G

Gini Index: Conceiving Inequality in One Single Number

Julia Swart
Utrecht School of Economics,
Utrecht University, Utrecht, The Netherlands

Synonyms

Gini coefficient; Gini concentration ratio; Gini ratio

Definition

The Gini index is a measure between zero (perfect equality) and one (maximum inequality) which summarizes the degree of inequality in a given place and time across the population. It is the most often used measure of statistical dispersion of income. A Gini index of zero indicates that everyone in the population has the same income, so there is perfect equality across the population. A Gini index of one lies on the other extreme and indicates that only one individual from the whole population has all the income, everyone else has no income. Numbers closer to zero indicate less inequality, and the closer the Gini index is to one, the more unequal income is within the population considered. The Gini coefficient is often used to measure income inequality, but its applicability crosses various areas, such as pollution, health, and land distribution.

Introduction

The Sustainable Development Goal 1 is to "End poverty in all its forms everywhere" (UN 2015). This goal is considered the most global challenge of our times but nevertheless fundamental for achieving sustainable development. In 2015 ten percent of the world population lived under extreme poverty, thus living with less than $1.90 per day – 2011 PPP (World Bank 2020a). In sub-Saharan Africa, the same figure was over 42% of the total population. Just as poverty is not evenly distributed across the world, it is also not evenly distributed within countries around the world. In diverse countries as Madagascar, Indonesia, Argentina, and the United States, poverty and inequality are interconnected. Poverty and inequality are linked through disparities of opportunity, including education, capital, and employment.

Reducing inequality matters for sustainable development to the same extent as eliminating poverty does. Doyle and Stiglitz (2014) argue that extreme inequality undermines political equality (e.g., how elected officials respond to the demand from richer and poorer people) and social stability (e.g., measured by violence and crime) and reduces the prospect of economic growth. Reducing inequality is also essential to

W. Leal Filho et al. (eds.), *No Poverty*, Encyclopedia of the UN Sustainable Development Goals,
https://doi.org/10.1007/978-3-319-69625-6_76-1

eradicate poverty. Fosu (2014), for example, find for a selection of sub-Saharan African countries that economic growth alone does not explain poverty reduction in the period mid-1990 until 2014. Part of the explanation lies on decreasing income inequality.

Income inequality also relates to environmental degradation. Income inequality could be detrimental to the environment. Torras and Boyce (1998) conducted an empirical analysis for different environmental indicators and found support for this hypothesis. Their hypothesis was based on what Heerink et al. (2001) termed later a *political economy argument*. This argument sustains that a more equal society is associated to more demand for environmental quality. Additionally, in a more equal society, there is more social stability which creates better business environment and therefore spurs investment in environmental-friendly goods and methods of production. Recently, more empirical papers have found evidence for the hypothesis that income inequality is detrimental to the environment (Kashwan 2017; Ceddia 2019). The evidence is however, not conclusive (Grunewald et al. 2017 find, for example, that the impact of income inequality on CO_2 emissions depends on the income level of the economy).

Poverty, the environment, and ethical concerns place income inequality as a central concern in society. It is fundamentally linked to all Sustainable Development Goals. Sustainable Development Goal 10 focuses on "Reduced inequalities" (UN 2015), and as such, the targets from SDG 10 cover fostering economic growth for the lower-income share of the population but also emphasizing that inequality has multiple facets, such as sex, race, and religion. Inequality can be measured in terms of income, but it also can be disguised in terms of more complex aspects, such as access to services and political representativeness.

The world is an unequal place. No statistical measure is necessary to come to this conclusion. A small city tour in a city like Rio de Janeiro, Mumbai, or even Paris makes clear that people's access to goods and services are not the same. But, how can we compare inequality? Is income inequality higher in Rio de Janeiro than in Mumbai? Is income inequality in Paris today higher than it was 20 years ago? To better assess income inequality and its progression through time, a statistical measure is fundamental. Among many alternative measures of income inequality, the Gini index stands out. It is by far the most used statistical measure of income inequality, which allows comparison across time and location.

One of the main attractiveness of the Gini index is that one single number provides an indication of how unequal a certain location is. Table 1 provides the 2017 Gini index for 77 countries in the world, ordered from lowest to highest Gini index and colored according to their region (see legend under the table). For this sample, the Gini index varies between 0.232 (Slovakia) and 0.533 (Brazil) (The Gini index is also often multiplied by 100. In this case, Slovakia would have a Gini index of 23.2 and Brazil of 53.3, and the Gini index would be bounded by 0–100 instead of 0–1 as presented here. The only difference is in scale, and there is no influence in a comparison across countries/regions and across time). Countries in Europe and Central Asia tend to have lower Gini indexes, indicating lower levels of income inequality. Often these countries have a recent past of communism, which kept inequality levels low. This in turn is reflected in low levels of inequality up until more recent years. Additionally, the region Europe and Central Asia includes the Northern European countries, with a well-developed and inclusive welfare state system.

