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Inequality is a relational concept that does not exist in an individual taken in isolation. It constitutes a property of the relationships between people. On the other hand, welfare is something that can at first be observed individually, or adding the set of people, called social welfare. In fact, inequality is a property of the social welfare function that we incur, or not, when we move from the measurement of the levels of welfare of each person to the calculation of welfare of the whole set of people that compose a society. We follow the economic tradition inaugurated by Anthony Atkinson's seminal work that derives inequality from an explicit social welfare function.

Concepts – Before relating social welfare and income inequality, the central aspect here, it is initially necessary to point out similarities and differences with other close concepts. First, the differentiation of objective measures of welfare from subjective measures. In the first case we deal with usual tangible variables such as income, consumption, education. In the second case, we have measures based on people's perceptions about these, or other issues. The literature of happiness propelled by the work of Richard Esterlin is within this last strand. The problem is that aspirations and value judgments vary between individuals, or even for the same individual over time.

It is still interesting to have a distinction of welfare measures with many dimensions of those with a single dimension. In the first case, we have measures based not only on income but on the lack of access to other basic elements such as education and health, included in the Human Development Index (HDI) designed by Amartaya Sen and Mahbub ul Haq and accompanied by the Program of United Nations Development Program (UNDP). Although richer, these indicators with multiple dimensions imply in a series of difficulties of operationalization as in the determination of the relative weights for each dimension.

In practice, despite being criticized - for good reasons - of leaving complexities outside its framework, the welfare indexes based on a single monetary dimension are the most used with the assumption - often unrealistic - that individuals in a market economy are able to directly acquire goods and services that meet your needs. It is often possible to impute values of rent for those who own their homes, of commuting time

lost evaluated at each hourly wage rate, of public education and health expenditures and to incorporate them directly into income based welfare measures.

Here we will follow measures of simple inequality. Responding to the classic question formulated by Amartaya Sen "Inequality of What?" with a simple answer: income per capita. Some will rightly argue that the reductionist strategy will transform the color portrait provided by household surveys into a black-and-white photo. Some will respond to this by citing the advantages of looking at the parts without losing sight of the whole, which forms the heart of the strategy described here.

Welfare and Inequality - To make it clear to the reader, we will be working here with measures of objective inequality and with a single dimension: income. In the economic literature it is derived from welfare measures subject to the same attributes. Let us look at the most well-known measure of inequality, the Gini index, which varies from zero to one. The larger the indicator, more unequal the society. In a utopian situation where everyone's income was the same, the Gini index would be zero. At the opposite extreme, if a single individual concentrated all the income of the society, and all the others would have zero income, the Gini index would be one. You do not need to be a genius to understand the unacceptable extension of a Brazilian Gini index above 0,5: we are closer to perfect iniquity than to perfect equality. The complement of the Gini Index is a measure of equality.

We have opted here for a simple initial solution of combining the effects of average income and inequality on a simple social welfare function proposed by Amartya Sen, Nobel Prize in Economics. The measure of social welfare equals the mean per capita income times the Gini complement to unit (i.e. becomes an equality measure) where inequality functions as a welfare-reducing factor in relation to the mean income level. For example, the average income of 630 *reais* per month per Brazilian in 2009 would be the value of social welfare according to Sen's simple measure if we lived in perfect equity. But the reality corresponds to 45.5% of this value, 287 *reais,* given the current extreme Brazilian inequality. The discount was even higher when the index was only 41.7% of the mean income in 2003. There was a 2003 and 2009 evolution of 44% in the level of social welfare versus 31.9% of per capita income in this period. In average, annual rates of growth of the per capita income of the PNAD is 4.7% per year against 6.3% of the Social Welfare. This gain refers to the reduction of inequality

observed in the period. Therefore, in this approach inequality is a component of the welfare measure.

More fundamentally, a specific measure of inequality is derived from a measure of welfare of a known functional form. Or more generally, it derives with known properties. Economics is not only the science of scarce resources for unlimited needs, as defined by Lionel Robbins in the 1920s, but also the field in so-called social sciences where the use of hypotheses try to measure the knowledge we have about the complex reality that we live. When we characterize a social welfare function, we are implicit or explicitly obliged to define all the properties or value judgments underlying its construction, as well as for the inequality function derived from it.

The economic literature synthesizes in a single number that corresponds to the level of social welfare from society as a whole. In general, the social welfare function assumes that if the welfare of a person in a given society improves and no one worsens, social welfare increases. This hypothesis is known as Pareto condition. Another hypothesis is anonymity, in which social welfare depends on the list of individual levels of welfare and not on their identity. For example, if we compare a situation in which the volume of resources of all people in the economy are exactly comparable to another situation when people possession are switched between but maintain the same distribution of resources, then the final level of social welfare and inequality will be by symmetry exactly equivalent to the initial welfare level.

The last and most controversial basic property of the social welfare function is the principle of transfers (or also known a Pigou-Dalton property), which basically says that people prefer equality. It is as if there is a veil of ignorance where no one knows who is who. Otherwise, the ordering chosen among different distributions would fall on the case where the individual who chooses would have all the income of the economy and the rest would have null income. The social choice in this sense is like a choice when there is uncertainty and people consider choosing which society they would like to be born. It would be the distributive equivalent of a risk aversion on the part of individual agents. For example, the social welfare measure most used, and most criticized, is per capita income. Within the economic approach, we can have the highest statistical inequality in the world, but the measure of inequality derived from a welfare function of the mean income will always yield a null inequality value.

In contrast, let us now take the most usual measure of inequality among analysts: the Gini index. The social welfare function that gives rise to the Gini index is one in

which the weights given to the income of any person of the population is inversely proportional to the proportion of people poorer than him. The richest person in the economy would be the person with the lowest weight in calculating the level of welfare of society, while the poorest would have the highest weights. It is a case of "the last one will be the first one".

