UNDERSTANDING INCOME INEQUALITY: CONCEPT, CAUSES AND MEASUREMENT

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ABSTRACT

This paper contributes to the understanding of the phenomenon of income inequality by first providing a logical delimitation of the subject of analysis in order to reach hermeneutic consistency; second, by reviewing the most important theoretical causes of income inequality as evidence of the enormous intricacy of this phenomenon and its multifacetic nature; third, by describing the most important instruments of income inequality metrics, with emphasis on the different objective measures available in the literature and the way they are calculated. Special importance is given to the Gini coefficient due to its generalized application in empirical studies.

Keywords: *Inequality, Income, Distribution, Inequality Metrics.*

1. INTRODUCTION

The study of inequality from the economic perspective cannot be analyzed as a single topic or even as a phenomenon to be approached from a generalized theoretical view when trying to understand the correct way to be interpreted, measured or even defined.

Regardless of the etymological origin[1], which basically denotes the absence of equality, the understanding of this term can be generally related to a negative connotation for a distribution of whatever assignation of interest to a defined group of recipient units (commonly individuals, households, countries or any other combination of units who can be defined as identifiable entities). This negative connotation is commonly associated to considerations of justice, seeing the referred absence as a sign of unfairness, in other words, tacitly elevating the concept of equality to the rank of a positive ethical value.

In order to be a subject of analysis, the absence referred by the etymological definition of inequality must necessarily be associated to another measurable element, which is normally the unit we will measure and try to objectively evaluate in relation to other distributions of the same elements, the most common examples being income, wealth, consumption, as well as other normative elements such as welfare and utility. This way, the objective of any study on inequality must invariably be focused precisely on the chosen element of reference, as inequality (as a topic) represents only the value judgment of the absence of a homogeneous distribution of such element. In this context, for example, the study of gender, race, opportunities or income inequality, are the chosen elements (the ones to measure and compare), and their distribution is the condition we will evaluate in relation to our judgment on its goodness or badness.

The previous explanation evidences the fact that any study on inequality, regardless of the question: *Inequality of what*?, is inexorably embedded with a subjective, and perhaps normative, value over the studied relationship. Once the value judgment about the sense we will be printing to inequality is emitted, it is possible to use objective measures for the chosen element of evaluation.

In this study, the element chosen to be measured in the context of the conventional understanding of economic inequality will be the income among individuals or households. This choice of variable is taken both from the

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[1] Rooted in the Latin language and derived from "*in-aequalis*", meaning "not-equal".

necessity of a valid indicator to be related to economic growth, which is the final purpose of this research, as well as from the need to concur with the developed literature in this area of study. This way, it is possible to ask the question: *How good or bad is income inequality?* Additionally, choosing income inequality as the variable to be measured offers a wide range of tools for measurement and analysis (which will be reviewed in the next section) in order to reach the most objectively possible conclusions and, hopefully, accomplish the objective of expanding the frontier of knowledge.

2. CAUSES OF INCOME INEQUALITY

Once we have delimited our study to the dispersion of income within individuals in an economy, we can now start to understand the probable causes for such distribution. Theoretically, there are several reasons for the existence of income inequality, most of them are actually related and many of them respond to the same underlying economic forces. In the following section the most relevant will be reviewed.

Rousseau stated more than two centuries ago in this *Discourse on the Origin of Inequality* that as individuals departed from the "primitive state" to conform societies where private property predominated and individuals developed a specific role in those societies, the conditions where set for the generation of all sorts of inequalities among them, Rousseau (1754). This way, a straightforward approach for understanding the causes of income inequality can come from a simple classification, following the intuition of Rousseau, in terms of the relation of the probable cause with the individual. This way we can stamp a broader sense of direction to the causes and the way inequality can be originated, be it by individual circumstances or imposed from external conditions. For this we can classify them into two groups of causes, the endogenous to the individual and the exogenously determined causes.

2.1 Endogenous causes

The endogenous or individual-specific causes can be best referred to a set of circumstances or characteristics intrinsic to individuals and which can potentially determine their future income as the result of influencing their comparative advantages either in the form of higher productivity or by the possession of scarce attributes which make them comparatively more market-valuable or even, in a broader sense, more socially competitive.

