Inequality of opportunity in Brazil: decomposition of the sources of injustice between 2001 and 2014

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Abstract

Purpose – This article aims to measure inequality of income and opportunities at the national and state levels in Brazil, highlighting their acceptable and unacceptable components.

Design/methodology/approach – To this end, a lower-bound estimate of income inequality (MLD) and inequality of opportunity (IOp) was developed using data from the National Household Sample Survey between 2001 and 2014.

Findings – It shows that the disparity of income measured by the MLD decreased 26.7 percent, while IOp measured by the IOp decreased 25.6 percent during that period. The decline in total inequality can be attributed to a 48.5 percent decrease of its unfair component and 51.5 percent decrease of its fair component. The average income of the most disadvantaged group (non-white women working in the informal sector) is shown to be only 29.5 percent of the income of the most advantaged group (formally employed white men). The groups at the greatest disadvantage were most benefited by the increase in income.

Originality/value – Beyond comparisons among countries, analysis at the subnational level make it possible to identify how the process that generates inequality acts in each state, revealing patterns undetected in the aggregate analysis. Its decomposition generates two products that are useful to policy-makers. The first is a base estimate of the degree of IOp present in society, which may be expressed as an indicator of the degree of IOp. The second examines the portion of total inequality attributable to IOp.

Keywords Equality of opportunity, Regional inequalities, Theories of justice

Paper type Research paper

1. Introduction

Analysis of the development of income inequality is justified by its constant presence in public debate. Empirical evidence shows that lack of social cohesion, rising crime rates, health problems, teenage pregnancy and obesity are related to the increase in income inequality (Pickett and Wilkinson, 2009). Negative effects are also seen in a country's institutions, including a decline in economic performance, macroeconomic instability and less sustainable growth (Atkinson, 2015). On the individual level, such inequalities and low income mobility may discourage effort, wasting an individual's potential.

On this basis, debates ensue about the justice of the processes of wealth concentration by considering its sources, a debate that often culminates in the issue of equalizing opportunities (Arneson, 1989; Cohen, 1989). This view is concerned with ensuring that individuals

performing the same activities (or exercising the same effort) are rewarded equally, regardless of their circumstances. Contrary to the effects of income inequality, greater equality of opportunities can lead to a more efficient use of human and physical capital, increase social cohesion and contribute to sustainable development (Roemer, 1998). Thus, this approach is complex because it is not trivial to separate inequality results coming from effort and from circumstances. These elements are often correlated and depend on the public debate to be set as fair or unfair sources of inequality.

The study seeks to contribute to the analysis of inequality of opportunity in Brazil, improving understanding of the economic and institutional mechanisms that influence it and providing government officials with information about public measures intended to counteract circumstantial disadvantages, eliminate poverty traps and promote development. To the moment, no study in the literature has shown the comparison of income and inequality of opportunities at regional levels in the country, measuring indexes by state for a 14-year period. Therefore, the study permits to see which groups benefited the most in the process of Brazil's economic growth by classifying people into types of circumstances that characterize inequality of opportunities.

Improving on the literature of measurement of inequality of opportunity, this study has three goals. First, it seeks to identify the lower bound of inequality of income and opportunities at the national and state levels in Brazil, highlighting their ethically acceptable and unacceptable components. Second, it seeks to determine the relationship between variations in both types of inequality. Third, it identifies the characteristics that unjustly influence individuals' positions in society. In a society that is heterogeneous in terms of race, gender, culture and regions as Brazil, it can contribute to a discussion about which groups have most benefited from the process of economic development and which groups are still at a disadvantage in this regard.

Beyond comparisons among countries, analysis at the subnational level makes it possible to identify how the process that generates inequality acts in each state, revealing patterns undetected in the aggregate analysis. The decomposition generates two products that are useful to policy-makers. The first is a base estimate of the degree of inequality of opportunity present in society, which may be expressed as an indicator *of the degree of inequality of opportunity*. The second examines the *portion of total inequality attributable to inequality of opportunity*. If estimated repeatedly over time, these indicators can offer useful diagnoses of how the distribution of opportunity develops at the national and state levels (Ferreira and Gignoux, 2011).

Ferreira and Gignoux's (2011) method of lower-bound estimation using ordinary least squares (OLS) is used, considering a continuous dependent variable (income) conditional on a set of binary circumstances (gender, white/non-white, formal/informal employment). By this measure, estimated total inequality based on the National Household Sample Survey (PNAD) cross-sectional data declines between 2001 and 2014, falling from 0.55 to 0.40. However, approximately 30 percent of the inequality in Brazil is attributable to unjust factors, which show an almost constant trend, from 28.3 percent in 2001 to 28.7 percent in 2014. Of the 26.7 percent decline in income inequality, 48.5 percent was due to the reduction in circumstance-based differences, while the remaining 51.5 percent represented a reduction in the differences due to effort or luck. Thus, the reduction of inequality is partially due to the reduction of components we would consider unfair as well as a reduction in what are generally considered fair components of inequality.

Of the components considered unfair, the movement of workers from informal to formal employment had the major impact, followed by differences due to family background, color and gender. A comparison of groups' incomes based on their circumstances shows that the average income of the group facing the greatest disadvantage, "non-white women working in the informal sector," is only 29.5 percent of the income of the group that enjoys the most

advantages, "formally employed white men." Among the states, Santa Catarina state offers the best index of opportunity, while the state of Piauí ranks last in this regard.

Following this introduction, Section 2 provides a review of the historical and empirical literature. Section 3 lays out the methodology used. Section 4 presents and discusses the results. Section 5 presents the final considerations.

2. Review of the literature

2.1 Historical

The twentieth century saw substantial progress in academic debates about income inequality. Methods of measurement benefitted primarily from Gini's (1912) work, enabling scholars to quantify inequality empirically and summarize it into an index, making it possible to compare levels of inequality among countries and track it over time. Widely used, these measures are known as the Gini index.

Beginning with Kuznets (1955), it was believed that the distribution of income followed a country's level of development, and it was assumed that a country's economic development would translate automatically into reduced inequality of income. It was believed that forces like freedom of individual opportunity would offset the effects of growing income inequality.

For a long time, due to Kuznets' (1955) work, the importance of inherited fortunes or industries was downplayed in economic thought, which argued that the new generation's entrepreneurs were rarely the sons and daughters of the previous generation's leading entrepreneurs. More recently, Piketty (2014) has shown that such heirs are not as insignificant or "rare" as had been claimed. Mazumder (2005) shows that the correlation between the income of one generation and the next can reach 0.6 in the USA, greater than had long been thought and raising doubts about actual economic mobility and the natural trend toward income equalization.

In *A Theory of Justice*, Rawls (1971) develops a systematic response regarding the level of inequality a society can tolerate from a normative perspective, arguing that economic growth plays an important role in welfare, as long as it is guided by principles that ensure a fair redistribution of income in society. It makes no sense to contemplate perfect equality at low levels of income, i.e. equality in poverty, but that economic efficiency should be considered together with distributive concerns (Swift, 2005).

