

## Inequality of Opportunities for Children in Metropolitan Regions of Brazil

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**Abstract:** The aim of this study was to analyze the inequality of opportunities for the metropolitan regions of the Brazilian capitals in 2010. Inequality of opportunity is considered a situation in which personal characteristics of an individual or family influence access to services such as clean water, education, sanitation and garbage collection. We estimated the Human Opportunity Index (HOI) for the capitals of Brazil and their neighborhoods. We also identified the main factors correlated with inequality of opportunity through Shapley's Model for neighborhoods of the cities with the best and worst HOI ratings. The educational and sanitation dimensions require special attention in social policies, since both combine low availability of service with high in equality of access, especially in the North-Northeast.

**Key words:** HOI, family, regions, garbage, Brazil

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### INTRODUCTION

Although, absolute poverty and inequality are closely related concepts, the objectives of reducing poverty and inequality have not received equal support. While the reduction of absolute poverty has always received universal and unconditional support and is the first of the Millennium Development Goals, measures to reduce inequality have never received unconditional support (Barros *et al.*, 2008).

Support for reducing inequality appears to vary among groups as well as according to the level and nature of inequality. When inequality is extremely high as in most Latin American countries and closely related to the origin of the family, gender and ethnicity, the consensus that it can be reduced in general, be more easily achieved. However, when inequality is the result of differences in effort choices or even talent among people who had access to the same opportunities and received the same treatment then support for compensatory policies to reduce inequality is usually much weaker.

This last point is related to the fact that income inequality has many sources, some more questionable than others. A reasonable distinction is that inequality in opportunities available to people, your chances basic living are more blameworthy than inequalities that arise because of the differential application of individual effort. According to Peragine (2004), inequality that arises from factors beyond personal responsibility should be compensated by society.

Two concepts of inequality of opportunity have prevailed: Roemer (1998) assumed that the individual results are determined by factors of "responsibility" and "not responsibility". According to this concept, one part of the income of an individual derives from effort (factors of responsibility) and another part that stems from factors such as religion, race, gender, called "not responsibility". A second vision developed by Pattanaik and Xu (1990) says that only the inequality arising from the circumstances are undesirable.

In Brazil, several studies have been conducted on inequality of opportunity, one of the first by Bourguignon *et al.* (2007). Researcher used the conceptual framework by Roemer (1998) and sought to quantify the degree of observable inequality of opportunity associated with empirical income distributions. The determinants of earnings were divided between those arising from conditions such as gender, place of birth and family wealth and those associated with individual effort. Researcher simulated the reduction of income inequality that would be achieved if the differences in these circumstance variables were eliminated. This difference between observed and counterfactual income inequality is then interpreted as a measure of inequality of opportunity.

Bourguignon *et al.* (2007) applied this approach to income distribution in urban areas of Brazil. The results suggest that inequality among Brazilian men can be attributed to a set of four circumstance variables: race, place of birth and education of father and mother.

Barros *et al.* (2008) in turn built a single indicator of inequality of human opportunity from 5 different indicators of opportunity for children: the percentage of children who completed the 6 grade on time, school enrollment of students aged 10 and aged 14 years, access to water, sanitation and electricity.

Later, Barros *et al.* (2009) analyzed the changes in indices of human opportunity, between 1995 and 2005 in Latin American countries. According to researchers for the inequality of opportunity to prevail, there must be a social consensus regarding the elimination of inequality of initial conditions that are exogenous to the individual's choices. However, the location of the child's birth is strongly associated with access to electricity, water and sanitation. The parents' education explains the child's access to educational service. These strong associations result in unwanted and complex challenges.

Foguel and Veloso (2012), using the same approach as Barros *et al.* (2008) measured the degree of inequality of opportunity in access to child care and preschool in Brazil using an index of opportunity that modifies the human opportunity index proposed by Barros *et al.* (2009). They used the supplementary questionnaires in the Pesquisa Nacional Amostra por Domicílios (National Household Survey) conducted in 2004 and 2006 and constructed a measure of opportunity that includes not only access but also the family's decision not to enroll the child in daycare. Researchers also showed that opportunities increased for both nursery school and for preschool between 2004 and 2006. However, the opportunities were significantly higher for preschool than for daycare even taking into account that the non-attendance of the child can be a voluntary decision by the family and not necessarily an indicator of lack of opportunity.

