Short notes on Distribution of Income and Development

"Statistics is the science according to which if yesterday I ate two chickens and you missed dinner, then we had on average one chicken apiece" (Trilussa)

In the models studied in class so far, and while looking at the data, we focused our attention on the aggregate values or the per capita ones (especially of GDP) at the countrywide level. This has been a reasonable strategy, since most (but not all) of the development indicators of one country are correlated to its per capita GDP. However to deepen the understanding of the development processes, and to have a larger view of the economic conditions of one country it is helpful to look at how income and wealth are distributed as well.

These notes will focus on the distribution of income and label as "inequality" the condition of unequal distribution of it. Notice that, except in the limiting case of a perfectly egalitarian situation in which everyone earns the same income, no matter which is her qualification or work effort, there will be always a positive inequality in each country, so that we are never comparing inequality with some abstract equality condition. Instead we are comparing different levels of relative inequality.

There are two main reasons to deal with the distribution of income in a Growth and Development Economic course:

- Because we are interested in the issue per se, since it has been argued that there are ethical reasons to be averse to the unequal distribution of income, if this latter is not caused uniquely by different skills and effort levels of the economic agents.
- Because there are economic consequences in the short run that depend on income distribution and because the income distribution could have lasting influences on the long run growth.

In order to analyze meaningfully this phenomenon we need to measure it. Deciding which measures to use amounts to select a list of criteria that we would like the index to satisfy, and to consider which are the constraints due to the availability of data.

Ignoring for the moment this latter issue and assuming that we know perfectly the income of each person in the country whose inequality we aim to evaluate (let these individual incomes be w_i for $i = 1, ..L$), a reasonable set of criteria for any measure of inequality are:

1. **Anonimity principle**: it does not matter which person is earning the income, so that if the income of the i^{th} person is permuted with the income of the j^{th} person the index does not change.
2. **Population principle**: the index does not depend on the absolute number of people living in the country. So if we have any distribution of incomes and we multiply for any number the people that are earning them, the index should not change

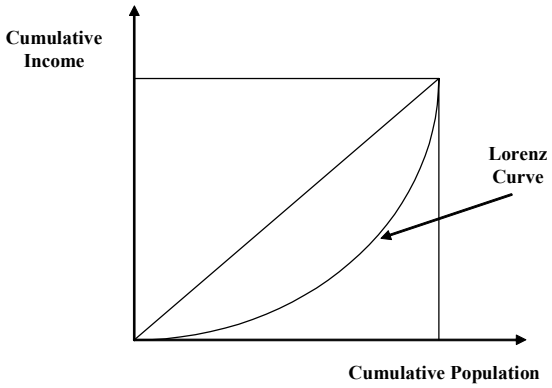
3. **Relative Income principle**: the index does not change if the income is measured in different units (cents instead of dollars, dollars instead of euros, etc.)

4. **Dalton principle**: define a regressive transfer any transfer of income from person i to person j when $w_i < w_j$, and a progressive transfer any transfer from person i to person j when $w_i > w_j$, the index increases as a consequence of regressive transfers and the index decreases as a consequence of progressive transfers.

Keeping these four principles in mind consider the most used indexes (see for example the data available in UNDP website):

A The Kuznets Ratios[1]: ratios $\frac{X}{Y}$ where X is the income earned by the top $x\%$ of the income earners and Y the income earned by the lowest $y\%$. The most commonly computed ratios are for: $x = 10\%$ and $y = 10\%$; for $x = 20\%$ and $y = 20\%$; for $x = 20\%$ and $y = 40\%$. This kind of indexes satisfy criteria 1,2,3, but don't satisfy the Dalton Principle (any transfer that interests only the central part of the distribution of incomes won't alter the ratios)

