (2009) claimed that both poverty and inequality are growing and she argued that foreign aid is the causal channel of the mentioned negative dynamics. Her conclusion meets those of most authors from the aid-skeptic stream and the self-discovery approach to development (Easterly 2002; 2006; 2008; Narayan *et al.* 2009). Conversely, other authoritative economists claimed that the dynamics of both poverty and inequality exhibit positive trends especially along the era of the millennium development goals and they expect a very significant inequality reduction together with the eradication of poverty by 2030 (Sachs *et al.* 2005a; 2005b; UN 2006; 2015).

Like the outcome of my analysis, Sachs *et al.* (2015) and UN (2015) point out that poverty eradication needs a significant inequality reduction.

Similarly, the latter two papers and the previously mentioned second wave of researchers found that SSA income has been increasing and inequality diminishing since a couple of decades.

While this would validate the potential of my procedure to come up with accurate results, the first wave of authors denying such positive trends of income and inequality would invalidate it. However, let me recall that the conclusions of both streams are drawn from mostly theoretical studies. Consequently, it is worth checking how well my results meet the outcome of empirical investigations.

5.2. Empirical studies

Very few empirical studies simultaneously analyzed the dynamics of growth and inequality in SSA. Most of them merely investigated the trend of the overall growth. Among many others, Maddison (1995) pointed out a declining trend in GDP growth of that region between the 1970s and the 1990s. In response to that bad news, considerable

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efforts were made to understand what impeded growth and to identify «realistic» solutions. As one of the major causes of the observed slow growth along those decades, Collier and Gunning (1999) pointed out the low level of both private and public domestic investments.

Considering that the average income in SSA was far below the subsistence level to generate saving, a wave of economists saw in foreign aid realistic alternative to savings in order to boost the capital accumulation process and the subsequent economic growth (Sachs *et al.* 2005a; 2005b). Consequently, SSA has become the main aid recipient of ODA (Figure 3).
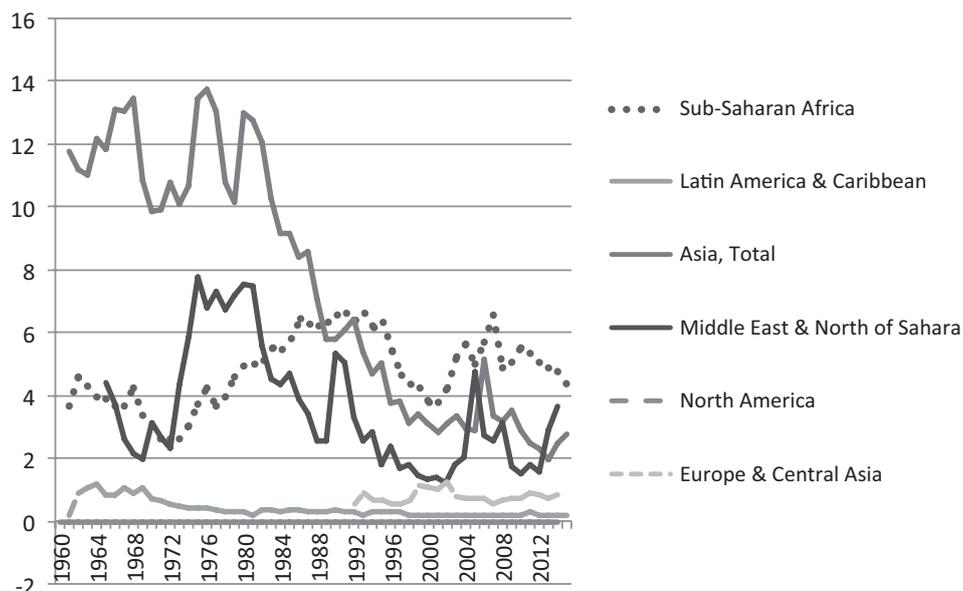

Figure 3
Regional distribution of ODA as a percentage share of GDP: 1960-2014. DAC (2016) and World Bank (2016)

After such an international intervention, some re-assessments of the dynamics of GDP and GDP growth in SSA Africa have been conducted. Pinkovskiy and Sala-i-Martin (2014) assessed the dynamics of both GDP and inequality. As the latter uses another methodological approach, it is a valuable source to externally check the validity of the conclusions drawn from my procedure.

As I have found by constructing and examining «equality weighted growth», Pinkovskiy and Sala-i-Martin (2014) found that not only income is rising in SSA, but also is reaching poorer citizens. To draw this conclusion, they used survey data on African income distributions and national accounts GDP. They then estimated the income distributions, the poverty rates, and the inequality indices of African countries between 1990 and 2011. Note that updating or replicating such a survey based investigation to another region is not as simple and practical as applying a GINI based inequality deflator on GDP then comparing the growth pace of the overall GDP to that of the equality weighted growth as I methodologically

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suggest. As both procedures give identical results, the «equality weighted GDP» diagnosis would be preferred for its simplicity and usage of publicly available data.

Similarly, Augustin Kwasi Fosu (2015) has come up with the same results by decomposing SSA poverty dynamics in that of income and inequality. He has shown that, in contrast to the eighties and nineties, SSA region has made considerable progress in terms of poverty reduction. This underpins the higher growth pace of overall growth in comparison to that of equality weighted and supports that the MDGs have well performed on both growth and poverty reduction dimensions as estimated in this paper.

Likewise, Augustin Kwasi Fosu (2013) found that that performance has not been robust to the 2007(8) global crisis. However, as predicted in this paper, he expects that good performance to resume with the end of the crisis.

6
Conclusion

Never ending poverty within a poor but growing economy is an issue of sharing prosperity more than that of poverty itself. This is because economic growth is exponential, persistent and follows the law of diminishing marginal returns. While the latter law induces higher growth rates in poor countries, the two first features predict per person income above the poverty threshold in few years. This makes poverty eradication more of an inclusiveness concern rather than an issue of poverty in itself. Due to lack of empirical evidences elaborated on this, many are those who are under-assessing MDGs results and questioning the orientation of the SDGs.

To shed light on this, I have resorted to GINI coefficient and constructed an equality weighted GDP growth which proves its ability to aggregate dynamics of growth and equality. Comparing its pace to that of the overall growth is informative. When overall growth moves faster than equality weighted GDP growth, inequality makes the majority of people worse off and the opposite happens when the former moves slower than the latter. I subsequently argue that any valid poverty reduction or eradication strategy should fall in the second case.

Based on this finding, I have re-assessed the poverty reduction dynamics in Sub-Saharan Africa since 1991.

While the empirical results prove that overall growth was faster than equality weighted growth before 2000, they highlight the opposite throughout the post-2000 period. This positively assesses MDGs era on both growth and equality promotion criteria.

Drawing on ARIMA forecast estimating around 5% equality weighted growth up to 2030, I further argue that poverty will soon be

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part of SSA history provided that such a growth pattern is sustainable. Otherwise, growth would primarily make better off advantaged instead of disadvantaged people. The lower forecasts and the crisis period estimation results underpin this. Subsequently, to eradicate poverty, Post-2015 development agenda does not need higher growth rates but policies ensuring that new wealth are fairly shared.

Finally, it should be taken into account that this study only evaluates the extent to which the SSA growth and subsequent new wealth shares and reduces poverty. Future investigations would complement it with causal analysis of the pinpointed shared prosperity pattern. In case of recourse to regression analysis, it would be interesting comparing results of the regression of the overall GDP to that of equality weighted GDP as done in this paper for their respective dynamics.

7
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