On the other extreme are Latin American and sub-Saharan African countries, with higher Gini indexes, indicating thus higher-income inequality. The level of income inequality is historically high in both regions, although there is an overall increase in income inequality in recent decades (Jolly 2006). UNCTAD (2012) argues that most Latin American and African countries experienced an increase in income inequality after the 1980s. This increase was a result of a combination between fiscal austerity, wage restraints, and flexibilization of the labor market. This trend, however, was not specific to these two regions but was also observed in many developed countries. Concern with rising income inequality has

Gini Index: Conceiving Inequality in One Single Number, Table 1 Gini index 2017: 77 countries

Country	Gini	Country	Gini	Country	Gini	Country	Gini
Slovakia	0.232	Poland	0.292	Spain	0.341	Argentina	0.412
Slovenia	0.237	France	0.293	New Zealand	0.343	Djibouti[a]	0.416
Czechia	0.245	Croatia	0.299	Greenland	0.343	Uganda[a]	0.428
Finland	0.253	Switzerland	0.301	Israel	0.344	Turkey	0.430
Belarus[a]	0.254	Ireland	0.306	Latvia	0.345	Peru	0.433
Moldova[a]	0.259	Cyprus	0.308	South Korea	0.355	Ghana[a]	0.435
Belgium	0.26	Luxembourg	0.309	Thailand[a]	0.365	Rwanda[a]	0.437
Norway	0.261	Canada	0.310	Bhutan[a]	0.374	Bolivia	0.440
Netherlands	0.271	Afghanistan[a]	0.310	Jamaica[a]	0.375	Dominican Rep.	0.441
Kyrgyzstan[a]	0.273	Estonia	0.316	Lithuania	0.376	Ecuador	0.447
Kazakhstan[a]	0.275	Barbados[a]	0.32	Serbia	0.378	Malawi[a]	0.447
Denmark	0.276	N. Macedonia	0.324	Georgia[a]	0.379	Chile	0.466
San Marino	0.277	Italy	0.327	El Salvador	0.380	China	0.467
Taiwan	0.277	UK	0.331	Gabon[a]	0.380	Costa Rica	0.483
Austria	0.279	Romania	0.331	Indonesia[a]	0.381	Paraguay	0.488
Sweden	0.28	Greece	0.334	Suriname[a]	0.381	Colombia	0.497
Hungary	0.281	Portugal	0.335	USA	0.390	Panama	0.499
Malta	0.282	Armenia[a]	0.336	Uruguay	0.395	Honduras	0.505
Kosovo[a]	0.290	West Bank and Gaza[a]	0.337	Bulgaria	0.402	Brazil	0.533
Germany	0.291						

Legend

Europe and Central Asia	North America	Middle East and North Africa
East Asia and the Pacific	South Asia	
Latin America and the Caribbean	sub-Saharan Africa	

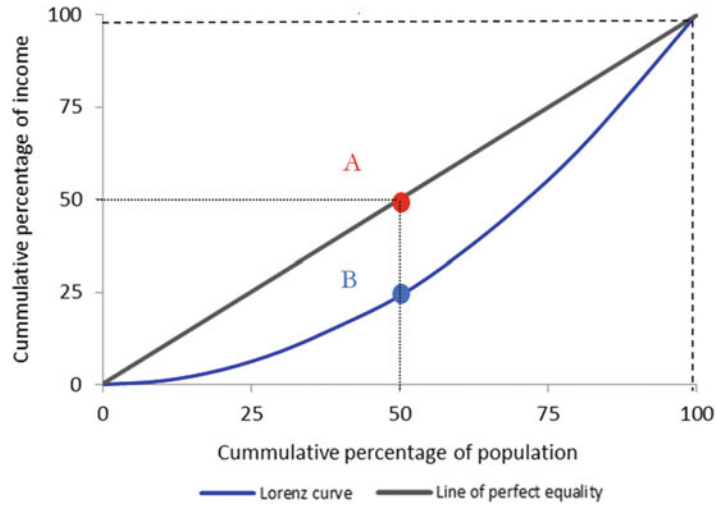
Source: UNU-WIDER (2019)

Notes: UNU-WIDER (2019) provides Gini indexes computed from different sources, and therefore, different approaches. To select the Gini indexes in Table 1, we gave preference to Gini computed for: all country area (as opposed to rural or urban areas); World Bank source, and when not available other international organization (e.g., Eurostat); and per capita scale

[a]Indicates that the Gini was computed based on consumption data. For the other countries, the Gini was computed based on income (net or net/gross)

spread out to developed countries. According to UNCTAD (2012), since around the 1980s, the share of wages in total income has fallen in most developed countries.

In the next sections, we will explore further these trends in income inequality. We start, nonetheless, in the next section with a more detailed presentation of the Gini index. We finalize with a brief discussion of the relation between income inequality and socioeconomic variables and with a conclusion section. Although the focus here is on income inequality, the Gini index has been applied



Gini Index: Conceiving Inequality in One Single Number, Fig. 1 A hypothetical Lorenz curve