Rawls' (1971) construction is an attempt to understand the nature and goals of a society that is perfectly just but is not exempt from criticism. In Sen's (2011) view, a theory of justice should not be transcendental but rather serve as a basis for rational public debate and practical efforts to combat injustice. Therefore, a theory of justice should incorporate multiple conceptions of welfare, considering equality in multiple dimensions, rather than limiting itself to income. This multidimensionality requires the studies precisely define the dimension of inequality in discussion. Beyond individual or family income, some theories define equality in terms of primary goods (Rawls, 1971), formal liberty (Nozick, 1974), capabilities (Sen, 1992) and opportunities (Fleurbaey, 1995; Roemer, 1998), among others.

The idea of distributive justice takes on a new dimension when the element of responsibility is introduced, as has been suggested by Dworkin (1981), creating a duality between free, autonomous choices and those income-determining elements over which individuals have little or no control. Arneson (1989) and Cohen (1989) draw a distinction between the fair component of inequality, attributable to autonomous choices, and its unfair component. This approach became known, in Fleurbaey's (1995) words, as *responsibility-sensitive egalitarianism*.

At the same time, Roemer's (1998) theory of equality of opportunity proposed an operational way to quantify the degree of equality of opportunity available in a society, which was subsequently implemented in empirical studies. Among citizens of any advanced democracy, there is a wide range of views regarding what is sufficient to ensure equality of opportunity,

ranging from the absence of discrimination to the provision of all goods and services needed to overcome inequalities. These views have in common the notion of the individual's responsibility to take an active role in achieving education, health, employment, income and even utility or welfare.

Thus, the theory of equality of opportunity is not essentially transcendent, recognizing the role of public debate regarding which circumstances are acceptable or objectionable in a given society. A concept of justice need not be determined universally, disregarding the preferences for justice held by members of a society. It is possible to identify the sources of injustice in each society that can be counteracted by public policies to obtain a social distribution that is considered at least *minimally* fair.

According to Almås *et al.* (2011), inequalities deriving from the number of hours worked or educational level are seen as fair, while factors of race, gender and parents' education and income are considered unfair. Unfair elements are those that shape individuals' potential outcomes but over which they have little or no control through their own choices.

The ethics of equality of opportunity imply a desire to equalize some aspect of individuals' circumstances and then hold individuals accountable for what occurs subsequently. Colloquially, the authors use the metaphor of "leveling the playing field": equal opportunity policies should create a level playing field, following which each individual deserves his or her outcome. Thus, final outcomes will reflect the individual's effort, constituting an ethically acceptable result, in addition to an element of luck (Roemer, 2002).

The question of luck is a point of debate in the theory. Should luck be considered fair or unfair? According to Swift (2005), equality of opportunity does not require that the element of luck be neutralized, as it is a function of the individual. It merely requires the removal of barriers that prevent individuals from competing on equal terms. This concept of equality of opportunity also allows for unequal rewards resulting from the use of attributes that are acquired by luck, such as an individual's natural talent or skills.

The development of indices to measure inequality of opportunity makes it possible to identify fair inequalities (those resulting from one's effort) and unfair inequalities (those resulting from one's circumstances). In this context, Roemer's theory of equality of opportunity (1998) provides a normative basis to the empirical approach.

2.2 Empirical

Estimates of the index of inequality of opportunity (IOp) seek to capture the weight of circumstances in defining outcomes, which may be calculated at the national, regional or municipal levels. This method of measuring inequality allows interpretations of what would be considered a fair distribution of income.

The methods of measurement can be broken down into *ex ante* and *ex post* approaches. The *ex ante* approach defines equality of opportunity as being a situation in which there is no disparity of circumstances that could influence the outcome. The *ex post* approach focuses on effort and considers equality to have been achieved when all those who exert the same degree of effort achieve the same outcomes, regardless of their circumstances. Fleurbaey and Peragine (2013) maintain that the two approaches are, at the same time, incompatible.

Checchi and Peragine (2010) use both approaches to measure the IOp in Italy. The authors find that IOp accounts for a third of total inequality in Italy. Moreover, the degree of inequality in the southern regions most affected by disparities is further compounded when the analysis is broken down by gender. The southern regions of Italy present the worst results because they combine a lower level of development with a lower *per capita* income than the rest of the country, accompanied by a high degree of total inequality. Thus, the index of IOp in Italy varies from 14.78 percent *ex ante* to 19.5 *percent ex post*.

Applying parametric and non-parametric methods, Marrero and Rodriguez (2011) find that the different methods yield very similar estimates when the circumstances are given equal weight but tend to differ when the circumstances are given different relative weights.

The authors find that in the USA, the correlation between circumstances and effort can account for between 5 and 20 percent of the index of inequality. Considering only race and parents' education, the authors found that the former accounts for 50–60 percent of the disparities in income between 1969 and 1985, falling to a modest 10 percent in 2007. On the other hand, the role of parents' education in explaining inequality grew from 40 percent in 1969 to 60 percent in 2007. According to the Shapely decomposition method, effort accounted for approximately 93 percent of total inequality, while only 7 percent was attributable to circumstances in 1973. Despite fluctuations over the period, with the circumstances factor reaching 10 percent in the late 1980s, its role decreased to 4 percent in 2007. Of this amount, the effect of parents' education is responsible for 60 percent, race accounts for between 5 and 10 percent and the cross-effects amount to 35 percent.

The discrepancies in results can also be produced by the chosen index, as Almås et al. (2011) show for Norway between 1986 and 2005. In the period, the standard Gini index captures a reduction in the inequality for income, while the unfairness Gini index reveals that it did not result in less IOp. Focusing on the Arab countries, Hassine (2011) estimated that IOp in Egypt remained stable, while disparities in earned income grew. Thus, the author noted a relative decline in IOp, with the role of circumstances falling from 22 percent in 1988 to 15 percent in 2006. Despite the relative decline in the index, the country continued to show substantial IOp, between 11 and 20 percent, with the apparent decline resulting from the increase in total inequality. The contributions of the father's and mother's job to income inequality is as important as any other circumstances for women but less relevant for men. IOp associated with the father's educational level declined from 6 percent in 1988 to 4 percent in 2006 (Hassine, 2011, p. 291).

In the analysis for Brazil, Annegues et al. (2015) also find divergences between the trends shown by traditional measures of inequality and measures of opportunity inequality. The authors calculated indices of entropy between 1995 and 2009 and found that measures of IOp in the country remained stable, with effort accounting for approximately 0.19, using the parametric method, and 0.21, using the non-parametric method. In these studies, the assumption of orthogonality between circumstances and effort is relaxed, but it still commonly made in parametric estimation.