Besides assigning weights to the welfare of different individuals as a function of income, it is possible to introduce preference for “equality across situations” in the individual welfare of people, rather than assuming that this corresponds necessarily to level of income of each person. For example, in the case of the Theil T Index, the logarithm of income is considered as the welfare function of the individual on the assumption that a given absolute income change size for the poor are relatively more important than for the rich. In order to reach the level of aggregate welfare, is taken a simple mean log income. One problem with Gini and Theil-T inequality indicators is that they only increase for PNAD marginal income increases greater than the 75^{th} and 87^{th} percentiles respectively (Hecksher et al. 2017). This income level is very far from what would be consider poor or extremely poor, what makes these measures particularly misleading for overcoming poverty purposes.

It is still possible try to minorate these problems by augmenting preferences for equality in the social welfare function combining from both the highest weights attributed to the poorest and/or decreasing gains of individual welfare from income increments. In the case of a measure nicknamed as Thini, where the logarithm of the Theil index is combined with the weight structure embedded in the Gini index, as proposed by Kakwani et all. (2010). In this case, this hybrid social welfare function and its derived inequality measure will result in greater sensitivity to income transfers at ranges closer to the bottom of the income distribution than for example their original measures taken in isolation. Another alternative is to use the same approach as proposed by Atkinson (1970) deriving the corresponding inequality directly from a poverty measure as the social welfare function to be pursued (Kakwani and Neri 2015).

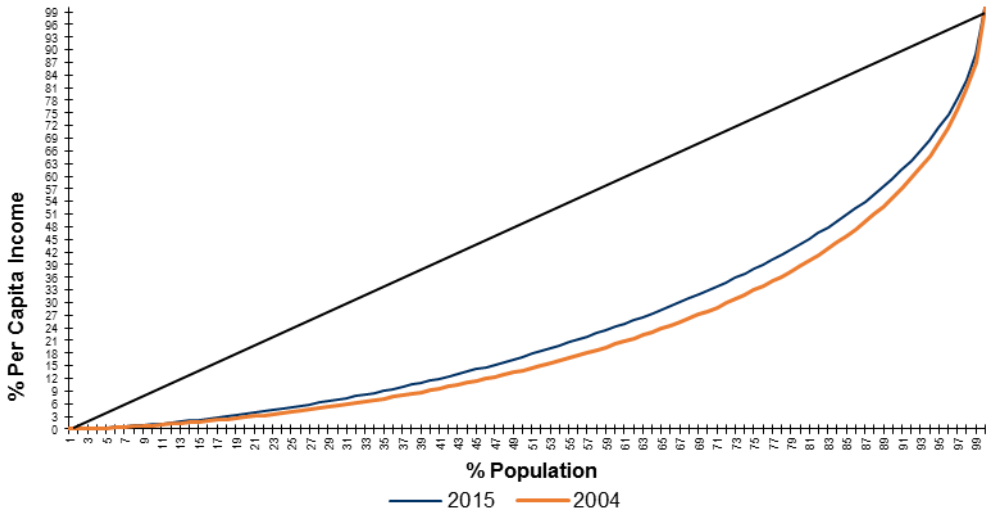
The general point is that the Atkinson's approach imposes the discipline of thinking about inequality measures as heirs to of one particular social welfare function of origin and its hypothetical properties.

Lorenz – The Lorenz curve is a graphical approach to the study of income inequality that is more general than the Gini and Theil indices. It is like the collective fingerprint

of a given society and through it is possible to make more general comparisons about inequality, based on the three assumptions cited above and not on specific functional forms.

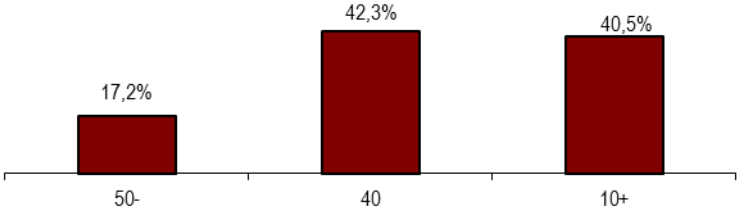
The graphical instrument of the Lorenz curve allows us to order the distribution of income from an inequality point of view. The Lorenz curve express the relationship between the proportion of people with incomes at least as high as a given value and the proportion of income received by these people. If the proportion accumulated of population have the exact proportion of accumulated income, we are in a world of perfect equality (45º line). In this case, the measure of inequality according to the Gini index would be zero. At the opposite extreme, the extreme inequality line corresponds to a situation in which everyone receives zero except the richest, who receives the total income (90º). In practice, the Lorenz curve is always between the line of perfect equality and that of extreme inequality. The closer it is to the line of perfect equality, the more egalitarian is the distribution of income. Graph below illustrates that per capita income inequality improved in Brazil between 2004 and 2014.This means that for a wide range of measures that respect the principle of transfers inequality improved between 2004 and 2015.

Lorenz Curves – Per Capita Household Income



Source: FGV Social from PNAD/IBGE microdata

Share in Total Per Capita Income - 2015



The same data shows that in 2015 with the top 10% would concentrate around 40,5% of the income while the bottom half would hold 17,2% of income. In the historical peak of inequality in Brazil registered by no coincidence during the hyperinflationary peak in 1989, the bottom 50% held 10,56% of income while the top 10% held 50,97% of total income, easy to remember where the respective income ratios between these two groups reached nearly 25 to 1 against. But inequality in Brazil is still in 2015 among the top 20% highest in the world in all the most important ranks available internationally.

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