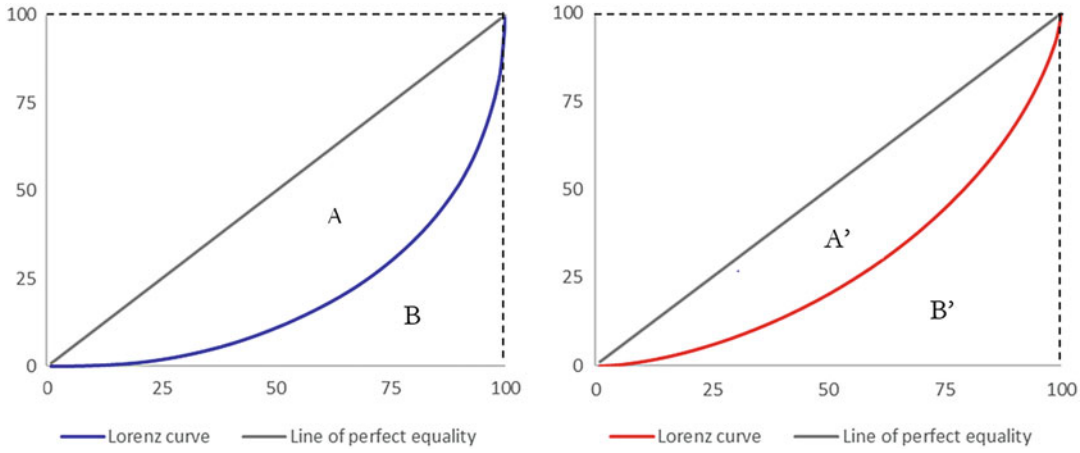
to measure dispersion for various variables, including carbon emissions (see Groot 2010).

Constructing the Gini Index

The Gini index was introduced in 1912 by an Italian academic, Corrado Gini, whose research lied on the intersection between statistics, demography, and sociology. Mathematically, the Gini index can be formulated in different ways. Gini himself, on his 1912 book "Variability and Mutability" (Gini 1912), expressed the now known Gini index, in 13 different ways (Ceriani and Verme 2012). In 1914, nonetheless, Gini related his index to the Lorenz curve, which has been since then the most common way to present the Gini index (see Gini 1914 for the original version of the article and Gini 2005 for the English translation).

The Lorenz curve is a graph plotting the cumulative percentage of population on the X-axis and the cumulative percentage of income (or other relevant variable for which inequality is present) on the Y-axis. The further down the Lorenz curve is from the 45° line $Y = X$ the more unequal this population is with respect to income. Note that the line $Y = X$ indicates a uniform distribution of income, characterized by all individuals within the population analyzed having an equal income. This line is also named *line of perfect equality* or simply *line of equality*. Figure 1 depicts a hypothetical Lorenz curve alongside the line of perfect equality. Point A in the Figure is in the line of perfect equality and indicates that 50% of the population earn 50% of the income in this economy (equality). Point B, on the other hand, lies below the line of perfect equality. It lies instead in the Lorenz curve and indicates that 50% of the population earn less than 25% of the income in this economy (inequality). The larger, therefore, the area between the line of perfect equality and the Lorenz curve, the higher the level of income inequality will be. The Gini index can be computed using this intuitive interpretation of the Lorenz curve.

To see that, Fig. 2 illustrates two Lorenz curves for Bolivia. The left panel in Fig. 2 graphs the Lorenz curve for the year 2000 and the right panel for the year 2017. The area between the Lorenz curve and the perfect equality line is larger in the year 2000 (denoted area A in the left panel) than in the year 2017 (denoted area A' in the right panel). This indicates that inequality was higher in Bolivia in 2000 than 2017. The Gini coefficient in year 2000 can be computed by comparing the size of area A (year 2000) relative to the area A+B (year 2000), where the latter area is the area of the right triangle with the hypotenuse equal to the line of perfect equality. For the year 2017 that would be area A′ relative to the area A′+B′.



Gini Index: Conceiving Inequality in One Single Number, Fig. 2 The Lorenz curve for Bolivia at two points in time: 2000 (left panel) and 2017 (right panel). (Source: World Bank (2020b). Data retrieved on January 17, 2020)

$$\text{Gini} = \text{A}/(\text{A} + \text{B}) \tag{1}$$

The area of a right triangle equals the product of the two legs (100 × 100) divided by 2. The area (A + B) is therefore constant and equal to 5,000 and the Gini coefficient is given by:

$$\text{Gini} = \text{A}/5000 \tag{2}$$

Note that if instead of working with percentage, one uses the ratio (thus 100% denoted as 1; 50% denoted as 0.5 . . .) then the Gini index would be defined as A/0.5 = 2A.

Equation (3) gives a formal way to compute the Gini index:

$$Gini = \frac{1}{2n^2\mu}\sum_{j=1}^{m}\sum_{k=1}^{m} n_j n_k \left|y_j - y_k\right| \tag{3}$$