Ferreira and Gignoux (2011) develop the parametric method further in their comparison of Latin American countries. In the case of Brazil, the authors used the data from IBGE 1996, applying the parametric estimate and the mean log deviation (MLD) index. The total earnings inequality in the country represents 0.617 of total inequality, while IOp differs by 0.215. Of the seven countries analyzed, Guatemala was the most unequal, with an IOp index of 0.23. In relative terms, Brazil leads with an IOp index of 0.349 in relation to total inequality. Using the same method and data from IBGE 1996, Bourguignon et al. (2007) estimated that 23 percent of the income inequality among males in urban Brazil can be attributed to unequal opportunities.

In a similar approach, Cogneau and Gignoux (2005) decomposed total income inequality in four circumstances analyzing the variation over two decades for Brazil. The authors used data from PNAD 1976, 1982, 1988 and IBGE 1996 because these samples contain information about the socioeconomic conditions. They found that inequality of income and IOp had similar trajectories, reaching their highest points in the late 1980s, during the periods when hyperinflation peaked. In 1988, total inequality had a Theil index of 0.772, and the IOp index was 0.239. Both indices then declined until 1996, when they were 0.179 and 0.173, respectively, close to their 1976 levels. Although the level of opportunity inequality remained stable, opportunity inequality fell as a share of total inequality from the mid-1970s to the mid-1990s due to an increase in total inequality during that period.

Together with family background, unequal access to education is identified as one of the main components of disparity in circumstances that affects income in the labor market. Therefore, the authors believe educational policies may be the key area in which public policy

can make a difference in promoting equality, given that changes in educational policy contributed to the rise of IOp in the 1980s and to its subsequent fall in the 1990s. Moreover, changes in intergenerational educational mobility were limited to the period and did not significantly affect inequality of income.

As an alternative to the method of calculating IOp used in this article, another line of research uses the human opportunity index (HOI). According to Dill and de Oliveria Gonçalves (2012), the HOI assesses opportunity as the population's access to services considered basic and universal, such as access to electricity, water, sanitation and schools. When these services are not available to a specific group, it constitutes a source of injustice derived from circumstances. This approach is beyond the scope of the current article, but further information can be found in Barros *et al.* (2009) and Lima and Bagolin (2018). The following section details the methodology used to measure IOp (*absolute IOp* and *relative IOp*) and inequality of income (*income MLD*) as well as to decompose the relative importance of circumstances.

3. Methodology

3.1 Indices of inequality of opportunity

There are two distinct methods for measuring Indices of IOp: *ex ante* and *ex post* (Fleurbaey and Peragine, 2013). Juárez and Soloaga (2014) claim that, conceptually, both approaches are equally valid but difficult to reconcile with each other. However, the *ex ante* approach is less restrictive, in that it does not require estimates of effort, which are usually not observable; the *ex ante* approach requires that the researcher define only the variables associated with circumstances. Following Bourguignon *et al.* (2007) and Ferreira and Gignoux (2011), this article uses the *ex ante* approach, estimating the following relationship:

$$y = g(\boldsymbol{e}, \boldsymbol{C}) \tag{1}$$

where y represents the outcomes, $\boldsymbol{C}$ is the matrix of circumstances and $\boldsymbol{e}$ contains the components of effort. In turn, $\widehat{y}$ represents the vector of estimated conditional outcomes. Following Checci and Peragine (2010), it is assumed that the function g is monotonically increasing for effort ($\boldsymbol{e}$) and identical for all individuals and the conditional distribution of effort is independent of circumstances. In the OLS approach, the second assumption prevents the relationship with the error term, which contains elements of effort and randomness, from biasing the estimated parameters of circumstances.

Using the values $\widehat{y}$, adjusted from the estimation of equation (1), an index is constructed that measures inequality (θ_a), as shown in expression (2):

$$\theta_a = I(\widehat{y}) \tag{2}$$

The best choice of index to measure inequality depends on the type of analysis that serves the study's purpose, as justified in the next subsection. The inequality captured by the index derives exclusively from the variation in $\widehat{y}$ caused by the circumstances specified in matrix **C**. This index is known as the absolute IOp. When the absolute inequality obtained from $\widehat{y}$ is divided by the real inequality of the sample y, it yields a measure of IOp (θ_r):

$$\theta_r = \frac{I(\widehat{y})}{I(y)} \tag{3}$$

Relative inequality of opportunity, called relative IOp, can be obtained when I (.) is equivalently defined for $\widehat{y}$ and y. Thus, we can obtain the relative measure when the outcome variable is continuous and $\widehat{y}$ gives us the estimated distribution.

Several considerations should be kept in mind regarding this methodological procedure. The estimation of equation (1) can be made either by non-parametric (Checchi and Peragine, 2010) or parametric methods (Bourguignon *et al.*, 2007). The non-parametric method requires

a greater number of observations in the sample, with a positive bias when we subdivide the sample into groups of circumstances with few observations. As shown in the literature, the discrepancies between the parametric and non-parametric is that the non-parametric methods tend to yield higher values of IOp than the parametric ones (Ferreira and Gignoux, 2011; ANNEGUES *et al.*, 2015). To estimate the lower-bound IOp, the parametric method is seen as an adequate approach (Bourguignon *et al.*, 2007; Ferreira and Gignoux, 2011).

A second limitation relates to the choice of the set of opportunities. To obtain the exact value for IOp, one must include all the circumstance variables that can contribute to determining income. According to Ferreira and Gignoux (2011), it is extremely unlikely that a database could be built to include all the circumstances that influence income in a society. Possibly relevant circumstances that might be omitted include parents' education and income or natural ability and talent.

Thus, what is sought is an estimate of a base value, assessing the lower limit of IOp in a society. For this reason, the parametric method is used, which assesses income based on the variables of gender, color and participation in the formal labor market. The inclusion of other circumstance variables does not diminish the value of inequality and increases it when the variables are not orthogonal to the results. Additional variables may be included if theories of opportunity identify them as potential sources of injustice.

3.2 Index of inequality

Based on the estimation of distribution in equation (1), components of injustice may be summarized using an index of inequality. MLD is the only measure that satisfies all the requirements and is used by most authors who estimate opportunity (Brunori, 2016). According to Ferreira and Gignoux (2011), the chosen measure of inequality must satisfy the properties of decomposability, path independence and Pigou–Dalton transfer principle.

The decomposability property ensures that the value of an index calculated for the total population is exactly equal to the sum of the indices calculated within and between the groups. Another requirement is that the index be path independent, meaning that the decomposition yields the same results using a direct approach or residual approach, remaining invariant no matter whether inequality within groups is eliminated first and inequality between groups is eliminated subsequently, or vice versa. The third requirement – that the Pigou–Dalton transfer be satisfied – means that transfer of income from richer to poorer individuals reduces the value calculated for the index of inequality.