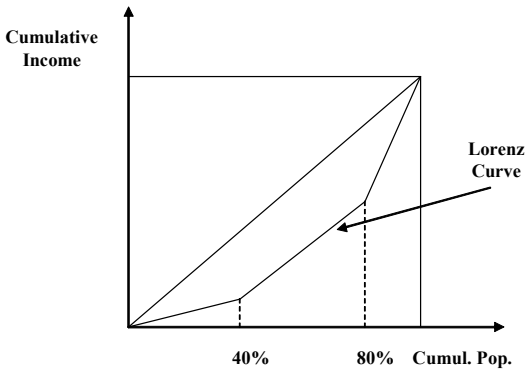
B The Lorenz Curve: assuming to know each individual income, it is possible to plot on a graph the cumulated distribution of population on the x-axis versus the cumulated distribution of incomes on the y-axis. This way we'll get a curve of the following shape:



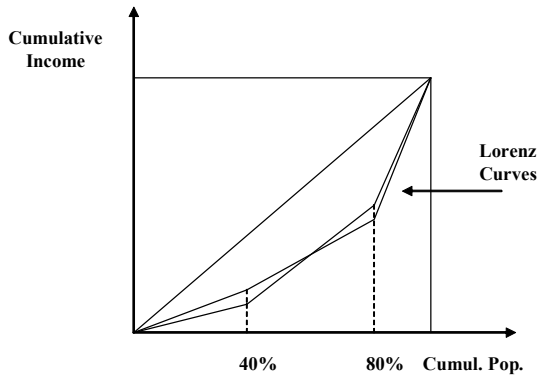
Practice Exercise 1 Explain why the Lorenz Curve is increasing with an increasing slope.

[1] Named after Simon Kuznets, winner of the 1971 Nobel Prize in Economics and author of "Economic Growth and Income Inequality", 1955, America Economic Review, a very influential early contribution on the connection between development and economic inequalities.

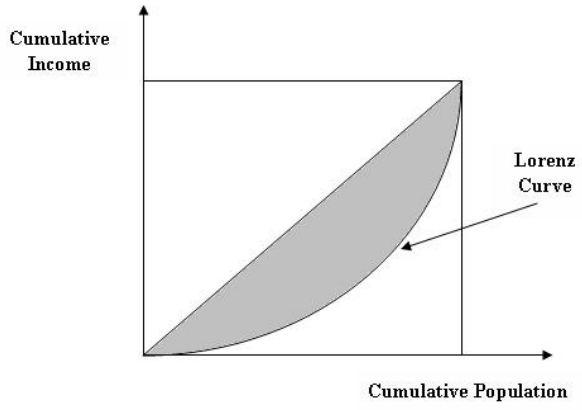
The closer the curve is to the 45 degrees line, the more the income is equally distributed. Since in most cases there won't be data on all the individual incomes, but there will be data for groups of people (top 10% income earners, following 20%, etc.), the Lorenz Curve is in practice a sequence of linear segments:



Notice that now the first three criteria are satisfied and the fourth is satisfied as well, meaning that if there is regressive transfer the whole curve will shift to the right (further from the equality line), while if there is a progressive transfer the curve will shift to the left (closer to the equality line). Therefore if we want to compare the relative inequality in two countries we could compare the respective Lorenz Curves, and state that the country whose curve is closer to the 45 degrees line has lower relative inequality. However the ordering induced by this index is not complete, meaning that in the particular case of Lorenz Curves of two countries crossing, we are unable to state which country has a more egalitarian distribution of income:



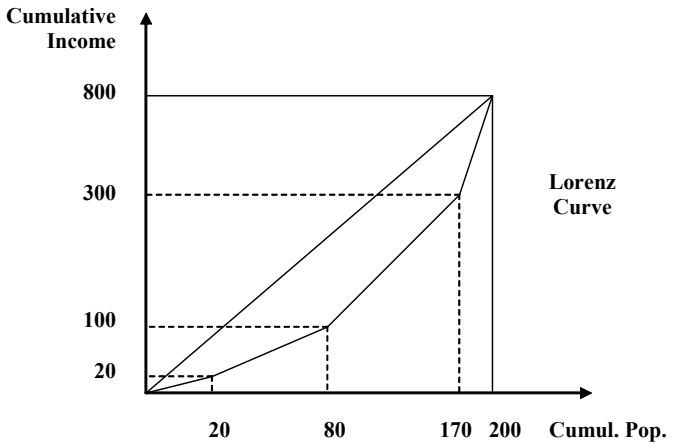
C The Gini Index: the most used measure of inequality in the distribution of income. It is the ratio between the area below the 45 degrees line and above the Lorenz curve (the gray area) and the area of the whole triangle below the 45 degrees line:



The ordering induced by the Gini index is complete, since for each income distribution there is one associated number. Here is one example on how compute the Gini index: let the first set of numbers represent the incomes and the second set of numbers represent the number of people earning each of these incomes:

$$(20, 80, 200, 500), (20, 60, 90, 30)$$

The corresponding Graph is the following:



The area of the triangle below the 45 degrees line is:

$$\frac{200 * 800}{2} = 80,000.$$

The area between the Lorenz Curve and the x-axis is:

$$\frac{20 * 20}{2} + \frac{(20 + 100) * 60}{2} + \frac{(100 + 300) * 90}{2} + \frac{(300 + 800) * 30}{2} =$$

$$200 + 3,600 + 18,000 + 16,500 = 38,300$$

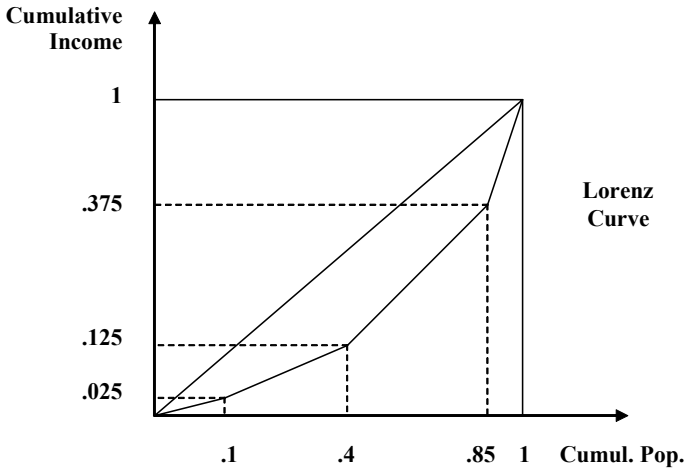
Therefore the area between the Lorenz Curve and the 45 degrees line is:

$$80,000 - 38,300 = 41,700$$

And, finally, the Gini index is:

$$GINI = \frac{41,700}{80,000} = .52125$$

Notice that we could get the same result if instead of using the absolute values we use the percentage ones. In this case, we would have: $\frac{20}{200} = .1$, $\frac{80}{200} = .4$ and so on. Following the same procedure for the cumulated income we get the following graph:



the area of the triangle is now equal to .5 and the Gini index is:

$$\frac{.5 - (\frac{.1*.025}{2} + \frac{(.025+.125)*.3}{2} + \frac{(.125+.375)*.45}{2} + \frac{(.375+1)*.15}{2})}{.5} =$$

$$\frac{.5 - (.00125 + .0225 + .1125 + .103125)}{.5} = .52125$$

In the example shown and computed in class we had the following distribution of incomes and population:

$$(100, 200, 300, 400), (25, 25, 25, 25)$$

And the Gini index was:

$$\frac{50,000 - (\frac{100*25}{2} + \frac{(100+300)*25}{2} + \frac{(300+600)*25}{2} + \frac{(600+1000)*25}{2})}{50,000} =$$

$$\frac{50,000 - 1,250 - 5,000 - 11,250 - 20,000}{50,000} = .25$$

Since the Gini index is computed using the data on individual incomes, the usual caveats that apply to this measurement apply to this computation as well: less developed countries will in general have less reliable data. Notice in particular that the presence of Home Production will increase the Index. This can partially explain why less developed countries tend to have higher Gini indexes.

Practice Exercise 2 Add 100 Home Production income to each income group in the previous example and compute the real Gini index for that country. Verify that it is lower than the one computed without considering the home production.