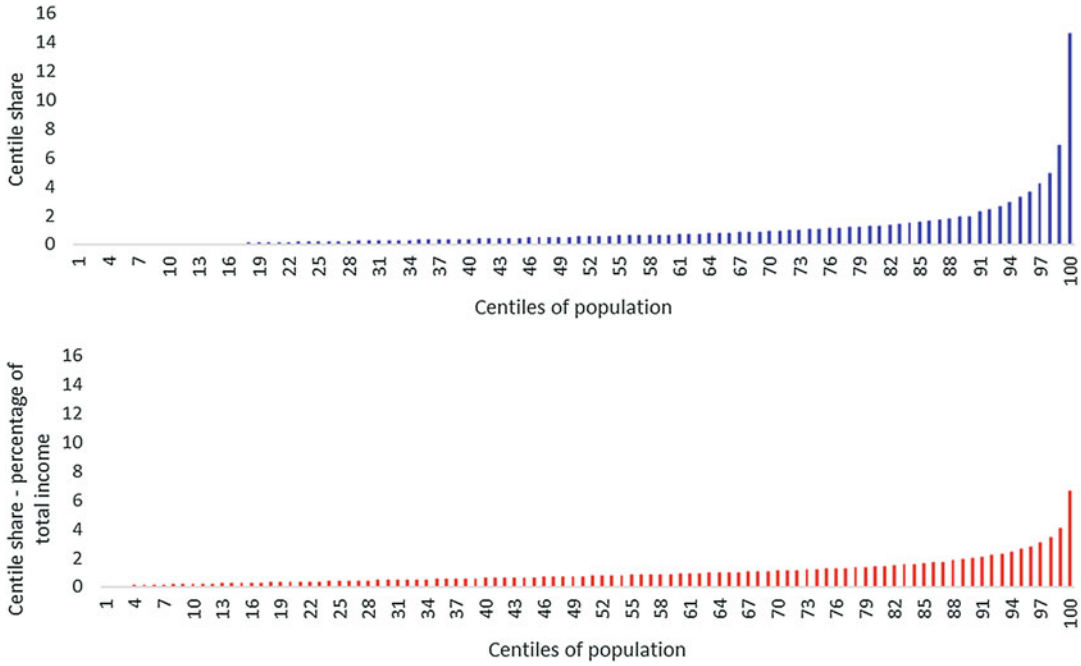
where m indicates the number of distinct incomes, n the total number of individuals, j and k are the class of income, n_j and n_k are the number of individuals earning income class j and k, respectively, μ is average income, and y is income.

Note that average income μ is defined in this case by:

$$\mu = \frac{1}{n}\sum_{j=1}^{m} n_j y_j. \tag{4}$$

The Gini index formula in eq. (3) takes the difference between all pairs of income and sums the absolute differences. The double summation implies that to compute the Gini index one first sums over all ks while holding each j constant and afterward sums over all the js. Finally, the Gini index is divided by population squared and mean income (Ray 1998).

The Lorenz curves for Bolivia in Fig. 2 are based on the World Bank data (World Bank 2020b) which gives the centile shares of income in Bolivia for a given year. Thus, in the raw data, the population has been ordered from poorest to richest and divided in 100 equal parts (each part is a centile). For each centile, the dataset gives the level of income that this fraction of the population (1%) has. This is presented in Fig. 3, where the top panel provides the data for the year 2000 and the bottom panel for the year 2017. These two panels in Fig. 3 have a representative shape for income



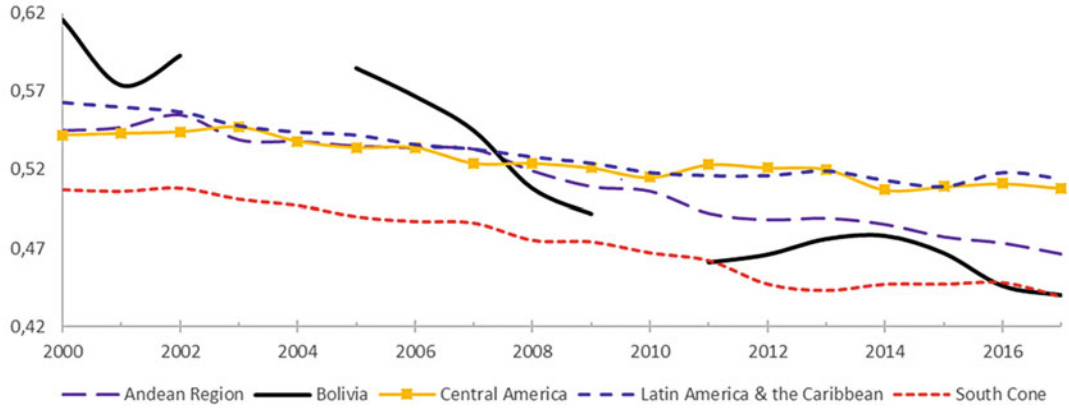
Gini Index: Conceiving Inequality in One Single Number, Fig. 3 Income distribution in Bolivia in two points in time: 2000 (top panel) and 2017 (bottom panel). (Source: World Bank (2020b). Data retrieved on January 17, 2020)

distribution for most (if not all) countries in the world. Income distribution has a long left tail, indicating that a large part of the population earns a small fraction of the income of the country, whereas only a small part of the population (on the right side of the graph) earns a significant fraction of the income of the country. In the period 2000–2017, the shape of the income distribution has flattened out in Bolivia, indicating a decrease in income inequality. This is translated in a Lorenz curve which is closer to the line of perfect equality.

After ordering the data, the next step to draw the Lorenz curve is to obtain the cumulative percentages of population and the cumulative percentages of income earned. These data should then be plot respectively on the X-axis and Y-axis. To compute the Gini index, area A (year 2000; similarly, A′ for year 2017) is determined by summing the vertical distance from Lorenz curve to the line of perfect equality for each centile. For Bolivia in the year 2000, area A was equal to 3079.75, and, in the year 2017, area A′ was equal to 2200.26. That gives a Gini index of 0.62 in 2000 and of 0.44 in 2017.

