

On the measurement and use of equality weighted growth

Pacifique Mongongo Dosa

Abstract. With the deadline of the Millennium Development Goals (MDGs), policymakers and aid practitioners are turning focus to the Sustainable Development Goals (SDGs). They argue that a slightly faster and inclusive growth would eradicate extreme poverty by 2030. This makes high growth rate and better income distribution a joint necessary condition for poverty eradication. However, there is no empirical studies assessing such an aggregated dynamics of economic growth and equality and drawing its implications in terms of trend in poverty reduction. Therefore, I resort to GINI coefficient to construct an equality weighted GDP growth merging them. Applying it to sub-Saharan Africa data, empirical results prove that the MDGs era is a turning point shifting a large share of growth on the disadvantaged people. However, such a pro-poor pattern is conditioned by a high and stable economic performance together with constant commitments for the poor. Otherwise, the opposite would happen as it has been displayed by figures in the aftermath of the recent global crisis.

Key words. Economic growth, Inequality, MDGs, SDGs, GINI coefficient

Resumen. Una vez cumplido el plazo de los Objetivos de Desarrollo del Milenio (ODM), los responsables políticos y los gestores de la ayuda internacional han focalizado su atención en los Objetivos de Desarrollo Sostenible (ODS), argumentando que con un ritmo de crecimiento económico ligeramente más rápido se asegurarían oportunidades para todos y se erradicaría la pobreza extrema para 2030. Consiguientemente, para erradicar la pobreza es condición necesaria combinar elevados ritmos de crecimiento y una mejor distribución del ingreso. Sin embargo, no existen estudios empíricos que evalúen la dinámica agregada del crecimiento y la igualdad, y que delimiten sus implicaciones en términos de tendencias para la reducción de la pobreza. El presente estudio emplea el coeficiente de Gini para construir una tasa de crecimiento del PIB ponderada por la igualdad, que se prueba útil para analizar las dinámicas de crecimiento e igualdad. El análisis aplicado a los países de África Subsahariana demuestra que la era ODM supuso un punto de inflexión en la focalización de una buena parte del crecimiento hacia las personas más vulnerables. No obstante, este patrón de crecimiento pro-pobre depende de la existencia de ritmos estables y elevados de crecimiento y de un compromiso constante con los pobres. En caso contrario, se desencadena un patrón contrario de crecimiento, como ha revelado la reciente crisis mundial.

Palabras clave. Crecimiento económico, desigualdad, ODM, ODS, coeficiente de GINI.

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I. Introduction

Policy makers, aid practitioners and researchers rely on high rates of economic growth in developing countries to eradicate the extreme poverty (ECDPM et al., 2015; HLPEP, 2013; Sachs, 2005; Narayan et al., 2009; UN, 2006). This is underpinned by an economic and a statistic argument, namely the capital accumulation process (Galor and Moav, 2004; Solow, 1956; Ramsey, 1928) 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 argue that growth is persistent and hence 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 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 $g = 4\%$. In fact, it is more likely that most of us will not die before income per person in poor countries exceeds the extreme poverty threshold. Does this predict the end of poverty with our generation? It depends on how that new wealth is distributed. As we know, both economic growth and income per capita give no information about wealth distribution.

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

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.

II. 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 size (Kakwani, 1977). These advantages make GINI ratio a benchmark of this investigation. For clarity and methodological reasons, I introduce the GINI based adjustment by percentiles based procedures.

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) excludes 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 $1, d_{i,t}^k$ is the income share of the k^{th} deciles of the 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 authors found a big enough sample of income percentiles for Caribbean countries, this is not the case in most developing economies. For instance, available data for sub-Saharan Africa exclude the use of $y_{i,t}^{ia}$ since they do not contain $d_{i,t}^k$. Instead, they summarize income distribution with GINI coefficient $g_{i,t}$. In the following section, I show that GINI coefficient is a good alternative of $d_{i,t}^k$ in such a situation.

2. GINI based adjustment

$(1 - \text{GINI coefficient}_{i,t})$ is a good alternative of $d_{i,t}^k$ to deflate both GDP and its growth from inequality. $(1 - \text{GINI coefficient}_{i,t})$ can even be preferred to $d_{i,t}^k$. Besides being available, $(1 - \text{GINI coefficient}_{i,t})$ 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. In reference to figure 1, $\text{GINI} = \frac{A}{A+B}$. The bigger A is, the farther the Lorenz curve is from the equality line and hence the higher are both GINI coefficient and the level of inequality.

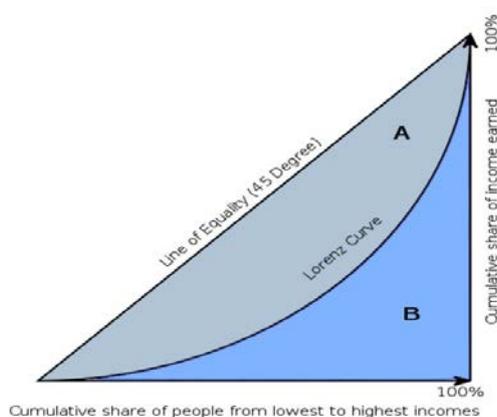


Figure 1: GINI components (GINI's Wikipedia page)

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 $(1 - \text{GINI coefficient}_{i,t})$ in expression 1. As detailed 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 $y_{i,t}^{ew}$:

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

In light of figure 1, it is noteworthy that:

- Lorenz curve gives the actual distribution of income among the population. Hence,

$$\int_{0\%}^{100\%} (\text{Lorenz Curve}) dp = 100\% \text{ of population} = 1 = \frac{A}{A+B} + \frac{B}{A+B} \quad [3]$$

- In expression 3, A and B areas measure mean income lags respectively from perfect equality and inequality. They provide percentage shares of revenues hold by those earning below the average from two opposite perspectives. While the first captures inequality, the second measures equality.