The most basic are the innate abilities embedded to each of us, intelligence, personality, charisma, or even physical attributes such as strength or skills are some of the most fundamental causes why individuals may differentiate themselves from others. Perhaps the most widely studied is intelligence, which can be measured by several instruments like IQ tests, which have been proven to have a positive correlation with future income.

A second endogenous cause of income inequality is one that can be considered a necessary complement to the above mentioned innate abilities, namely, the variety of preferences among individuals which can potentiate or undermine any physical or intellectual attribute. These preferences, are influenced by social and cultural values due to the fact that they are, in general, constructed as the result of collective inertia, derived of costumes, traditions, idiosyncrasy and other variables such as history and geography which can determine the individuals attitude towards certain preferences or choices such as work, education, risk aversion[2], or even decisions over leisure and income preferences. This of course does not mean that every individual in a certain society will develop the same preferences. Such as the sociological definition of culture encloses basically everything in human experiences, there are infinite numbers of factors which can influence the individual preferences. The basic idea behind this argument is that each individual, regardless of its innate abilities, can make different decisions and follow different paths which in turn can affect their income level and which will differentiate one from the others.

Related to the previous are the sources of inequality attributed to the physical differences between individuals. Gender and race are among the most frequent causes for inequality within societies, even in modern democracies. The income gap between men and women is more evident when observing the differences in wage incomes, the example of the United States depicts a clear view of how this phenomenon is present even in a developed economy. According to the 2004 population survey of the US Census Bureau, the average earnings of full time workers was of $31,223 USD for females and of $40,798 for males, indicating a difference equivalent to 23.5% of the male income, in other words, women's wage incomes represent 76.5% of the man´s income[3]. As shocking as this gap may be seen, it is worth noticing that it has been reduced during the last decades, according to estimations of Sanborn (1964) the gender wage gap in the 1950's was equivalent to a difference of 42%,

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[2] For example, low risk aversion has been proven to be a constant attribute among entrepreneurs.
[3] For more information on this topic see De Navas-Walt et al. (2005).

meaning that women earned as much as 58% of the men's average wage income. One decade later, in the 1960's, the gap had been reduced only by 2% according to Fuchs (1971).

Several studies have tried to define and measure the income differences among man and women (Sanborn, 1964; Fuchs, 1971; Becker,1957; Oaxaca, 1973), among many others), most of them concur in the fact that this condition is the outcome of a wide set of possible causes, among the most important are the differences in educational attainment and its effects on productivity, hours assigned to work, occupational choices, motherhood and maternity leave, as well as discriminatory reasons such as professional and educational barriers, labor market bias in favor of men, motherhood penalties and occupational segregation among many others found in the literature.

The effects of these gaps can exert a direct influence the overall income inequality levels, as well as in other important socio-economic indicators. Ferreira (1999) as well as Gradín et al. (2006) find similar results in that the gender gap, and specifically the wage gap, is positively correlated with poverty levels, the former in the context of the Brazilian economy and the latter in the European Union.

The pattern of income differences widens even more if we include the racial element in the equation. According to the same 2004 US census, the average earnings for the white (non-Hispanic) population averaged $48,977 USD, while the average for the Hispanic population was of $34,241 USD and for the Afro-American population of $30,134 USD, a difference of over 30% for Hispanics and of 38.5% for Afro-Americans. In this case, the different characteristics and size of the population might be determinant in the income levels, more than the race or the nationality, factors such as educational levels or legal status might explain such differences. The fact that in the average income for the Asian population is of $57,518, significantly higher than for the white population might be evidence of that. Nevertheless, the existence of racial discrimination as an element defining the income gaps is an issue present in the debate.

2.2 Exogenous causes

Perhaps one of the most important long-established causes of income inequality is land concentration. Its effects can be traced in history to every corner of the world and through every country's history. Medieval age Feudalism in Western Europe is one of the clearest examples of this phenomenon and its effects on the distribution of wealth and income, where vast extensions of land[4] where the property of a lord who would grant their exploitation to vassals who in return where obliged to hand over most of the production.

Land distribution as a source of income inequality is naturally related with the rural context of societies, where production and the generation of wealth were highly associated with agricultural activities. With the industrial revolution and the associated rural-urban displacements[5], the effects of land concentration on income inequality where largely substituted by new forms of social organization such as Bourgeois societies, in which land possession was substituted by capital concentration and the ownership of the means of production in the newly developed industrial societies. Here, the proletarian working classes where the inheritors of the inferior conditions previously held by vassals, and where also the recipients of the associated income inequality.