This sharp decline of income inequality was very atypical in Latin America in this period (see Fig. 4). Vargas and Garriga (2016) find that the decrease of income inequality in Bolivia (one of the poorest Latin American countries) was mainly driven by labor income growth at the bottom of the income distribution, which was partially stimulated through pro-poor labor policies (e.g., increase in minimum wages and transfer to selected population groups like elderly people and school-aged children). A comparison of the two panels in Fig. 3 shows that in 2000, the 30% poorest Bolivians earned together only 3.1% of the total income. In 2007 they earned 8.24% of the total income, implying a significant reduction in poverty rates. According to the World Bank (2020b), 28.6% of Bolivians live with less than 1.9 dollars (2011 PP) a day in 2000. This figure decreased to 5.8% in 2017.

Figure 4 shows that whereas in Bolivia the Gini index dropped from 0.62 in 2000 to 0.44 in 2017, in Latin America and the Caribbean, the drop was significantly more modest, from 0.563 in 2000 to 0.514 in 2017. Overall, the inequality decrease in Latin America was driven by economic growth



Gini Index: Conceiving Inequality in One Single Number, Fig. 4 The Gini index, 2000–2007: Bolivia, Andean Region, Central America, Latin America and the Caribbean, and the South Cone. (Source: World Bank (2020b). Data retrieved on January 17, 2020. Notes: The classifications of subregions used in the LAC Equity Lab, World Bank (2020b) are (1) Central America: Costa Rica, Dominican Republic, El Salvador, Honduras, Panama, Nicaragua, and Guatemala; (2) Andean Region: Bolivia, Colombina, Ecuador, and Peru; and (3) South Cone: Argentina, Chile, Paraguay, and Uruguay. Brazil and Mexico are each considered as different subregions due to their large population size and are thus not included in these classifications)

(see Cord et al. 2014). Although decreasing, the Gini index in Latin America is still one of the highest in the world. Compare to Slovakia, for example, with a Gini index of 0.234 in 2017 (see Table 1). On the extreme, a Gini index of 0 would imply perfect equality. In this case, the Lorenz curve would lie on the 45° line, the line of perfect equality. Thus, area A would be zero. This situation would happen if all individuals earned the exact same income. The other extreme, of complete inequality, results in a Gini index of 1. This would imply that only one individual would have all the income of that country or region.

The Gini index is thus bounded between 0 and 1 (see eq. (5), Table 2 and Fig. 5).

$$0 \leq \text{Gini index} \leq 1 \tag{5}$$

Desirable Properties of the Gini Index

In addition to being a simple index to compute and intuitive to understand, the Gini index has other desirable properties. Four of the desirable properties are (*i*) symmetry, (*ii*) population size independence, (*iii*) mean independence, and (*iv*) Pigou-Dalton Transfer sensitivity. Below we define these four properties satisfied by the Gini index (see also Haughton and Khandker 2009; and Ray 1998).

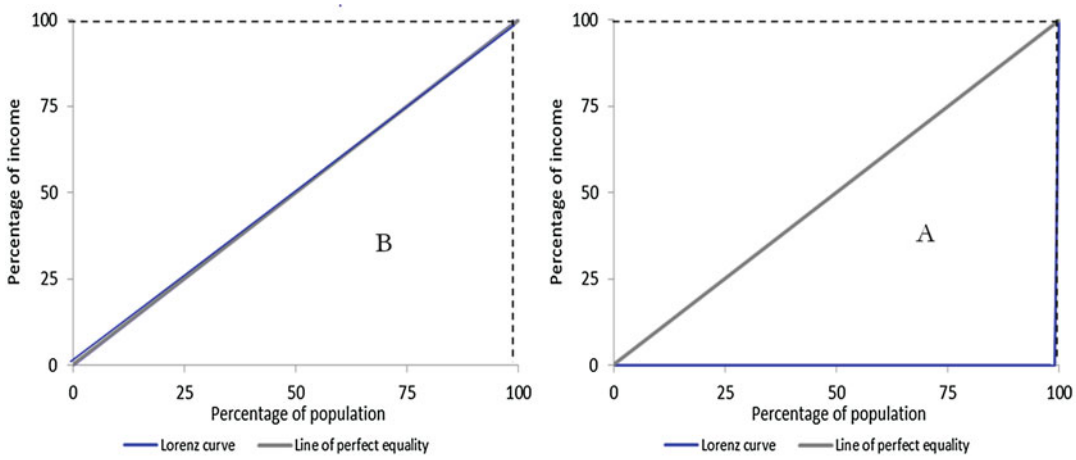
(i) *Symmetry* (also referred to as *anonymity principle*): If there is permutation of income between any two people, the measure of inequality does not change.

The symmetry property implies that no matter who is earning what, as long as the income earned remains the same, we can always arrange the income distribution in the same way, that is, $y_1 \leq y_2 \leq y_3 \leq \ldots \leq y_n$, were n indicates the number of individuals. The fullfilment of this property by the Gini index is intuitive: to draw the Lorenz curve one needs to rank the individuals from poorest to richest, regardless of an individual named Alexander being the poorest or another named Anthony being the poorest. Thus, it does not matter who is poor and who is rich, only the ordering matters.