Another fact worth considering when dealing with indexes is that they are a snapshot of the income distribution in a particular moment in time, and this information could be sometimes misleading. Consider the following example: we would like to compare two countries, Sparta and Athens. Let all data be in thousands dollars. Assume that in Sparta 50% of the people earn 20 per year and 50% earn 40. Suppose too that everybody begins to work at the age of 23 and retires at 63. When each person enters the labor force she draws her income from this distribution (so has a 50% probability to earn 20 and 50% to earn 40), and then she will get this same income along all her lifetime. Assume instead that in Athens 50% of the workers earn 10 per year and 50% earn 50. Suppose again that everybody starts to work at age 23 and retires at 63. However in Athens each worker draws her income from the distribution every year (so on average she will earn 10 for 20 years and 50 for other 20 years). At any moment in time the Gini index in Sparta is lower than the Gini index in Athens, while the average wage is the same in the two countries. However considering the lifetime earnings there is clearly less inequality in Athens (everybody has the same expected wage in every period, while in Sparta, after the first period, somebody will have forever a low wage and somebody else forever a high wage).

Practice Exercise 3 Compute the Gini Indexes for Sparta and Athens in each year.

Practice Exercise 4 Assume that each period lasts 10 years, and that there is a draw of income at the beginning of each period, with the income being then constant for the whole period. Compute the lifetime incomes in Sparta and Athens (assume that all incomes are in constant prices) and the percentage of people earning them. Then compute the Gini indexes on these distributions of incomes and populations. In which country there is higher inequality?

Once clarified how to compute the inequality indexes and which information they give (as well as which information they don't), it is possible to mention the main issues implied by the unequal distribution of income with respect to the Development process.

Simon Kuznets in 1955 was the first economist to address formally this question. He hypothesized that while developing a country would first experience an increase and then a decrease in inequality, following an inverse U-shape pattern. The main idea behind this observation can be described in a simple way: when countries develop most workers move from the primary sector to the secondary and tertiary ones. Usually wages in the former are lower than wages in the latter two. When almost everybody is in the primary sector, there is very low inequality, then when only a part of the labor force changes occupation inequality rises, finally when most of the labor force is in the secondary and tertiary sectors inequality will tend to decrease again.

Practice Exercise 5 Assume that in Atlantis there are only two economic sectors: agriculture and industry. Wages (expressed in thousands of dollars)

are 25 in agriculture and 50 in industry. Assume there are 100 workers, and that in each period 10 workers move from agriculture to industry. Assume that in period 0 there are 90 workers in agriculture and 10 in industry. compute the Gini index for periods $1, 2, 3, 4, 5, 6, 7, 8$. Compute the Kuznets Ratios for $x = y = 10\%$, for $x = y = 20\%$ and for $x = 20\%$, $y = 40\%$ in the same periods. Comment your results.

There are three main arguments often given by economists to argue for the relevance of the distribution of income when analysing long run growth:

1. **The aggregate savings argument**: if the savings share of income is not fixed (so that aggregate savings are a fixed proportion of aggregate income), but varies with individual income, then different distributions of incomes will yield different levels of aggregate savings, even if they have the same average income. Suppose that the proportion of income that is saved increases with income: then any regressive transfer will have a positive effect on aggregate savings. Suppose instead that the share of income that is saved decreases with an increase of personal income: then it is a progressive transfer that has a positive effect on aggregate savings.

2. **The political economy argument**: (this argument is formalized in Alesina, Rodrik, *The Quarterly Journal of Economics*, 1994) a very unequal distribution of income could cause a political pressure for an increase in redistributive policies (usually higher taxes and higher transfers). In turn, due to the distorsive effects of taxation, this will lead to slower GDP per capita growth.

3. **The human capital argument**: an unequal distribution of income, in presence on imperfect capital markets, could prevent some children from acquiring the optimal level of skills and education, so slowing the human capital growth.

References

[1] Alesina A., Rodrik D., (1994), "Redistributive Politics and Economic Growth", The Quartely Journal of Economics, vol 109, pp. 465-490

[2] Kuznets S., (1955), "Economic Growth and Income Inequality", American Economic Review, vol 45, pp.1-28

[3] Ray D. (1998), Development Economics, Princeton University Press, Princeton NJ