The MLD index is part of Theil's (1967) informational approach to the measurement of inequality, one of a large group of commonly used measures of inequality (Cowell, 2003). The probability of an event's occurrence is considered inversely proportional to its informational value. As applied to income distribution, the probability is replaced by the information about each individual's income. The index is zero when everyone has the same income and rises as inequality of income increases.

Cowell (2003) posits a general formula that defines a family of generalized entropy measures, given by:

$$I_{GE}^{\alpha}(F) = \frac{1}{\alpha^2 - \alpha} \int \left[\left[\frac{x}{\mu(F)} \right]^{\alpha} - 1 \right] dF(x) \qquad (4)$$

where x represents income, $\mu(F)$ represents the average of the distribution function F and $F(x)$ represents the proportion of the population with income less than or equal to x. The parameter $\alpha \in (-\infty, +\infty)$ captures the distributive sensitivity. For a large and positive α, the index becomes more sensitive to changes in distribution that affect the upper tail, while a negative α means greater sensitivity to changes in distribution in the lower tail. The cases that interest us are those in which $\alpha \to 1$, giving the Theil-T index, and those in which $\alpha \to 0$, the MLD.

3.3 Index decompositions

We seek to decompose the indices of IOp to determine the relative importance of each circumstance, understood as the quantification of the contribution of an individual regressor to the estimated multiple regression model. Ferreira and Gignoux (2011) claim that decomposition can provide an idea of relative importance but warn that this should not be seen as a causal relationship. Many of the circumstances may be correlated, so the coefficients would suffer from multicollinearity, which in turn poses a problem for the decomposition but not for the point estimates of IOp.

According to Grömping (2006), the difficulty of decomposing R^2 with correlated regressors lies in the fact that each order of regressors may generate a different decomposition from the sum of squares. The Lindeman, Merenda and Gold (LMG) measure proposed by Lindeman $et\ al.$ (1980) solves this problem by decomposing the R^2 into non-negative contributions, which, when added together, equals the total R^2, through the average of the sequential sum of squares among all possible orderings of the regressors.

The LMG measure is expressed by:

$$LMG(x_k) = \frac{1}{p!} \sum_{r\,permutation} seqR^2(\{x_k\}|r) \tag{5}$$

where r denotes the r-permutation, with $r = 1,\ldots,p!$, and $seqR^2(\{x_k\}\lor r)$ is the sequential sum of squares for regressor x_k in the ordering of the regressors in the rth permutation. For example, three regressors of circumstances are used ($p = 3$), so there are six orderings ($3! = 3 \times 2 \times 1 = 6$) and six different estimates for each explanatory variable. The relative importance of each variable is given by the average of six estimates. Bi (2012) cautions that averaging over orderings is computationally intensive, becoming unfeasible for a large number of regressors, such as 30 or more regressors.

In short, the procedure consists of estimating a distribution of income based on circumstances (gender, color and employment in the formal sector) and applying the MLD index of inequality to determine the IOp. The estimated distribution is decomposed according to each circumstance to assess its relative importance using the LMG method. The next subsection presents the descriptive statistics of the PNAD data used in this study.

3.4 Descriptive statistics and circumstances

This study uses the cross-sectional databases of the National Household Sample Survey (PNAD/IBGE) from 2001 to 2014, with the exception of 2010. When needed, the data for 2010 are calculated as an average of 2009 and 2011. Only the individuals with income different from zero and of economically active age, between 18 and 65, are included in the sample. Thus, the national samples vary between 130,000 and 150,000 observations per year.

Income is used as the outcome variable because it is a powerful predictor of other results such as health, employment, housing and family background, among others. According to Fishkin (2014), income is considered an "instrumental good," i.e. one that can easily be converted into other goods, including those that promote equality of opportunity, like education. According to Reeves and Sawhill (2014), it should be made clear that the focus on the monetary dimension does not imply that income is the only important factor, but evidence shows that income is directly correlated with other goods and therefore provides a concrete, robust and comparable measure. Table I shows the descriptive statistics of the PNAD from 2001 to 2014, including data on income and number of individuals by age, color, gender and whether they are employed in the formal sector.

Descriptive statistics show that the average monthly individual income increased in nominal terms from R\$593.70 in 2001 to R\$1,738.00 in 2014. It also represents an increase in

Variable	Category	2001	2014
Income	Nominal monthly average	593.70	1,738.00
	Real monthly average	1420.70	1738.00
Age group	18–24	20.21%	15.48%
	25–31	21.33%	19.45%
	32–38	20.80%	20.42%
	39–45	17.73%	17.90%
	46–52	12.25%	15.25%
	53–60	7.68%	11.50%
Color	White and yellow	51.97%	43.52%
	Black, brown and indigenous	48.03%	56.48%
Gender	Female	39.59%	42.47%
	Male	60.41%	57.26%
Employment	Formal sector	49.82%	52.20%
	Informal sector	50.18%	41.80%
Sample size		134,178	147,077

Source(s): Prepared by the authors

real terms. Adjusted for 2014 prices, 2001 income is equivalent to R$1,420.20. This translates into an increase in real terms, with 2001 income representing 82 percent of 2014 income.

With regard to the age of sample participants, one notes that the older age groups become larger, while the younger age groups become smaller. This process is typical of a country at an advanced stage of demographic transition, exhibiting an increased number of elderly relative to young people.

The number of workers employed in the formal and informal sectors[1] shows that the informality scenario in the labor market was reversed during the period analyzed. Workers employed in the formal sector represent 49.82 percent of the total in 2001, rising to 58.2 percent in 2014. Informal employment is considered a circumstance because it captures the regional differences in labor market conditions. One could argue that individuals have the option of migrating or seeking work in the formal sector. For the purpose of this study, these options are seen as limited for individuals in socially disadvantaged circumstances. Both options rely on higher levels of income and education, so workers in the informal sector can be considered "trapped," without any real possibility of migrating or changing jobs.

The formality of work in labor markets has been treated as effort variable in some studies applied to Brazil. However, there are considerable limitations to the extent it can be controlled by individuals. Workers may explicitly prefer to act as formal workers, because of higher salaries, pension benefits and legal guaranties, but the descriptive statistics (Table I) show otherwise. In countries and regions with high levels of informality, as Brazil, there are workers who cannot join the formal market, even if they decide to migrate to another region. In Brazil, 42 percent of the workers are employed in informal jobs in 2014, and 50 percent in 2001. Then, it can be argued that the formal market does not embrace all these workers looking for formal jobs, so they have to accept lower-income informal occupations. Besides, the proportion of informal workers tends to rise in years of economic crisis, reflecting limitations in the opportunity to choose due to degradation of formal regional labor markets.

The levels of informal employment are higher in the North and Northeast regions, demonstrating a direct relationship between the state's per capita income and informal employment. Thus, the states of the South, Southeast and Center-West regions offer more formal employment and have the highest *per capita* income.