Education is by far one of the most important determinants of the future income level of any individual. In this sense, the prevailing educational policies and the variations in access to education in a country can potentially influence the levels of inequality. A society with a poor access to education could find itself in a situation in which the few who could obtain education and acquire skills will allocate in working positions that offer high salaries. If the supply of skilled workers is scarce enough not to meet the current demand, wages will rise even further. Additionally, if the opposite occurs with the non skilled population who could not have access to education, the excess supply will drive wages to even lower levels, thus widening the gap between the incomes of educated and uneducated population.

Another modality of this effect comes from an erroneous educational policy. A country where there is no formal coherence between the demand characteristics of the labor market and the supply of skilled force can generate important wage differentials which translate into income inequality. An example could be that of an industrial region, where there is an excess supply of university graduates and a scarce supply of technical skilled workers.

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[4] These extensive properties where known as Fiefs
[5] It is worth pointing out the enormous influence of the period denominated as the "enlightenment", where new liberal ideas influenced social movements like the French Revolution, which effectively generated the end of the feudal period.

Here the skilled worker's deficit would have to be solved by attracting, with higher wages, workers from other regions, and the wages for the jobs destined to the overpopulated university graduates would fall[6].

As the prior example shows, income disparities in a market economy will most probably be associated with the prevailing wage distributions in the economy. This way, the labor market plays a fundamental role in the determination of inequality levels, not necessarily as the cause, but as the intermediary effect of other circumstances which may wield the demand or supply sides of this market. Many examples of the way the labor market can influence income inequality can be cited. Immigration is one of them, under certain circumstances can contribute to lower wages for the unskilled sector of the economy, and to an increase in income inequality[7]; on the other hand, Esquivel (2009) found that immigrant transfers and remittances have income equalizing effects in the recipient countries; Collective bargaining implemented by labor unions can pressure wages upwards and generate unemployment and inequality. If in the public sector, the difference between the equilibrium wages and the bargained ones will be burden by tax payers, lowering their income; Several studies (Berndt and Morrison, 1995; Autor et al. 1998; Bartel and Sicherman, 1999; IMF, 2007; Esquivel and Rodriguez-López, 2003) have found technological change in the form of improvements in communication and information technologies to increment the productivity of high skilled workers in a higher amount than it does for unskilled labor, thus generating a skill-biased technical change which can generate faster growth in real wages for skilled labor, therefore generating earnings inequalities. Another group of studies reached the same conclusion but found the reason to come from changes in the relative demand for skilled workers as the result of shifts in economic dynamics such as the ones generated by trade liberalization (Freeman, 1995; Gottschalk and Smeeding, 1997; De Santis, 2002; Acemoglu, 2003).

Economic cycles and global recessions such as the one experienced starting 2008 in most economies, resulted in sharp rises in unemployment rates as the result of a decline in aggregate demand, which prompted income inequality within and between countries. Some authors as novel laureate Joseph Stiglitz point out that the policies implemented to stop the effects of the recession, such as the enormous rescue packages offered by the United States government to a number of financial institutions and industries (such as the automotive sector), may cause even more income inequality if financed by public deficit which will later oblige the government to increase tax rates (Stiglitz, 2010). The prior examples are only a glance on the importance of the labor market as a vehicle for the determination of inequality levels from a wide variety of economic circumstances.

Globalization is perhaps one of the most interesting examples of a contemporary exogenous cause of income inequality and one that also works through the labor market. Although there is no clear consensus on the exact effects of trade and financial liberalization on income distribution, many studies have analyzed both the tendencies and the correlation between both variables over the last decades. The tendencies go in several directions: First, there is some degree of consensus in that trade liberalization has income equalizing effects, (Esquivel and Rodriguez-Lopez, 2003; IMF, 2007; Esquivel, 2009). For developed economies, the increase in imports from developing economies is asociated to lowering income inequality, while for developing countries, the equalizing effects come from the icrease in low skill labor intensive exports such as agricultural products; Second, gobalization in the form of financial liberalization has been found to be associated with increases in income inequality thorugh the generation of skill biased wage differentials. This biases are driven by increases in the demmand for skilled labor, which result in that wages of skilled labor grow while wages for unskilled workers tend to fall or at least remain unchanged.