- Drawing on the same expression 3,

$$\frac{B}{A+B} = 1 - \frac{A}{A+B} \Leftrightarrow \frac{B}{A+B} = (1 - \text{GINI coefficient}) \quad [4]$$

Together, equation 2 and 4 give:

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

Indeed, $\frac{B}{A+B}$ 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:

$P_s = P_0 G^P + P_1(1 - G^P)$ (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 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.

III. Dynamics of equality weighted GDP in sub-Saharan Africa

1. From 1991 up to date

The blue and Green 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.

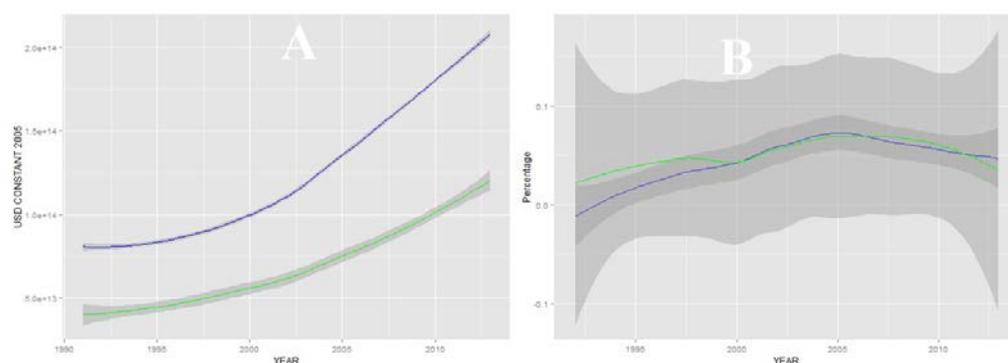


Figure 2: GDP and equality weighted GDP (Author's computation based on WDI-2015)

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 the one of overall GDP growth. This means that good effects of growth were not primarily on the advantage of the poor. Since 2000 until 2007, the opposite is observed. The increasing pace of equality weighted GDP growth becomes faster than the one 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).

Variable	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
GINI coefficient in %	37.73	43.07	44.90	45.13	46.98	53.44
GDP USD const. 2005	7.989e+13	8.863e+13	1.084e+14	1.249e+14	1.585e+14	0.13370
EWGDP USD const. 2005	3.719e+13	4.987e+13	6.295e+13	6.908e+13	8.767e+13	1.236e+14
GDP growth	-0.01859	0.03443	0.04702	0.04383	0.05797	2.087e+14
EWGDP growth	-0.18150	-0.01187	0.07222	0.05228	0.11420	0.16060

Table 1: Main statistics: 1991-2013 (Author's computation based on WDI-2015)

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 within developing countries. 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 achieved a temporary shift to the detriment of disadvantaged people. This 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.

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, the ones 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.

IV. Conclusion

Never ending poverty within a poor but growing economy is an inequality more than a poverty issue. This is because growth is exponential, persistent and follows the law of diminishing marginal returns. While the latter induces higher growth rates in poor countries, the two first predict per person income above poverty threshold in few years. This makes poverty eradication more of a growth distribution concern rather than an issue of poverty itself. Due to lack of empirical evidence on the latter, many are those who are under-assessing MDGs results and questioning the orientation of the SDGs. To shed light on this, I resort to GINI coefficient and construct 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 meet the second case. Drawing on this, I re-assess poverty reduction dynamics in sub-Saharan Africa since 1991. While 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 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 rate but a good enough inequality reduction strategy.

V. References

1. ECDPM, DIE, and ODI (2015). European report on development 2015, combining finance and policies to implement a transformative post-2015 development agenda. Technical report, European Commission.
2. Galor, O. and Moav, O. (2004). From physical to human capital accumulation: Inequality and the process of development. *The review of economic studies*, 71(4):1027–1063.
3. Haughton, H. and Khandker, S. R. (2009). *Hand book on Poverty and Inequality*. World Bank.
4. HLPEP (2013). A new global partnership: eradicate poverty and transform economies through sustainable development. Technical report, UN Secretariat.
5. Kakwani, N. C. (1977). Applications of Lorenz curves in economic analysis. *Econometrica*, 45.
6. Narayan, D., Pritchett, L., and Kapoor, S. (2009). *Moving Out of Poverty: Success from the Bottom Up*, World Bank Publications. Palgrave Macmillan.
7. Ramsey, F. (1928). A mathematical theory of saving. *The economic journal*, 38(152): 543–559.
8. Sachs, J. (2005). *The end of poverty: economic possibilities for our time*. Penguin.
9. Sen, A. (1976). Poverty: An ordinal approach to measurement. *Econometrica*, 44.
10. Solow, R. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1):66–94.
11. Solow, R. (2007). The last 50 years in growth theory and the next 10. *Oxford Review of Economic Policy*, 23(1):3–14.
12. Tezanos, S., Quinones, A., and Guijarro, M. (2013). Inequality, aid and growth: macroeconomic impact of aid grants and loans in latin America and the Caribbean. *Journal of applied economics*, 16(1):153–177.
13. UN (2006). *Doubling Aid: Making the “Big Push” work*. United Nations.