De Figueiredo and Ziegelmann (2010) estimated inequality of opportunity for Brazil and its main sub-populations from a method developed by Lefranc *et al.* (2008). Researchers considered the inequality of opportunity as a situation where the income distribution of individuals, conditioned by their social origins, may be the ranked usings to chastic dominance criteria. The results showed that the hypothesis of inequality of opportunity is significant and is higher in the Northeast of Brazil.

Despite the existence of studies that attempted to estimate the inequality of human opportunity for Brazil, there has been little evidence generated for children in metropolitan areas and neighborhood in Brazil. According

to IPEA while an important component of poverty is located in rural areas, particularly in the Brazilian Northeast, there is also a significant, far from negligible, proportion of metropolitan poverty. This poverty-urban and metropolitan has specific characteristics because the population in these places has less access to so-called non-monetary income (derived from production for self-consumption). In addition, the cost of metropolitan life tends to be much higher than in the interior, particularly because of the housing cost.

Another important feature of urban and metropolitan poverty is that spatial segregation in metropolitan is a strong determinant of people's poverty. Differentiation among intra-urban areas in terms of infrastructure, security, availability of public spaces, among others, influences the levels of well-being of individuals and families.

One of the great challenges of social policies, especially in metropolitan areas is to turn liabilities into opportunities that is to make the characteristics of the place of residence cease to be decisive factors in the reproduction of poverty. Thus, for the formulation and implementation of public policies for metropolitan areas, it is essential to identify priority sites for state intervention. In other words, the areas where the most vulnerable segments of the population are concentrated should be located and should become in principle, the priority targets of public policies.

Given this context, the question that arises is what is the behavior of human inequality of opportunity for children in the metropolitan areas of Brazil? What is the set of neighborhoods or urban subspace within cities that are in a condition of greater vulnerability as regards the conditions of opportunity?

Therefore, the purpose of this research study is to measure the index of inequality of opportunity for children of metropolitan regions of Brazil and to identify the main factors associated with this inequality.

The index of inequality of opportunity will be built on the framework developed by Barros *et al.* (2008). Researchers argued that in the case of basic goods and services that are fundamental to the full development of a child, the concept of opportunity can be operationalized by measuring children's access to these services. They considered as basic variables opportunities related to education (completion of sixth grade on time and school attendance at ages 10-14) and housing (access to clean water, sanitation and electricity).

## INEQUALITY OF OPPORTUNITY: LITERATURE REVIEW

The economic literature on inequality of opportunity is based on some contributions from philosophy including Dworkin (1981), Arneson (1989) and Cohen (1989). The basic idea is that results or measures such as income, wealth and health which often are called “advantages” are determined by two types of factors: those for which individuals may be liable and those for which they cannot be. According to Roemer (1998), inequality due to the first which we call the “effort” are normatively acceptable while those due to the latter what they call the “circumstances” are unfair and should in principle, be eliminated.

Assume that  $Y$  is an individual result of interest: education or access to an important social service for example. In accordance with Roemer (1998), they distinguish between two generic determinants of individual outcomes: circumstance  $c$  which are characteristics outside individual control and effort  $e$ , representing all factors affecting earnings that are assumed to be the result of personal responsibility. We partition the population into a set of type,  $T = \{1, 2, \dots, t\}$ , whereby a type  $t$  comprises a subset of the total population with similar circumstances. The income or outcome of interest ( $Y$ ) of individual  $i$  is defined as depending both on individual circumstances on personal effort:  $Y = \psi(c, e)$  the distribution of result and its corresponding degree of inequality are functions of the joint distribution of factors  $c$  and  $e$ .

If there is equality of opportunity, the condition should not affect the outcome ( $Y$ ). That is the result  $Y$  and condition,  $c$  should be stochastically independent. If  $Y$  is education and race ( $c$ ), equal opportunity should require that the distribution of education is the same in all race categories.