Nevertheless, there are still significant contradictions in related literature, some studies, like the one developed by Dreher (2008) found that the effects of globalization are accountable in some degree for the increase in income inequality in developed countries, while this effect is relatively small in developing economies. On the other hand, Saba (2004) found trade liberalization to generate income inequality in developing countries, through the skill-biased wage differentials derived from an increase in the demmand for skilled labor.

De Soto (2000) explores an alternative view for the international differences in income among countries. He proposes that the main cause for the development differences between less developed and developed countries is the inability of the first to produce capital by effectively incorporating all the available assets to the formal

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[6] An interesting example is that of the Argentinean number of graduated Psychiatrists, the largest in the world with an estimated of 42,000 practitioners. 110 professionals per 100,000 inhabitants, over four times the average of most developed western economies.

[7] A recent study by Docquier et al. (2010) confronts this view and finds in the context of the European economies, that immigration exerts positive effects on average wages and on reducing wage inequality.

economic system. The underlying cause of this situation is the structural weakness in the formal property systems which can generate the potential for the additional generation of capital from existing assets.

A more general and long term view of the causes for income inequality, and possibly the most widely cited, is the one that perceives inequality as a necessary condition in the dynamic process of economic development. Kuznets (1955) proposed the well-known inverted "U" hypothesis (later developed by Robinson, 1976), in which countries, in their path to development, would necessarily pass through a period of high inequality derived from the gradual shifts of labor from agrarian less rewarded activities to urban industrial more rewarded work. The general idea is that poor agrarian economies have a fairly homogeneous distribution of income as most inhabitants perform in economic activities with similar returns. As a country continues to develop and starts an industrialization process, which is normally accompanied by the development of the urban conglomerates, a shift will start to occur in the distribution of wages as people start to flow from the rural areas to the urban settlements where they will now access higher wages in the industrial sector, this in turn, will generate an increase in income inequality. The final phase of this hypothesis comes when countries reach a certain level of development and the majority of the population is now immerse in industrial activities. At this point, governments will be able to provide generalized access to education and to implement income equalizing policies such as transfers or social protection programs.

Finally, the concept of intergenerational inequality as a cause for income inequality can be associated to many of the previously explained causes. It is fundamentally related to the endogenous effects of inequality on the determination of some key decisions that individuals and their parents face during their life and which will affect the future income of their offspring. Fertility choices, education and health provision, as well as bequests or economic support are some of the most important elements that can determine the income level enjoyed by a second generation and their possibilities of, for example, overcome the poverty traps generated by the perverse cycle of inherited poverty.

We now turn to another important topic related to inequality and the one which will provide some of the necessary tools for reaching a result in the quest for understanding the phenomenon of income inequality. Namely, the matter of the correct way to measure income inequality.

3. MEASUREMENT

In order to further understand the nature and effects of income inequality, it is necessary to review the different ways in which it can be measured. The use of mathematical procedures and statistical tools to develop these measures is the most common procedure in the economic studies of inequality. From the most basic Parade income ranking to the entropy measures, the overall objective of inequality metrics is to perform the most objectively possible computation of a highly subjective phenomenon. This section reviews the most widely used inequality measures, as well as the procedures for their estimation. Additionally, comments on the advantages and disadvantages of some of them will be provided, in order to support their use in empirical studies. Special emphasis will be made on the positive measures, in particular on the Gini coefficient, as it is the main inequality measure employed in the literature. Finally, a description of the most important characteristics that should be taken into account when computing income inequality measures will be reviewed.