Men predominate in the sample selected, representing 60.41 percent in 2001 and 57.26 percent in 2014. The proportion may be lower in the more recent period because women are

more present in the labor market and therefore more likely to be counted after individuals with no income are excluded from the sample. The proportion of self-reported black, brown and indigenous people also shows an increase from 48.03 percent in 2001 to 56.48 percent in 2014. People who described themselves as white or yellow were placed together in the category "white" because they present similar levels of income and education.

Based on this information, a worker's employment in the formal vs informal sector, gender and color is analyzed to determine their role in explaining income differences in Brazilian society. The goal is to measure what role circumstances play in explaining inequality of income and to identify what proportion of inequality can be considered fair or unfair from the normative perspective of the theory of equality of opportunity. The indices measured express the lower limit of inequality because it is impossible to capture all the circumstances that constitute sources of injustice and because inequality may be underestimated due to methodological issues of the PNAD.

Family background is an important explanatory factor that is harder to find on a national level. Family background raises questions about intergenerational mobility, which are relevant to estimate IOp, because, in some cases, the family is a source of unfair inequality. There is no national database available containing information about the education and income of parents since IBGE 1996. This limitation is treated by estimating the indexes of inequality and inequality of opportunities using IBGE 1996 supplement on family background. With these results, we assume that its relevance is constant over the subsequent period from 2001 to 2014, adding the IOp that derives from father's and mother's education and literacy to the circumstances of formality, color and gender.

The assumption that family background remains constant over time is based on estimates for the USA that show income mobility between parents and children ranging between 0.2 and 0.4, remaining stable over the past 20 years (Solon, 1992; Lee and Solon, 2009).

The choice to include only individuals of economically active age may result in less inequality than if the sample had included the entire population because elderly people usually present less earning capacity. It is also recognized in the national and international literature that studies based on household surveys may underestimate the true inequality of income because the questionnaire is unable to capture accurately the income of higher-income households but remains sensitive to lower-income households (Medeiros *et al.*, 2015a; Hoffmann and Ney, 2008). However, Barros *et al.* (2006) question this underestimation. Also, reported incomes may be downward biased for those working in the informal sector if they fear legal consequences on their answers. Thus, these estimates represent the lower limit of total inequality of income.

Attempts to estimate the lower limit of IOp are supported by the literature. Roemer (2006) addresses the question of which factors should be considered circumstances, showing that even studies that take a conservative position, recognizing only a few circumstances, produce policy recommendations that are strongly compensatory. Thus, the present study chooses to estimate indices of opportunity using three sources of wage discrimination: gender, race and employment in the formal, as opposed to the informal, sector.

The following section provides the estimates obtained for total inequality and IOp at the national level, detailing the relative importance of each circumstance. It goes on to analyze the evolution of inequality, its components and the scenarios in different states of Brazil.

4. Results and discussion
4.1 Inequality of opportunities
Firstly, the degree of IOp in the Brazilian society is estimated, showing its evolution from 2001 to 2014. The relative importance of each circumstance as a source of injustice is also identified. Thus, the average advantage levels are analyzed for each group, making it

possible to rank the groups of individuals with common circumstances (types) from least to most favored, creating an opportunity profile for the society. The profile makes it possible to identify the individual characteristics of those in the top and bottom layers of the distribution of outcomes. Subsequently, the indices of IOp are estimated for each of the Brazilian states, ranking them according to their relative positions in the first and last years of our samples. Finally, the results are discussed in light of the economic theory.

The indices of inequality are estimated using MLD and are directly comparable. The indices take the value 0 if all incomes are distributed equally among the individuals of a society. As the distribution becomes more concentrated in one group or individual, the value of this index increases. Unlike the Gini I=index, which ranges from 0 to 1, the MLD index has no upper limit.

A measure of total inequality (index of total income inequality) and two measures of IOp (index of IOp) are constructed. The first index of IOp (absolute IOp) can be read as an indicator of the *level of IOp*. The second is a relative index of inequality and represents the *portion of total inequality attributable to IOp* (relative IOp).

The first estimates used IBGE 1996, the most recent national level database with family background information available. The total income inequality, the MLD index, for 1996 is 0.534, while the IOp, the absolute IOp index, showed 0.12. Relative to the total inequality of income, the IOp represents 22.5 percent. These estimates included mother's literacy condition, with a relative importance of 19.5 percent, father's literacy with 16.3 percent, mother's schooling with 3.7 percent and father's schooling with 2.4 percent. The estimates are correlated, so they are grouped into family background, accounting family background as responsible for 42 percent of IOp in 1996, or 0.05 of absolute IOp. Color has a relative importance of 29.9 percent, sex is responsible for 14.4 percent, while formality shows 13.9 percent.

If estimated repeatedly over time, these indicators can offer useful diagnoses of how the distribution of opportunities develops at the national and state levels (Ferreira and Gignoux, 2011). A comparison of trends over time makes it possible to depict inequality in Brazil, decomposing it into its fair component, which derives from individual responsibility, and its unfair component, which derives from circumstances.

Figure 1 shows the indexes of total inequality and IOp estimated for Brazil between 2001 and 2014, including the circumstances formality, color, sex and the assumed constant estimative of family background based on IBGE 1996.

Figure 1 (1) includes the lighter colored part of the bars expressing the total income inequality estimated for Brazil between 2001 and 2014. It shows a substantial drop from 0.552 in 2001 to 0.405 in 2014. This reduction represents a gradual and significant change of 26.7 percent.

The darker colored part of the bars represents the index of absolute IOp, showing the *level of IOp* observed in each year. The IOp, attributable solely to circumstances, declines by 25.6 percent, falling from 0.156 in 2001 to 0.116 in 2014. It can, thus, be seen that in 2001, 0.156 of the 0.552 value for total inequality is attributable to differences of opportunity. In other words, 28.3 percent of the inequality is unfair. In 2014, 0.116 of the total value of 0.405 for inequality derives from differences in opportunity. Thus, 28.7 percent of the inequality is unfair in 2014.