(ii) *Population size independence* (also referred to as *population principle*): If population size changes, with proportional increases in each of the income classes, then the measure of inequality does not change, all else equal. Suppose, for example, that population size doubles in such a way that for each income class twice as many individuals are present.

Gini Index: Conceiving Inequality in One Single Number, Table 2 The two extremes: Perfect equality and total inequality

	Area A	Area B	Gini index
Perfect equality	0	5000	$= A/(A + B) = 0/(0 + 5000) = \mathbf{0}$
Complete inequality	5000	0	$= A/(A + B) = 5000/(5000 + 0) = \mathbf{1}$



Gini Index: Conceiving Inequality in One Single Number, Fig. 5 The two extremes: Perfect equality (Left-panel) and total inequality (right panel)

In this case, an income inequality measure satisfying the population size independence would not change. Inserting $2n$ instead of n in eq. (3) shows that the Gini index would not change, as long as m, the number of distinct classes, and y_j/y_k, the income of each class, does not change. Note that in eq. (3), the Gini index is normalized by dividing the numerator by population squared (and by mean income). The population size independence property implies, therefore, that whereas population shares matter, the absolute value of the population does not.

(iii) *Mean independence* (also referred to as *relative income principle*): If all incomes are multiplied by a common factor, then the inequality measure does not change. Suppose a certain income distribution is given by $y_1 \leq y_2 \leq y_3 \leq \ldots \leq y_n$, then if everyone gets twice as rich, the new distribution would be $2y_1 \leq 2y_2 \leq 2y_3 \leq \ldots \leq 2y_n$.The absolute level of the incomes has changed, but not the relative incomes (e.g., $y_2/y_1 = (2y_2)/(2y_1)$). Thus, inequality has remained the same.

(iv) *Pigou-Dalton transfer sensitivity* (also referred to as the *Dalton principle*): Any transfer of income from individuals with a higher income to individuals with a lower income reduces the measure of inequality. Likewise, a transfer of income from a relatively poor individual to a relatively rich individual (a *regressive transfer*) increases the measure of inequality. Regressive transfers result in an outward shift of the Lorenz curve (away from the line of perfect equality) and thus an increase in the Gini index.

A final relevant property is the *Lorenz criterion*. The Lorenz criterion states that Lorenz curves further away from the line of perfect equality indicate higher inequality. Thus, if there are two Lorenz curves and one lies at every point to the left of another Lorenz curve, then the one more to the left represents an income distribution with

less inequality. The Lorenz criterion is moreover satisfied if an only if it is simultaneously consistent with *symmetry*, *population size independence*, *mean independence*, and *Pigou-Dalton transfer sensitivity.*

Shortcomings

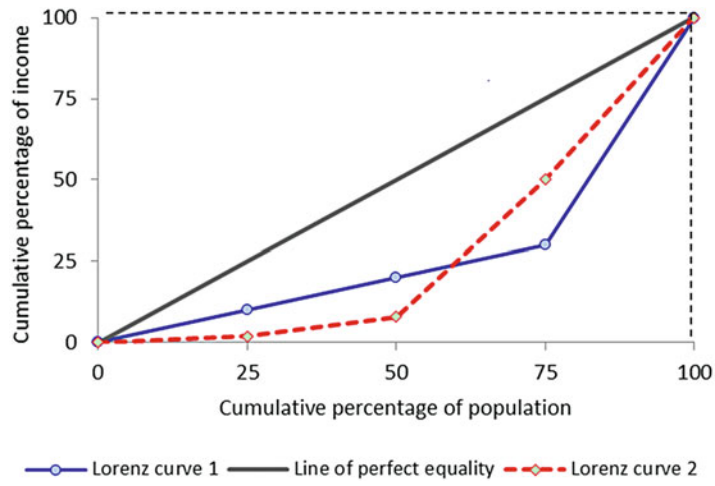
Despite its wide use and the desirable properties which the Gini index satisfies, there are a few limitations to the Gini index. One of them is that the Gini index cannot show the sources of inequality through decomposing of the index (Haughton and Khandker 2009). *Decomposability* is a desirable property of an inequality measure which the Gini index does not satisfy. This property states that an inequality measure can be decomposed by specific dimensions, such as population groups and subregions. If the inequality measure satisfies the decomposability property, than by decomposing an economy into two parts (e.g., North and South) and computing this inequality measure for both these parts, the measure of inequality for the whole economy would be a weighted average of the two parts plus a term proportional to the inequality in the averages of the two parts.

Another shortcoming of the Gini index (and any other inequality measure) does not relate to how the index is computed but instead to the singular source of data used to compute the index. Inequality is many sided, an individual might not be perceived as poor, nonetheless, face high costs to guarantee access to education, health services, etc. Alternatively, an individual might have a lower-income level but be compensated by subsidies such as food stamps and free public education. Additionally, some might report no formal income but through engagement in informal economic activity obtain some earnings. An attempt to take this critique in consideration is to construct the Gini index using consumption data instead of income. Nonetheless, such data is not broadly available, and it also does not reveal what is being consumed. All in all, concerns with inequality have a deeper component, which is whether individuals in society have access to the same economic resources which allow them to live a happy life and increase their well-being.