According to Sen (1973) inequality measures can be classified into two broad types, the objective and the normative. The normative measures usually deal with inequality from a view of its effect on a social welfare assignation. Here, inequality is no longer seen objectively and its measurement involves other normative perspectives such as ethics, welfare or utility levels. Possibly, the most important measures of this type are the ones who employ a Social Welfare function for the estimation of inequality persistence. The logic behind this measure is rather straightforward; it arises from the notion that any measure will inevitably involve an implicit normative judgment in that there are certain distributions better for everyone than others (Dalton, 1920; Sen, 1973)

If we assume that a fixed amount of income can be distributed among a set of individuals, that we can determine the form of a distribution that is optimal for everyone, and that this function can reach a maximum that occurs when incomes are equally distributed. Then we could be able to take a decreasing function of the social welfare function to measure income inequality. This initial approach was set forward by Dalton (1920) and was later developed by Aigner and Heins (1967). Later, Atkinson (1970) introduced the utilitarian approach to this measure by assuming that the total social welfare is the sum of the individual utilities of income. This specification also assumes diminishing marginal utility of income (concavity) and homogeneous utility functions for all individuals. Other examples of the use of this kind of normative approach for the measurement of inequality are Champernowne (1952), Tinbergen (1970), Bentzel (1970), Atkinson (1970).

The main disadvantage of this measure is that maximizing utilities does not take into account the distribution within the individuals as well as the transfers that may occur among them, thus it does not provide a useful tool for evaluating inequality and its dynamics within groups.

The remaining part of this paper will be oriented to describing the objective measures of inequality, from the simplest relative mean deviation, to the Gini coefficient and the entropy measures such as the Theil index. The main feature of the objective measures of inequality is that they are characterized by the use of statistical and mathematical tools for the estimation of income dispersion among a set of individuals.

3.1 The Relative Mean Deviation

Also known as the Schutz (1951) coefficient, the relative mean deviation is one of the simplest inequality measures, but one that differentiates from other in that, for example, does not only take into account the extreme values of the distribution. The relative mean deviation basically compares the income levels of each individual with the mean income of the population, then sums the absolute values of the differences between them and views it as a proportion of the total income.

$$D = \sum_{i=1}^{n} |\mu - y_i| n\mu$$

Where *D* is the relative mean deviation, μ is the mean income of the population, *n* is the size of the population, and y_i is the individual income.

The weakness of this measure comes from the fact that it is insensitive to regressive transfers; this is, to transfers from poorer individuals below the mean income to richer ones that also lie below the mean. If, for example, the mean income is $1,000 and there is an individual (A) with income of $200 and transfer part of his income to another individual (B) with income $900, then this increase in inequality will not be registered by the relative mean deviation formula, thus providing potentially inaccurate measures of income inequality.

3.2 The variance

A simple way to avoid the problem of the relative mean deviation is to simply obtain the square from the absolute values of the difference between the mean and the actual incomes, so that transfers such as the one previously exemplified can be captured. This simple statistical measure of dispersion is useful for its simplicity and it is calculated the following way:

$$V = \sum_{i=1}^{n} (\mu - y_i)^2 / n$$

Where V stands for the variance and the other variables follow the previous nomenclature.

Even though the variance does comply with the condition of reflecting the changes in the distribution at different levels of income, it has the disadvantage of not being able to meet the requirement of scale invariance, which requires the inequality level to remain unchanged when the income of everyone is multiplied by a constant. An additional disadvantage is that this measure depends on the mean level of income, which can cause some bias as it can reflect the same value for different relative variations in income and different mean incomes, thus affecting the comparability of the measures. For example, a les egalitarian distribution with lower average income than a more egalitarian with higher average income can result in the same variance.

3.3 The coefficient of variation

The coefficient of variation lacks of the problem generated by different mean average, as it is obtained by calculating the square root of the variance and dividing it by the mean level of income.

$$C = \frac{\sqrt{V}}{\mu}$$

An additional feature of the coefficient of variation is the fact that it is sensitive to income shifts at any level and in any direction, this makes it an attractive choice for measuring inequality. The donwside of this measure, as well as of the previously described, is that it is calculated in relation only to the mean income, while the most

complex and measures as the Gini coefficient, capture the differences between all pairs of individuals, and not just from the mean, which, as said by Sen "might not be anybody's income whatsoever". (Sen, 1973. p. 28)

3.4 The variance and standard deviation of the logaritms

When aplying logarithms to the income we can expect to eliminate some of the unpredictability of the raw and absolute data, since the values come out as an addition of a constant after the logaritmic transformation, and are dismissed when differences between mairs of incomes are being accounted for. The variance is compued normally, but the values for the mean and actual income are substituted for their logaritmic values, it is as follows:

$$L = \sum_{i=1}^{n} \frac{(\log y_i - \log \mu)^2}{n}$$

While the standard deviation of logaritms is calculated as:

$$H = \sum_{i=1}^{n} \sqrt{\frac{(\log \mu - \log y_i)^2}{n}}$$

The most relevan property of these logaritmic measures is the fact that they emphasize the income differences at the lower brackets of the distribution, therefore, if the interest of analysis is on this segment, this can be a usefull tool, otherwise we find that this logaritmic measure still has the disadvantage of depending on the mean income level.