The evolution of the percentage represents the portion of total inequality attributable to IOp, i.e. the relative index of IOp (relative IOp), whose evolution is displayed in Figure 1 (2). At the beginning of the period, the relative IOp accounts for 28.3 percent of inequality; it rises to 31.4 percent in 2009. The minimum was reached it 2011, when it dipped to 27.5 percent. Comparing 2001 with 2014, relative IOp rose by 1.5 percent during that period. Therefore, we can say that relative IOp remains stable over time as fraction of total inequality, varying from 27.5 to 31.4 percent.
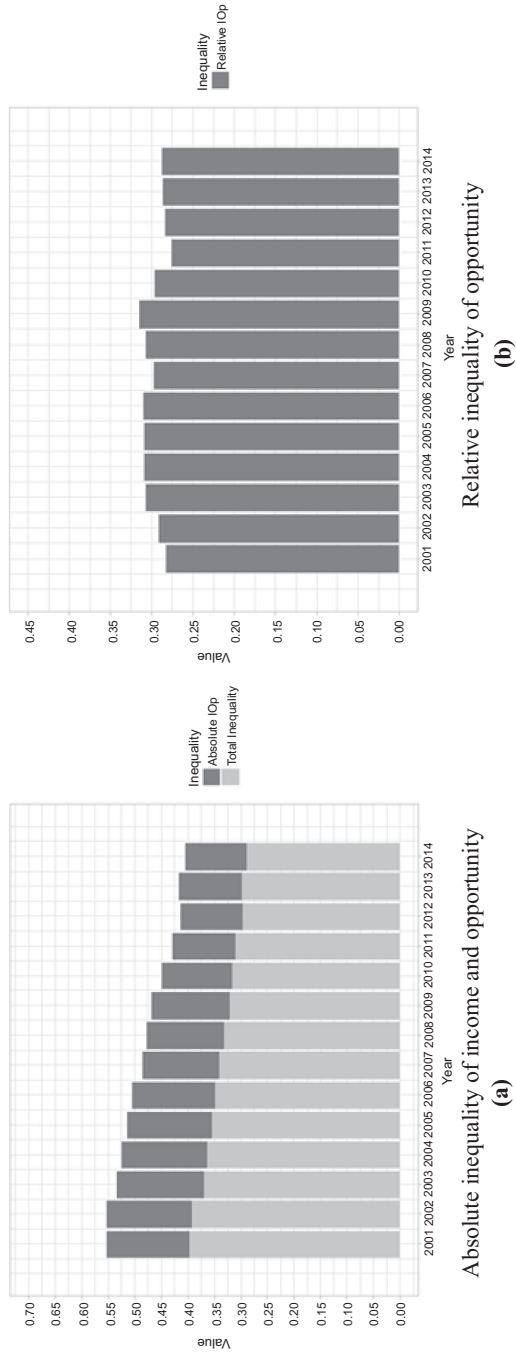
Figure 1.
Index of absolute and
relative income
inequality and IOp,
Brazil, 2001 to 2014

Source(s): Elaborated by the authors

The decline in absolute Inequality of Opportunity (IOp) and total inequality, and the stability of relative IOp, implies that the decrease in income inequality during that period is due in part to a reduction in both fair and unfair components. This means that, of the 26.7 percent decline in total inequality, 12.9 p.p. is due to a reduction in circumstance-based inequality and the remaining 13.7 p.p. derives from a reduction of inequality due to factors of effort or luck. The difference is subtle: the unfair component of inequality is accountable for 48.5 percent of the reduction and the fair component contributes with 51.5 percent in the period between 2001 and 2014.

We still wish to determine which components of unfair inequality were most responsible for the 25.6 percent reduction in absolute IOp. Figure 2 shows the relative importance of each source of injustice in the years examined.

The most relevant circumstance to explain differences in income is whether the individual is employed in the formal or informal sector, accounting for 35.2 percent of the IOp in 2001, peaking at 43.4 percent in 2009 and declining to 36.7 percent in 2014. Thus, the differences generated from being employed in the formal sector rose until 2009 and then returned to initial levels in 2014.

Family background, which includes father's schooling and literacy, mother's schooling and literacy, arises as the second most important circumstance. It is assumed that the contribution to absolute IOp is constant at 0.05, as it was in 1996. In comparison with the other sources of inequality, it accounts for 35.4 percent in 2001 and 35.3 percent in 2014. This subtle variation is due to the changes in the other circumstances, so with the data analyzed, we cannot state if it grows or recedes.

Color is the third most relevant circumstance, accounting for 22.7 percent of the inequalities in 2001, falling to 16.2 percent in 2009 and rising to 20.7 percent in 2014. Finally, gender accounted for 6.7 percent of the difference in 2001, rose to 7.4 percent in 2011 and held steady at 7.3 percent in 2014. The variations are small, and the relative importance of each circumstance can thus be said to have remained virtually constant over the period.

According to Roemer (2006), policy-makers can learn much about who benefits from the fewest opportunities in a country simply by looking at the groups (types) of circumstances.
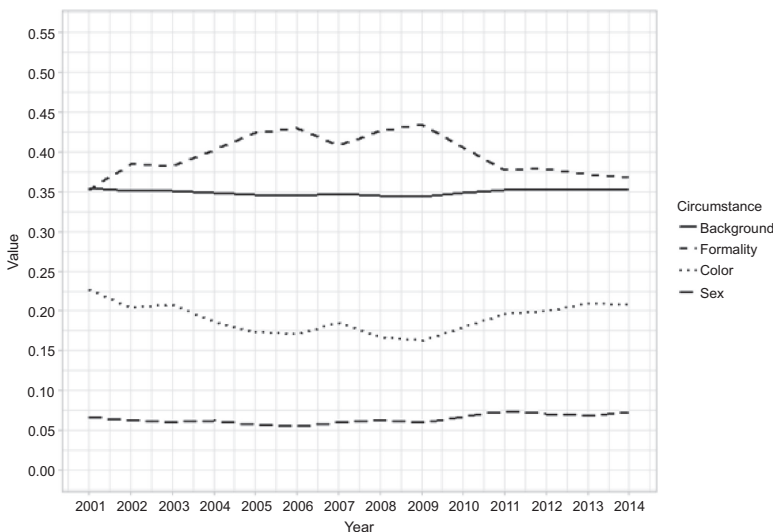
Source(s): Elaborated by the authors

Figure 2.
Relative importance of each circumstance in explaining inequality, Brazil, 2001 to 2014.

One can construct a profile of opportunity constraints that shows which group has benefited least from national prosperity, held back by predetermined or inherited characteristics. Theoretically, if circumstances were irrelevant to outcomes, the average income of each group would not differ.

Thus, one can identify which groups had greater or smaller gains over time. To this end, the individuals are grouped according to the circumstances they share, ranking them from highest to lowest income. These are known as the society's opportunity profiles. Table II shows the opportunity profiles estimated for Brazil in 2001 and 2014.

Analysis of Table II shows how relevant circumstances are in determining average income. The group that enjoys the most advantages (Position 1) is "white men employed in the formal sector," with a real average income of R$2,065.56. By comparison, the group with the most disadvantages (Position 8) consists of "non-white women employed in the informal sector," with a real average income of only R$609.05 in 2014. There is an almost four-fold difference in income between the highest- and lowest-income groups.

Although the relative positions have remained the same during the period analyzed, there is evidence of convergence between incomes over that time. All experienced real growth, but the lowest-income group, saw the greatest gains. The group in Position 8 showed income growth of 65.70 percent, compared to an increase of only 23.6 percent for the group in first position. The higher ranked the group, the smaller its growth during the period.