Sen (1973) makes a distinction between inequality measures, such as the Gini index, which attempts to "catch the extent of inequality in some objective sense," and a more normative attempt to measure inequality, for which "a higher degree of inequality corresponds to a lower level of social welfare for a given total of income" (Sen 1973, p. 2).

Such distinction between an objective and normative way to measure inequality links to Atkinson (1970) critique of the Gini index. Atkinson (1970) critique is based on the Gini index being sensitive to transfers at all income levels. In particular, in general, more weight would be given to transfers in the center of the distribution than at the lower ends of the distribution (the tails). Nonetheless, taking social and ethical considerations into account, one could care more about transfers going to the left tail. Atkinson's inequality measure (Atkinson 1970) incorporates a weighting parameter which captures the extent to which there is aversion to inequality. It is possible, for example, to set this parameter such that only transfers toward the lowest-income individuals affect the inequality measure.

To illustrate this point, consider Fig. 6 which depicts two hypothetical Lorenz curves (Table 3 presents the data supporting these two curves). These two Lorenz curves cross one another but have nonetheless the same Gini index, 0.450. The first and second poorest quartiles in the Lorenz curve 2 are much poorer than the ones in the Lorenz curve 1. Poverty is more acute in the population depicted by Lorenz curve 2 than 1. However, the third quartile in the population depicted by Lorenz curve 2 is richer than the same quartile depicted by Lorenz curve 1, bringing the Lorenz curve 2 closer to the line of perfect equality than Lorenz curve 1. Inequality in these two hypothetical economies is the same, if judged by the Gini index. Atkinson (1970) proposes that an inequality measure could account to this by setting a weight to inequality in the lower-end tail.



Gini Index: Conceiving Inequality in One Single Number, Fig. 6 Two crossing Lorenz curves with same Gini index

Gini Index: Conceiving Inequality in One Single Number, Table 3 Two hypothetical income distributions resulting in the same Gini index

Cumulative percentage of population	Lorenz curve 1 – cumulative percentage of income	Lorenz curve 2 – cumulative percentage of income
0	0	0
25	10	2
50	20	8
75	30	50
100	100	100
Gini index	**0.450**	**0.450**

Income Inequality and Socioeconomic Variables

Income inequality can have profound socioeconomic impacts and become self-enforcing. Individuals with less income are more likely to experience lower access to quality education, health-care, leisure, and many other services and goods which increase the opportunities created later in life. Although the focus here is on income inequality, it is worth noting that inequality can be measured in different terms, and different inequality data are not necessarily perfectly correlated. Other inequality data include, for instance, ownership of properties such as land, houses, and durable goods and ownership of financial assets, and so on. Overall, inequality of wealth tends to be higher than inequality of income. The relation with socioeconomic variables, nonetheless, tends to be the same.

Kuznets (1955) analyzed the movement of income inequality compared to economic growth for the United States, England, and Germany. His analysis was based on annual income incidence in different broad classes (thus, Kuznets did not compute the Gini index). His findings were puzzling because it indicated a decrease in income inequality in these countries around the 1920s onward, reverting an upward trend observed in the end of the XIX century. Kuznets (1955) findings became influential, and since then it has been cited in the literature as the *Kuznets Hypothesis*. According to this hypothesis, income inequality rises at lower levels of economic development, and after a threshold level has been reached, income inequality decreases with economic development. This is illustrated by an inverted-U-shaped curve plotting income per capita on the horizontal axis and an inequality measure (such as

Gini Index: Conceiving Inequality in One Single Number, Fig. 7 Kuznets curve

the Gini index) on the vertical axis. Figure 7 shows a hypothetical Kuznets curve.

Two main reasons for the decrease in income inequality proposed by Kuznets (1955) are (*i.*) technological change, which brings with it new industries and new entrepreneurs. New entrants shift incomes from older industries toward newer industries, decreasing income inequality. (*ii.*) Increase in importance of service income. In particular, individuals in lower brackets of income experience a larger relative increase in income (thus decreasing income inequality) as they pursue increasing performance following up on the steps of professionals with higher income. Intuitively, when new professions develop, the pioneers receive a high compensation for it as their skills are scarce. This increases the incentives for others to follow on the same professional steps, increasing the pool of professionals with similar skills.

Since Kuznets (1955) influential work, the Gini index has been widely used to analyze the relation between income inequality and economic development. Evidence has, however, been mixed. Deininger and Squire (1998), for example, find little evidence for the Kuznets hypothesis. In particular, these authors find that for a large cross-section of countries, the inclusion of regional dummy variables makes the evidence for the Kuznets hypothesis disappear. Indeed, enlarging the econometric models to incorporate other factors that affect income inequality (such as institutions, education, and international trade) are often more relevant to analyze and understand income inequality trends than restricting to income per capita alone (see for example Angeles 2010; Jaumotte et al. 2013).

Concluding Remarks

Understanding the determinants of income inequality is an ongoing research agenda, in particular because of its impact on personal well-being and society's sense of fairness. The Gini index bridges academic research to the broader audience by setting complex economic theory into plain text. Whereas the Kuznets hypothesis, the impact of international trade and specialization on income inequality, and other economic theories used to analyze trends in income inequality may seem to require an economic background, the Gini index is easy to grasp.