Therefore, the measure of inequality of opportunity must be a measure of the difference between conditional distributions of outcomes. The distance between this conditional distribution and magnitude of inequality of opportunity is determined by the shape of the function  $\psi$ . There are two concepts of inequality of opportunity with different information required for its measurement. In the first, the measure must be achieved without observing effort and the function  $\psi$  is estimated. In the second, the effort must be estimated.

There is an alternative definition of inequality of opportunity where the stochastic dependence of effort and circumstance is not included. In this case, it is considered a distribution of earnings, conditional on effort. Equality of opportunity must imply perfect equality of outcomes given the level of effort (Barros *et al.*, 2008).

The Human Opportunity Index (Barros *et al.*, 2009) summarizes in a indicator two elements: how many opportunities are available that is the rate of coverage of a basic service and how equitably these possibilities are distributed, if the distribution of the coverage is linked to the exogenous circumstances. Thus, an increase in the coverage of basic service nation wide improves the index. However, if this increase in coverage benefits a particular disadvantaged group (for example, a poor region), it will further reduce the inequality of opportunities, increasing the rate more than proportionally.

Researchers defines basic opportunities as a subset of goods and services for children such as access to education, drinking water which are crucial in determining opportunity for economic advancement in life. Universal provision of basic opportunities is a valid and realistic social goal. In children, most societies agree on the importance of a set of basic opportunities, at least at the level of intentions, even different societies may have different patterns on the right set of basic opportunities, some global consensus on some of them (Barros *et al.*, 2009).

In this case, we chose to estimate the human opportunity index, developed by Barros *et al.* (2009) for neighborhood groups of metropolitan regions of Brazil. Thus, we have an ordinal measure for inequality of opportunities, identifying possible sites with greater vulnerability.

## EMPIRICAL STRATEGY

To measure the inequality of children's opportunity in metropolitan areas of Brazil, we will use the same measure of inequality of opportunity adopted by Barros *et al.* (2008). Researchers developed a version of the Dissimilarity index ( $D$ ), widely used in sociology and applied to dichotomous data. The human opportunity index is measured by actual school attendance, sanitation, water access and others services.

**Human Opportunity Index:** This is a index that agree two elements: coverage and disparity among opportunities.  $X(i)$  be a vector that represents the set of all

circumstances for children  $i$ . Where  $p(x)$  as the coverage rate specific to the circumstance group  $x$ . Accord to Barros *et al.* (2009) and Foguel and Veloso (2012), the equality of opportunity was respected if  $p(x) = \mu$  (average) for all possible circumstance groups. In other words, when the allocation of access to school and access to sanitary services for all circumstance groups respects the share of each group in the population then the principle of equality of opportunity was respected.

In some situations the coverage rates of some circumstance groups are below or above the average coverage rate, in this case the equal opportunity isn't respected. In Eq. 1, we can measure the number of opportunities that not respect the equality of opportunity principle:

$$C = (p(x) - \mu)f(x) \quad (1)$$

Where:

$C$  = The total of inequality of opportunity

$f(x)$  = The cumulative distribution of circumstance groups

In the Eq. 2, we have relationship between the number of inequality of opportunity and the total of available opportunities.  $D$  represents a measure of the inequality of opportunity, known as the dissimilarity index:

$$D = \frac{C}{\mu} \quad (2)$$

$C$  and  $D$  are measures of inequality of the allocation of opportunities. We are interested in measuring inequality of opportunities in terms of the distance towards the ideal of opportunity for all. Barros *et al.* (2008) proposed a measure of opportunity:

$$O = \mu - C \quad (3)$$

In Eq. 3,  $O$  discounts from the available opportunities all those that are improperly allocated, in other words,  $O$  represents a measure of the distance for the ideal of opportunity for all. The opportunity index is given to:

$$O \equiv \mu(1-D) \quad (4)$$

The equation below is a set of equations that was presented in Barros *et al.* (2009) and Foguel and Veloso (2012). It represents the analytical way to estimate the opportunity index:

$$\mu = p(x)f(x), \text{ if } p(x) \leq \mu$$

If have:

$$(p(x) - \mu)f(x)$$

$C$  can also be written as:

$$C = \frac{\mu - p(x)}{f(x)} \text{ if } p(x) \leq \mu \quad (5)$$

Follow:

$$E(p(x) - \mu)$$

it follows from Eq. 1 and 5 that:

$$C = \frac{1}{2} E(p(x) - \mu) \quad (6)$$

Barros *et al.* (2009) find that:

$$C = \mu - \frac{1}{2} E|p(x) - \mu| \quad (7)$$

Now, we have that  $\mu = E[p(X)]$ , we can rewrite (7) as:

$$C = E[p(x)] - \frac{1}{2} E|p(x) - E[p(x)]|$$

#### Relation between family background and inequality of opportunity:

We also want to identify the key factors that affect the condition of inequality of opportunity between the neighborhoods of the metropolitan regions of Brazil. Decomposition of inequality of opportunity is aimed at evaluating how each personal circumstance included in the analysis of the indicator contributes to the formation of its value. We will perform the breakdown of the index of inequality will be held in contributions in each of the personal characteristics considered for the calculation of the IOH. Considering the fact that gender as an example, this decomposition enables one to check which part of inequality of opportunity is due to the fact that the individual is a woman.

The Shapley value was introduced by Shapley analysis of a cooperative game theory concept. Its application and extension to the decomposition of distributive indices was developed by Shorrocks (1999). This method provides a framework for dealing with any type of exercise decomposition and has the property of additivity of components which implies an exact decomposition (Shorrocks, 1999; Duclos and Araar, 2006).

The idea behind applying the Shapley decomposition would be to identify how much the measure of inequality of opportunities would change when we add a circumstance to different pre-existing sets of circumstances. The change in inequality as a result of adding a circumstance appears to be a reasonable indicator of the “contribution” of a circumstance to inequality of opportunities. Implementing this idea however needs to take into account the fact that since the circumstances are correlated to each other, the change in the measure obtained by “adding” a circumstance depends on the initial set or subset of circumstances to which it is added. Thus, to identify the unique impact of adding a circumstance to the measure, we would need to consider all the changes that occur when the circumstance of interest is added to all possible subsets of pre-existing circumstances and take the average of all these possible changes.

According to Barros *et al.* (2009), we can measure inequality of opportunities by the dissimilarity index (D) as defined in expressions (Eq. 8). The value of these two measures is dependent on the set of circumstances considered.

The index has the important property that adding more circumstances always increases the value of D. If we have two sets of circumstances A and B and set A and B do not overlap then  $HOI(A, B) \leq HOI(A)$  and  $D(A, B) \leq D(A)$ :

$$DA = \sum_{S \subseteq N} \frac{|S|!(n-|S|-1)!}{n!} [D(S \cup \{A\}) - D(S)] \quad (8)$$

Where:

n = Set of circumstances that includes n circumstances in total

S = Subset of n which does not contain the circumstance A

**Data source:** The data source we use is “The 2010 Population Census of Brazil”. The CENSO consisted of a survey of all the households in the country and is fielded by Brazilian Bureau of Census (Instituto Brasileiro de Geografia e Estatística-IBGE). It provides information for counties and set of neighborhood (“área de ponderação”). It is possible to get information about metropolitan regions.

CENSO’s basic questionnaire covers the main dimension of socioeconomic conditions of household including family structure, education, labor market status of household members and their income.