The regional aspects of IOp are also analyzed, with the results estimated individually for each state in the country and interpreted based on the positive and normative views found in the economic theory.

In absolute terms, 24 states have improved their indices of IOp, showing lower values in 2014 than in 2001. The exceptions were the states of Roraima, Sergipe and Maranhão. In relative terms, 15 states improved their positions, five remained in the same position (Amapá – AP, São Paulo – SP, Alagoas – AL, Paraíba – PB, Piauí – PI), and seven lost positions (Rondônia – RO, Roraima – RR, Amazonas – AM, Pará – PA, Rio Grande do Norte – RN, Maranhão – MA, Sergipe – SE).

The state of Santa Catarina shows the best result with an IOp of 0.074, an improvement over its second-place ranking in 2001, with 0.089. In both the initial and final years, the lowest position is held by the state of Piauí, with 0.226 in 2001 and 0.199 in 2014.

The relative disadvantage of states in the North and Northeast is obvious in the 2014 ranking. The lower half of 2014 results consists exclusively of states in Brazil's North and Northeast regions. Five of the seven states in Brazil's North region and all nine of the Northeastern states appear in this lower half. The states of Brazil's South, Southeast and Center-West regions all appear in the top half, along with the states of Amapá and Rondônia (the only Northern states to rank in the top half in 2014).

Position	Gender	Color	Type of employment	Income in 2014 (R$)	Income in 2001 (R$)*	Share of the sample
1	Male	White	Formal	2065.56	1670.82	14.65%
2	Female	White	Formal	1530.57	1160.93	12.48%
3	Male	Non-white	Formal	1430.92	1043.75	17.82%
4	Male	White	Informal	1186.48	846.81	9.70%
5	Female	Non-white	Formal	1060.31	725.23	11.93%
6	Female	White	Informal	879.18	588.39	6.86%
7	Male	Non-white	Informal	821.94	529.00	15.86%
8	Female	Non-white	Informal	609.05	367.56	10.71%

Source(s): Prepared by the authors. * Income from 2001 adjusted to 2014 prices

Table II.
Opportunity Profiles,
Brazil, 2001 and 2014

The geographical distribution of IOp can be seen in the maps of Brazil from 2001 to 2014, shown in Figure 3. The states shown in darker colors have higher rates of IOp. Overall, the map becomes "lighter colored" overall due to the decline in IOp in most states, but the most accentuated inequalities persist in the states of Brazil's Northeast.

It is beyond the scope of this study to identify the specific reasons for change in each state. However, explanations of the processes that cause significant declines in some states while other states experience the same or even higher levels of IOp would be a fruitful topic for future studies. The following section proposes hypotheses that may explain the trends observed. The normative implications of the theory and the results are also discussed.

4.2 Discussion of results
Regardless of the method of measurement used, income inequality in Brazilian society is among the highest in the world. In recent estimates, Medeiros *et al.* (2015b) show that the richest 1 percent of the adult population concentrates more than a quarter of the country's entire income. The richest 5 percent hold almost half the income. The concentration is so great that the top one-thousandth of the population accounts for more income than the poorest 50 percent of the population combined. The authors used confidential data from income tax returns and found a small decline during the period 2006–2012.

The present study showed an alternative view of the situation of inequality in Brazil. Measured by MLD, the results show a substantial reduction in income inequality, from 0.552 in 2001 to 0.405 in 2014. Despite the reduction, this level of inequality ranks Brazil among the countries with the highest concentrations of income in the world.

On the other hand, the decline in the absolute IOp shows that the decrease in income inequality during that period is due in part to a reduction in both fair and unfair components of inequality. This means that of the 26.7 percent decline in total inequality, 12.9 p.p. is due to a reduction in circumstance-based inequality and the remaining 13.7 p.p. derives from a reduction of inequality due to factors of effort or luck. From a normative perspective, the decline in levels of circumstance-based IOp is ethically desirable. The same cannot be said about the reduction of inequalities due to the components of effort or luck.

What is considered luck may be related to asymmetry of information in a scenario in which risks are not fully measurable or in which there are elements of real uncertainty. Economies of scale are another factor that may benefit individuals unevenly by amplifying the fruits of some people's efforts more than that of others. If an individual consciously chooses a profession or
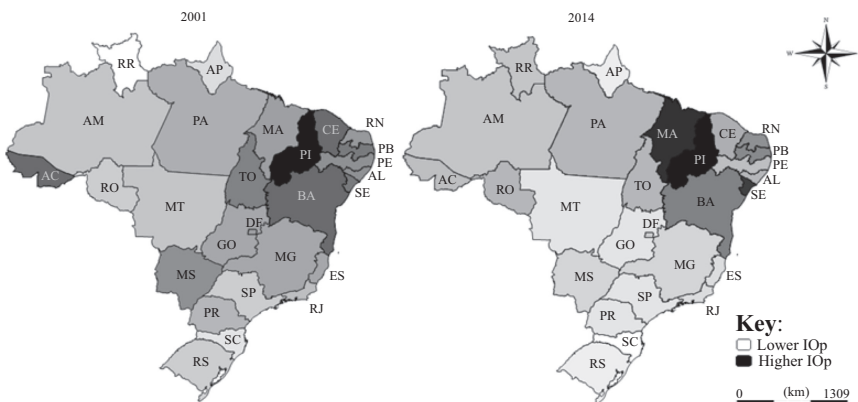
Source(s): Elaborated by the authors

Figure 3.
Maps of opportunity in
the states of Brazil,
2001 and 2014

activity whose scale of gains better rewards his or her efforts, one can argue that he or she deserves the outcomes. However, if these gains are not known due to limited access to information, there is more room for arguing that these inequalities should be compensated.

The question then arises as to how much inequality a society should tolerate. Should unlimited increases in inequality due to effort be ethically acceptable? It was estimated that 51.4 percent of reductions in inequality result from reducing disparities in the rewards for effort and luck. At first glance, it would seem that reducing this sort of inequality would have a negative impact on society. However, the theory does not specify an optimal degree of inequality due to effort that society should tolerate. The question of reducing or increasing rewards for effort remains open, depending on the level of inequality in a society.

As Roemer (2012, p. 191) says, "I am militant on annihilating inequality due to circumstances; I am uncertain about how much inequality to allow due to differential effort." This lack of definition requires a more comprehensive theory that incorporates elements of efficiency and growth in the distributive debate. Redistribution without growth implies redistribution with less power, fewer resources and greater resistance from society. It may be more viable to apply redistributive policies to portions of income that are growing rather than to make reductions to portions of income that are stagnant or declining. This point is recognized in theory, requiring a broader concept of justice, which is not the focus of the theory of equality of opportunity.