The Gini index is a simple and intuitive statistical measure which has been widely used to indicate inequality within a population. Despite some shortcomings, it allows to easily get a sense of how unequal a certain location and society is. It translates complex historical socioeconomic events into one single number and opens the discussion to how fair society was and is. Analyzing in conjunction to other inequality measures and other graphical representations allows a better visualization of income inequality in a given

place and time. Nonetheless, by itself, the Gini index provides a good first impression of how unequal a given society is.

Mapping and quantifying income inequality are an essential step to fight poverty, as both are intertwined. Income inequality is associated to diverse social problems, including drug use, crime, school dropouts, and many others, which contribute to poverty. There is, thus, a vicious circle between income inequality and poverty, requiring that both are combated in a comprehensive and coordinated manner. In the "2030 Agenda for Sustainable Development," the United Nations (UN 2015) argues that fostering inclusive and sustained standards of living is only possible by reducing income inequality. The Gini index contributes to the first step of reducing income inequality, that is, quantifying it, and it has the greatest advantage of simplicity. The second step is that policy makers take action when presented with the local, regional, and national data on the Gini index. This is a fundamental step for achieving the sustainable development goals.

Cross-References

- ▶ Country Income Levels Classification: Relationship to Poverty
- ▶ Genesis and Measurement of Multidimensional Poverty Index
- ▶ Influence of Culture and Migration in Reducing Poverty and Inequality
- ▶ Poverty Index: Welfarist and Multidimensional Approaches

References

Angeles L (2010) An alternative test of Kuznets' hypothesis. J Econ Inequal 8:463–473

Atkinson AB (1970) On the measurement of inequality. J Econ Theory 2:244–263

Ceddia MG (2019) The impact of income, land, and wealth inequality on agricultural expansion in Latin America. PNAS 116(7):2527–2532

Ceriani L, Verme P (2012) The origins of the Gini index: Extracts from Variabilità e Mutabilità (1912) by Corrado Gini. J Econ Inequal 10:421–443

Cord L, Barriga Cabanillas O, Lucchetti L, Rodriguez Castelan C, Sousa LD, Valderrama D (2014) Inequality stagnation in Latin America in the aftermath of the global financial crisis. Policy Research Working Paper, No. 7146. World Bank Group, Washington, DC

Deininger K, Squire L (1998) New ways of looking at old issues: inequality and growth. J Dev Econ 57:259–287

Doyle MW, Stiglitz JE (2014) Eliminating extreme inequality: a sustainable development goal, 2015–2030. Ethics Int Aff 28(1):5–13

Fosu AK (2014) Growth, inequality and poverty *in* sub-Saharan Africa: recent progress in a global context. Oxf Dev Stud 43(1):44–59

Gini C (1912) Variabilità e Mutuabilità. Contributo allo Studio delle Distribuzioni e dell Relazioni Statistiche. C. Cuppini, Bologna

Gini C (1914) Sulla misura della concentrazione e della variabilità dei caratteri. Atti R Ist Veneto Sci Lett Arti LXXIII(II):1203–1248

Gini C (2005) On the measurement of concentration and variability of characters. Metron Int J Stat LXIII (1):3–38

Groot L (2010) Carbon Lorenz curves. Resource and Energy Economics 32(1):45-64

Grunewald N, Klasen S, Martínez-Zarzoso I, Muris C (2017) The trade-off between income inequality and carbon dioxide emissions. Ecol Econ 142:249–256

Haughton J, Khandker SR (2009) Handbook on poverty + inequality. The World Bank, Washington, DC

Heerink N, Mulatu A, Bulte E (2001) Income inequality and the environment: aggregation bias in environmental Kuznets curves. Ecol Econ 38(3):359–367

Jaumotte F, Lall S, Papageorgiou C (2013) Rising income inequality: technology, trade and financial globalization? IMF Econ Rev 61(2):271–309

Jolly R (2006) Inequality in historical perspective, WIDER Research Paper, no. 2006/32, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki

Kashwan P (2017) Inequality, democracy, and the environment: a cross-national analysis. Ecol Econ 131:139–151

Kuznets S (1955) Economic growth and income inequality. Am Econ Rev 45(1):1–28

Ray D (1998) Development economics. Princeton University Press, Princeton

Sen A (1973) On economic inequality. Oxford University Press, Oxford

Torras M, Boyce JK (1998) Income, inequality and pollution: a reassessment of the environmental Kuznets Curve. Ecol Econ 25:147–160

UN (2015) Transforming our world: the 2030 agenda for sustainable development. United Nations, A/RES/70/1

UNCTAD (2012) Trade and development report, 2012. Policies for inclusive and balanced growth. United Nations Publication, Sales No. E.12.II.D.6, New York/Geneva

UNU-WIDER (2019) World Income Inequality Database (WIID4). https://www.wider.unu.edu/about/frequently-asked-questions, https://wid.world/data/

Vargas J, Garriga S (2016) Explaining inequality and poverty reduction in Bolivia. IMF Working Papers, 15/265. https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Explaining-Inequality-and-Poverty-Reduction-in-Bolivia-43471

World Bank (2020a) World Development Indicators. https://databank.worldbank.org/reports.aspx?source=world-development-indicators

World Bank (2020b) LAC Equity Lab: income inequality – income distribution, Washington, DC. https://www.worldbank.org/en/topic/poverty/lac-equity-lab1/income-inequality/income-distribution