Table 1: Construction of Human Opportunity index-variables

Dependent variables (opportunity index logit)	
Variables	Description
School access	Dummy equal to 1 if the child has school access
Garbage collection	Dummy equal to 1 if the child’s house has garbage collection access
Water access	Dummy equal to 1 if the child’s house has safe water
Sanitation access	Dummy equal to 1 if the child’s house has sanitation service
<b>Regressors</b>	
Lnincome	Per capita income (ln)-income from all source including social transfers
Ffam1	Family composed of the mother, father and children
Ffam2	Family composed of the single mother
Race	Dummy equal to 1 for White
Tsiblings	Number of siblings
Parents’ education	Head of household education level

This database has information for a set of 8 districts of metropolitan regions of Brazil (Belem, Fortaleza, Recife, Salvador, Rio de Janeiro, Sao Paulo and Porto Alegre). For the case of Belem, we have 45 set of neighborhoods in Fortaleza 56, 40 Recife, Salvador 63, 201 Rio de Janeiro, Sao Paulo 312, 68 in Belo Horizonte and Porto Alegre 45.

In Table 1, we have the main variables that will be used in this study, in logistic regressions (construction of Opportunity Index).

## RESULTS

Most policy makers would prefer to have sufficient resources to provide basic opportunities to all of the children in a society, no matter what the children’s background is. This desire is seldom realistic, especially in developing countries with budget constraints. Policy makers are forced to make choices about how a limited set of opportunities will be distributed.

For policy makers in a country without sufficient resources to immediately provide all basic opportunities to the population, should their policy try to minimize inequality of opportunity in a situation of limited total opportunities or should it seek to raise the average access rate?

To help answer this question, we estimate the dissimilarity indicators (inequality of opportunity) and coverage indicators of access to services (education, sanitation, garbage collection and water) in addition to indicators of equality of opportunity.

In Table 2, we show the indicators for the educational outcomes for the metropolitan regions of Brazil. We realized that for the average service coverage, access would on average be greater in the capital of Sao Paulo than the other capitals of South, North and

Northeast of Brazil. The capitals with lower average access to educational services are located in the North and Northeast of Brazil (Belem and Recife).

Coverage is a measure of the stock of available opportunities but does not take into account how they are distributed. The measurement of distribution of the opportunities is the dissimilarity indicator also shown in Table 2. We note that this indicator is not zero in most cases of the cities studied, suggesting that there is n't a pattern of uniform distribution of educational services here measured by the school children in the sample who completed 6th grade on time. The cities with the worst indicator of unequal access to educational service are Recife and Salvador, both with 12.73 and 12.36% dissimilarity. These results suggest that there is disparity among the children of these cities.

HOI combines two elements-coverage and inequality in a single calculation. This function can provide the amount of resources available to the managers, weighted by the inequality distribution. According to the information presented in Table 2, the capitals with less equality of opportunity with respect to school delay are located in the North and Northeast of Brazil, Salvador, Recife and Belem.

The results for the other services garbage collection, water and sanitation are shown in Table 3. Sanitation is

the worst of all services in all capitals, both in regards to coverage and the dissimilarity indicator and consequently the human opportunity.

The results in Table 3 suggest that the sanitation service has more unequal distribution of access, low coverage and HOI when compared to other services. The capitals with the best coverage indicator of access to sanitation are Belo Horizonte (about 95%) and Rio de Janeiro (92.46%). With regard to access to garbage collection and water, the results of the HOI for the capitals studied showed values close to 100% indicating that there is high prevalence of services with equitable distribution among the people of these localities.

Table 3 estimated coverage, dissimilarity and HOI for access to services in metropolitan regions of Brazil (capitals).

However, the results in Table 3 draw attention to disparities among Southern, Southeastern and Northeastern Brazil. The Northeast is the region with the worst sanitation coverage, Recife has about 59% coverage of the service, very similar to the situation in Belem (Northern Brazil).

Now that we have an overview of human equality of opportunity for the metropolitan areas of Brazil, let us try to observe equality of opportunity within the cities. Our goal is to observe which are inconsistent or equal opportunities for the neighborhoods of the capitals studied.