3.5 Income shares and income quantile ratios

Other common class of inequality measures are the simple comparisons between different income groups, previously ranked according to income quantiles (usually quintiles or deciles). They generally consist in comparing extreme values of the distribution, for example the highest over the lower quantile, or any other combination that can depict the relationship between higher income earners and lower.

Due to ist simpleness to compute and to the fact that it is quite easy to interpret and explain, it was one of the most widely used inequality measure in the initial literature on the inequality-growth relationship, before more complex and reliable measures arise (i.e. the Gini coefficient, the Theil index, among others).

The most common ratios are the 20/20 which compares the amount of income of the bottom 20 percent in contrast to the highest 20 percent, nevertheless the combinations can be copious, 10/20, 10/10, 5/10, 1/10, among many others.

The drawbacks of this measures are several, they, for once, are only sensitive to changes in the two compared income shares so they do not depict overall changes in within distribution; additionally, they do not provide an absolute measure of income inequality, as they do not fall into an absolute scale of measurement; additionally, the measure can be skewed due to outliers in the distribution and it does not weight the included observations.

3.6 The Theil index

This inequality measure belongs to the entropy measures from information theory and was developed by Theil (1967). Entropy, in this context, can be understood as a property of a group of income earners who are unable to be distinguished from each other by their resources. In other words, higher entropy means higher equality in income distribution. On the other hand, higher inequality (lower equality) means low entropy or higher rudundancy. As the Gini coeffceint, the Theil index goes from 0 to 1, but because of the previous reasons, the Theil index reflects inequality in an oposite scale reference. A value of 1 reflects total equality (maximum entropy) and a value of 0 represents maximum inequality (maximum redundancy).

The Theil index can be calculated through the following formula:

$$T_T = T_{\alpha=1} = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{y_i}{\bar{y}} \cdot ln \frac{y_i}{\bar{y}} \right)$$

Where y_i is the income of individual *i*.

One of the most important features of the Theil index is its property of decomposability, which allows to "break down the inequality measure into a weighted average of the inequality existing within subgroups of the population and the inequality existing between them". (Bourguignon, 1979. p.1) This property further allows decomposing inequality to measure both between region elements of inequality as well as within regions in order to obtain a more in depth view of the phenomenon. Moreover, the opposite also applies, as this measure can also be aggregated over groups to a general index.

Aditional features of this inequality measure are the posibility to be transformed into other inequality measures such as the Atkinson index[8] or, in the case of a specific variation of the Theil[9], it shares similar characteristics with the Hoover index. As with the Gini coefficient, the Theil index satisfies the transfer principle.

The shortcomings of this measure include the imposibility to compare populations with different sizes (i.e. contrary to the Hoover index), the fact that it can be mathematically and conceptually complex to uderstand, as well as the fact that it lacks of an intuitive and simple graph to represent it.

Perhaps the most representative description of a weaknes of the Theil index is the one provided by Sen (1973) when he asserted the following:

> *But the fact remains that it is an arbitrary formula, and the average of the logarithms of the reciprocals of income shares weighted by income shares is not a measure that is exactly overflowing with intuitive sense.* (Sen, 1973: 36)

3.7 The Hoover index
The idea behind this measure is quite simple; it is the proportion of income that would need to be redistributed from the upper half in the income distribution to the lower one, in order to achieve maximum distributional equality. As in the Theil index, the value of the index ranges from 0 to 1, being 0 the value of perfect equality (where no redistribution is necessary) and 1 of maximum income inequality (where all income would be redistributed).

Graphically, the Hoover index can be depicted through the Lorenz graph as the longest vertical line between the 45° line of maximum equality and the Lorenz curve. The formula for calculating the Hoover index is the following:

$$H = \frac{1}{2} \sum_{i=1}^{N} \left| \frac{E_i}{E_{total}} - \frac{A_i}{A_{total}} \right|$$

Where E_i is is the income in the i[st] quantile, N is the number of quantiles A_i is the size of the i[st] quintile (i.e. the number of individuals), E_{total} is the sum of incomes for all quantiles and A_{total} is the sum of all individuals.