The redistributive proposal of the theory of equality of opportunity seeks to compensate individuals for the disparities in results that are due to circumstances. Through the process of public deliberation, one can try to arrive at a consensus regarding which inequalities are fundamentally unfair. This is the appeal of measuring IOp. Once society accepts the ethical idea of a minimum set of circumstances, one can formulate policies about those circumstances.

Therefore, the study showed that the reduction of unfair sources of inequality accounted for 48.6 percent of the reduction of total inequality. The absolute IOp was 0.156 in 2001 and 0.116 in 2014. The 25.6 percent decline was significant, but there is still room for social policies that focus on reducing this index in Brazil.

IOp stemming from differences of gender, color, family background and employment in the formal vs informal sector was considered ethically unacceptable. Measures of their relative importance showed that in 2014, 36.7 percent of the unfair inequality derived from working in the informal sector, 35.2 percent from father's and mother's schooling and literacy, 20.7 percent was related to a person's color and 7.3 percent was tied to gender. These weights remained virtually unchanged throughout the period.

According to the economic theory, some good explanations for income disparities associated with color and gender come from theories of discrimination. According to Akyol et al. (2015), there are three main explanations for income differences based on discrimination: taste discrimination, statistical discrimination and occupational crowding.

Becker (1957) is responsible for formulating the theory of taste discrimination, in which the costs and benefits of an economic exchange depend on the color and gender of the parties involved in the exchange. The notion of prejudice is expressed by a coefficient of discrimination. For example, hiring a black employee has a higher "cost" to the employer if the employer has racial prejudices. This difference is reflected in the lower salary offered to the employee who is the target of the discrimination.

According to Borjas (2012), statistical discrimination is commonly used by companies to fill information gaps when they cannot predict the risks and rewards of hiring a certain person. Faced with having to choose between two workers with exactly the same productivity attributes, discrimination may take the form of drawing analogies about the average dropout or turnover rate of the group to whom the candidate is seen as belonging.

Statistical discrimination may constitute an important source of IOp based on color or gender. For example, faced with having to choose between a male and a female job candidate with the same education and relevant information, the employer may consider that men as a

group are less likely to quit a job than women as a group and therefore offer the job to the male candidate, even if there is no empirical evidence to support this. In addition, higher crime rates among blacks may give employers the impression that a black employee is more likely to commit an infraction than a white employee.

In her hypothesis of occupational crowding, Bergman (1974) argues that women are systematically excluded from occupations considered "male" based on educational choices, which are then reflected in access to better-paid occupations and positions.

In turn, differences between formal and informal employment may be related to the structure of the regional labor market. According to Barros and Rands (2011), the mere existence of regional income disparities arising from specialization in productive technologies does not, by itself, constitute social injustice. The author explains the regional inequalities in Brazil as a function of the unequal distribution of human capital. It is estimated that the *per capita* gross domestic product (GDP) of the Northeast region would increase by 20 percent relative to the Southeast region if both regions had the same average years of schooling. Per capita GDP in Brazil's Northeast is currently only 60.4 percent of per capita GDP in the Southeast region; if the population in the Northeast had education levels on par with the Southeast, it is estimated that the Northeast's per capita GDP would rise to 81.6 percent of the Southeast's per capita GDP.

The importance of employment in the formal sector as a circumstance of opportunity may be closely tied to the regional distribution of human capital. States in the North and Northeast regions, where the rate of formal employment is lower than in the rest of Brazil, have greater difficulty attracting and producing highly educated and productive workers. In these regions, the income gap between highly skilled and low-skill workers tends to be greater than in the rest of the country, which is reflected in a more marked IOp.

Important studies have investigated the hypotheses raised, but there is still no consensus about which best explains differences of opportunity. This is fertile ground for future studies regarding the theory of opportunity. This article consisted of empirical investigation of the sources of IOp, but not the causes of the disparities between groups.

Finally, the estimates of IOp constitute a base value, or a lower limit, for the scenario of disparities in Brazil. Their values may be even higher, given the use of PNAD data and the omission additional circumstances. Based on the hypothesis of orthogonality, we are not considering the effects that could arise by the correlation between circumstances and effort. Effort can often be a characteristic attributable to the individual, making it an additional source of IOp.

It is not clear whether a more accurate measure of the portion of income that goes to the richest households would result in higher levels of IOp. It is unlikely, but theoretically possible, that income differences in the upper strata may derive solely from greater effort or better luck. The uncertainty in Roemer's theory as to acceptable levels of income disparity has direct implications for the notion of justice with regard to such an extreme distribution of outcomes. However, a discussion of inheritance would make the circumstance of family background more important, requiring its consideration.

5. Final considerations
The theory of equality of opportunity suggests that social and economic inequality can stem from factors beyond the individual's control. Not all differences of income are ethically unacceptable in this view, as individuals deserve to be rewarded for their efforts. According to this concept of egalitarianism, it is necessary to identify the sources of inequality to describe justice in a society.

Although it remains among the highest in the world, the level of income inequality has been reduced in Brazil. Between 2001 and 2014, the disparity of income, measured by the MLD index, fell significantly from 0.552 to 0.405. Within these values, 0.156 and 0.116 represent the values of absolute IOp. Thus, total income inequality fell 26.7 percent, and IOp

fell 25.6 percent during this period. Of the decline in total inequality, 48.6 percent can be assigned to a decline in the unfair component of inequality, while the fair component represents 51.4 percent of the reduction.

The weight of circumstances that contribute to IOp remained virtually constant, with 36.7 percent attributable to working in the informal sector, 35.3 percent to family background, 20.7 percent to color and 7.2 percent to gender. A comparison of groups' incomes based on their circumstances shows that the average income of the group facing the greatest disadvantage, "non-white women working in the informal sector," is only 29.5 percent of the income of the group that enjoys the most advantages, "formally employed white men." However, it was the most disadvantaged groups that showed greatest income growth between 2001 and 2014. Among the states, Santa Catarina state offers the best index of opportunity, while the state of Piauí ranks last in this regard. Corroborating the results of similar studies, the present work also found that the indices of IOp are higher in the North and Northeast regions than in the rest of Brazil.

As it concerns public policies, besides maintaining the conditional income transfer programs, like Bolsa Família, the results shows that alternatives that could foster the formalization of labor conditions could have impacts over the inequality reduction. Informality is more frequent in micro and small companies of the commerce and service sectors, public policies could aim at these segments. Therefore, improvements in programs like Simples Nacional and others that aims at reducing tax and bureaucracy burden on small companies and discharges of payrolls could be a subject to future studies for public policies propositions.

Note

1. Formal employment refers to the following categories of workers: employee with signed employment record card (i.e. have formal labor contract), member of the armed forces, public servant and domestic servant whose labor card is signed by the employer. Informal employment refers to the following categories of workers: employee without signed employment record card, domestic servant whose labor card is not signed by the employer, self-employed, producers of goods for their own consumption, construction for own use, non-remunerated work and non-applicable.

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