### Decomposition of inequality of opportunities among children-metropolitan region:

In this study, we intend to realize the decomposition of inequality of opportunity (d-index) for capitals with the best and the one of the worst result for HOI, Sao Paulo and Recife. The dissimilarity index as discussed in the previous study is a synthetic measure indicating how outcome probabilities

Table 2: Indicator for scholastic delay: children that completed 6th grade on time in metropolitan regions of Brazil (capitals)

Cities	Scholastic delay (completed 6th grade on time)		
	Coverage	Dissimilarity	HOI
Recife	62.29	12.73	54.36
Belem	62.95	10.12	56.58
Fortaleza	75.31	7.19	69.89
Salvador	62.34	12.36	54.64
Belo Horizonte	77.56	6.01	72.90
Rio de Janeiro	72.41	8.62	66.17
Porto Alegre	70.01	10.09	62.95
Sao Paulo	81.49	5.43	77.06

Researcher's calculation

Table 3: Indicator for access to housing services in metropolitan regions of Brazil (capitals)

Cities	Sanitation			Water			Garbage collection			
	Coverage	Dissimilarity	HOI	Coverage	Dissimilarity	HOI	Coverage	Dissimilarity	HOI	HOI total
Recife	63.73	6.45	59.62	93.95	0.89	93.10	96.36	1.62	94.80	75.47
Belem	63.14	7.56	58.35	89.93	2.05	88.08	96.03	1.55	94.54	74.38
Fortaleza	70.33	3.22	68.07	94.36	0.95	93.46	97.94	0.73	97.92	82.33
Salvador	89.53	3.41	86.42	94.50	0.87	93.68	95.59	1.03	94.61	82.33
Belo Horizonte	94.38	1.89	92.59	98.69	0.27	98.42	99.11	0.48	98.62ta	90.63
Rio de Janeiro	92.46	1.69	90.89	97.44	0.36	97.08	98.65	0.46	98.19	88.08
Porto Alegre	88.43	4.24	84.67	97.24	0.93	96.32	98.39	0.96	97.44	85.34
Sao Paulo	88.70	5.43	77.06	96.36	0.50	95.90	99.64	0.14	99.48	87.37

Researcher's calculations

depend simultaneously on all components of a defined set of circumstances. In addition to this measure, it is also possible to have measures that indicate the extent to which outcome probabilities depend on a specific circumstance. For policy design, it may be important to analyze how each circumstance contributes to overall inequality of opportunity. In study, all circumstances were considered simultaneously to compute the synthetic d-index. In this study, specific measures are computed in relation to particular circumstances.

In Table 4, we have the results for completion of 6th grade on time for Recife and Sao Paulo. Similar results were obtained for the other four basic opportunities. The numbers represent the proportions of the available opportunities that would have to be redistributed among the children to attain equality of opportunity, if only one circumstance was considered.

In Sao Paulo, for example, the specific d-index educational values calculated for each circumstance range from 0.60 for numbers of siblings per household (tsiblings) to 0.79 for parents' education. That is, if the only circumstance considered was the parents' education, 79% of the available educational opportunities need to be reallocated in this city. In this case, the inequality resulting from difference in parents' education is larger than those from gender, location, presence of both parents and number of siblings.

With respect to the other dimensions of access to opportunities, such as basic sanitation, garbage collection and water, the circumstance parents' education had greater weight in the inequality of opportunity in Sao Paulo.

For the city of Recife, the results of the decomposition of the HOI for completion of 6th grade on time shows that inequality of opportunities resulting from differences in parents' education is larger than the results from family structure, gender, race or location.

Table 4 shows analogous results for one of the elements of housing conditions. The analysis of the specific d-indexes for sanitation shows that in Recife, urban rural alone is not in an important circumstance for explaining inequality in children's access to sanitation, other circumstances considered. The most important circumstance is parents' education. Clearly, being born to a father and mother with little education is critical to a child's probability of having access to sanitation.

**Equality of opportunities for neighborhood-results for metropolitan region of Brazil (capitals):** This study presents the results of the Human Opportunity Index (HOI) for the neighborhoods of Recife and Sao Paulo. We intend to identify how opportunities are distributed inside one of the worst and best capitals from the previous study: Recife and Sao Paulo.

The HOI calculated for the neighborhoods of Recife for access to educational services can be viewed in Fig. 1. Although, a strong disparity in access to the service exists overall, there is a cluster of neighborhoods with high rates of equal opportunity: Aflitos, Gracas, Apipucos, Espinheiro, Pamamirim, Casa Forte and Derby.