3.8 The Gini coefficient
Attributed to Gini (1912), is by far the most widely used measure of income inequality, the reason for this may be the fact that it is a straightforward, easy to understand and not at all complicated to calculate. Another reason for its populatiry can be attributed to the availability of inequality datasets, particularly the one of Deininger and Squire (1996). Its value ranges from 0 to 1[10], being 0 the value of perfect equality and 1 of maximum inequality (i.e. one individual holds all the income and the rest hold no income). Another advantage of the Gini coefficient is that it can be easily represented in the Lorenz (1905) graph for a graphical, more intuitive, description, as it represents the ratio of the difference between the line of absolute equality and the Lorenz curve which represents the income distribution among population quintiles.

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[8] This relationship is associated to the Atkinson entropy measure of inequality, which can be computed trough the Theil index by employing the function $1 - e - T$. The reader should not be confused with the normative measure of inequality also developed by Atkinson (1970).

[9] There are three different alternatives for the calculation of the Theil index based on the distribution of income and individuals. In the first, individuals are stochasically distributed to incomes and, second, incomes are stochastically distributed to individuals and a third obtained from averaging the first two indices. This third alternative is the one sharing similarities with the Hoover index.

[10] Although it is commonly multiplied by 100 in empirical studies.

As mentioned above, the Lorenz graph performs as the natural instrument for graphically depicting the Gini coefficient. The Lorenz curve plots the proportion of the total income (y axis) and the amount that each quantil of population (x axis) has, in cumulative terms. A 45° line represents absolute equality and the Lorenz curve represents the current distribution of the income, as the Lorenz curve reaches farther away fron the 45° line more inequality dominates the distribution. (see Figure No. 1). This way, the Gini coefficient can be calculated as the ratio of the area between the lorenz curve and the absolute equality line, divided over the total area under the 45° line.

$$\text{Gini} = \frac{A}{(A + B)}$$

There are several ways to calculate the Gini coefficient, we now proced to review the most recurred ones in related literature.

a) A first way of calculating the Gini coefficient (Dasgupta et al., 1973), is the one that estimates for a population homogeneous on the income values and that are indexed in an increasing ($y_i \leq y_{i+1}$) order is the following simplified formula:

$$Gini = \frac{2 \sum_{i=1}^{n} i y_i}{n \sum_{i=1}^{n} y_i} - \frac{n+1}{n}$$

Which is "more matematically tractable and computationally convinient for individual level data". (Allison, 1978. p. 4)

b) Another way of calculating the Gini coefficient is by reffering it to the Lorenz curve. As mentioned above, the Gini coefficient is defined as the ratio of the areas on the Lorenz curve graph, since A+B equals 0.5, the Gini coefficient will be:

$$Gini = \frac{A}{(0.5)} = 2A = 1 - 2B$$

If the Lorenz curve can be represented by a function *Y=L(X)*, the value of B can be calculated through the following integration formula:

$$Gini = 1 - 2 \int_0^1 L(X) dX$$

c) An alternative formula is the one described below, notice how it clearly shows that the Gini coefficient is a measure of dispersion (known as Gini's coefficient of mean difference) divided by twice the value of the mean income:

$$Gini = \frac{\frac{1}{n^2} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j|}{2\mu}$$

Where the numerator represents the average absolute difference between all pairs of incomes.

d) Finally, A more general and simplified formula for the calculation of the Gini coefficient was developed by Deaton (1997) with the following specification:

$$Gini = \frac{N+1}{N-1} - \frac{2}{N(N-1)\mu} \left(\sum_{i=1}^{n} P_i Y_i \right)$$

Where P_i is the income rank P of person i, with an income of Y, in a way that the poorest individuals receive a rank of N and the richest of 1.

The previous have been the most recurred methods for calculating the Gini coefficient, we now follow the analysis of this important measure with a review of the advantages and disadvantages of this inequality measure.

3.8.1 Advantages of the Gini coefficient

The following is a list of the main advantages of using the Gini coefficient as a tool for objectively measuring income inequality levels.

- Perhaps the most important advantage of the Gini coefficient is that it satisfies the four main principles that any inequality metric should meet in order to be considered a reliable measure, namely:
    a. *The transfer principle*, also known as the Pigou-Dalton principle (Dalton, 1920 and Pigou, 1912), where a transfers from a poor individual to a richer one should translate into an increase in the measure of inequality, no matter the size of the transfer or the relative postion of the poor regarding the rich.
    b. *The scale independence,* which states that if the general income level increases by a fixed ammount, then the overall value of the inequality measure should not chane at all.
    c. *The anonimity principle,* by which the identity of the income recipients does not matter for the value determination of the inequality measure.
    d. *The population independence,* which means that the inequality measure should not be influenced by the size of the population.
- The Gini coefficient can be employed to compare different income distributions of different groups of populations, be it different countries, regions or any georaphical area.
- Another relevant advantage is that it is a ratio analysis type of measure, instead of being a non representative measure such as per capita income or any other measure that averages income to the population.
- It is an uncomplicated measure, easy to understand and to calculate with the additional property of showing how income changes for any bracket of the income distribution.

- Comparing its value for the same unit of analysis and different time periods allows to evaluate the evolution of income distribution dynamicall, to see if it has improved or worsened.

3.8.2 Disadvantages of the Gini coefficient

As all inequality measures do, the Gini coefficient does present some donwsides on its measurement. Some of them are shared with most inequality measures and are an intrinsec part of the difficulties arisen when trying to objectively measure something as complex as income distribution. On the following lines, those disadvantages are properly described.

- The main disadvantage of the Gini measure of inequality, calculated trough the Lorenz curve, is that the value for the Gini can be the same for different sets of distributions. The Lorenz curve can have different chapes that capture the same area under the curve and thus reflect the same Gini coeffcient, this can be a serious disadvantage for someone interested in analyzing and perhaps comparing the structure of the income distribution in the different population quantiles.
- A second shortcoming of the Gini coefficient comes from the fact that it is a point estimate of the income distribution and it does not capture the lifetime income of a person, which is known to change over time and can affect its position within the income distribution.
- Related to the previous, the Gini coefficient fails also to account for the lifetime changes in income or tto take into account factors like age distribution and mobility within income brackets which could depict a better measure of the overall income inequality.
- Different Ginis from different sets of population cannot be averaged to obtain a combined measure of income inequality, for example, in a large country with highly heterogenous regions, a Gini coefficient may be calculated for each of those regions, but they cannot be averaged to get a combined value, a single calculation for the whole country must be obtained.
- When calculating the Gini coefficient from income quantiles, the use of less quantiles will yield a lower Gini than one calculated from more income quintiles. Thus generating measurement bias.

4. CONCLUDING REMARKS

The previous study has delimited the complex phenomenon of inequality into a specific study subject, namely, the study of inequality in the distribution of income, in order to provide a valid conceptual framework for the understanding of this topic. A general description of the most important theoretical causes of income inequality has been provided as evidence of the enormous intricacy of this phenomenon and its multifacetic nature. Income inequality is understood as the result of a combination of endogenous and exogenous circumstances that affect simultaneously individuals and population groups in a dinamic way. These series of conditions generate the circumstances for having a certain distribution of income among individuals, and supports the idea that

income inequality levels within a society are not only the result of social policy, redistributive efforts or economic development, but they are also partially defined by the personal decisions of individuals, their effort and productivity, as well as from a collective inertia that comes from common culture and circumstances.

The second part of this paper reviews the most important instruments to measure income inequality in order to provide a general understanding of this important thopic. Inequality measures are classified into two broad types, the objective and the normative. The normative measures usually deal with inequality from a view of its effect on a social welfare assignation and its logic arises from the notion that any measure will inevitably involve an implicit normative judgment in that there are certain distributions better for everyone than others (Dalton, 1920; Sen, 1973). The objective measures of inequality are characterized by the use of statistical and mathematical tools for the estimation of income dispersion among a set of individuals. Within this type of measures, the Gini coefficient is the most widely used due to its advantages in portraying efficiently the distribution of income and the advantages of being relatively simple to calculate and the possibility of employing graphical instruments for its representation.

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FIGURES

Figure 1. Graphical representation of the Gini coefficient.