A similar situation was also observed in the dimension of sanitation. There is a cluster of neighborhoods with low access to the service in the city of Recife. These neighborhoods are the same ones that have unequal opportunity in the education dimension. Thus, for the neighborhoods in yellow in Fig. 1 and 2, only 59% of the available opportunities are equally distributed, a value lower than those observed for the other districts of the capital.

With respect to Sao Paulo, Fig. 3 presents information on equality of opportunity and education gaps among the various districts of the capital. Note a large concentration of neighborhoods with high values for HOI (above 90%): Pinheiros, Moema, Saude, Higienopolis, Perdizes and Vila Mariana and a concentration of neighborhoods with less access to opportunities: Paraisopolis, Marsilac, Parelheiros, Cidade Tiradentes, Guaianases, Perus and Tremembe, for example.

It is noteworthy that Sao Paulo is among the metropole of Brazil with largest calculated values for HOI but it is still possible to identify a pattern of disparity of opportunities among neighborhoods, judging by access to education.

Table 4: Contributions (%) to inequality from child's education and housing conditions by circumstance

Circumstance	Education	Sanitation	Garbage	Water
<b>Recife</b>				
Parents' education	82.60	72.06	23.62	40.23
Ffam1	3.15	7.32	7.70	3.28
Ffam2	1.45	4.00	3.66	2.44
Tsiblings	2.77	1.22	15.48	4.66
Lnincome	4.61	10.87	37.27	8.00
Rural	0.00	0.00	0.00	0.00
Race	5.42	4.53	12.27	4.38
<b>Sao paulo</b>				
Parents' education	79.59	39.04	42.72	58.10
Ffam1	7.41	1.36	5.47	9.59
Ffam2	1.59	0.85	2.32	12.91
Tsiblings	0.60	10.18	9.45	0.52
Lnincome	3.92	28.71	21.29	2.72
Rural	0.28	6.15	5.80	15.05
Race	6.61	13.12	12.96	1.11

Researcher's computations

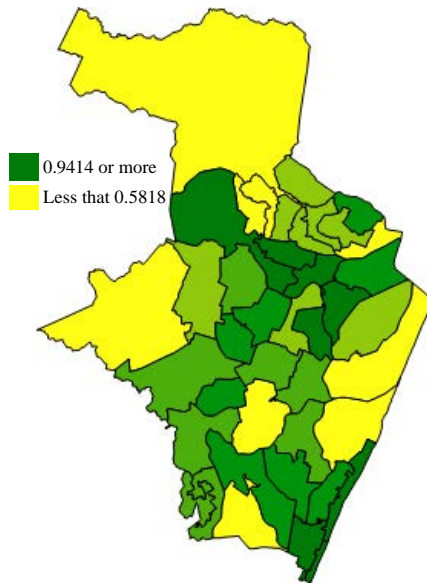


Fig. 1: Recife HOI to education-children in 6th grade on time (Generate to researcher)

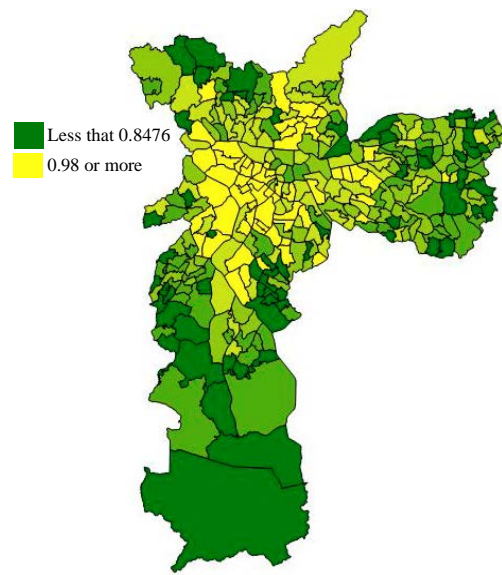


Fig. 3: Children with 6th grade on time for the neighborhoods of Sao Paulo (Generate to researcher)

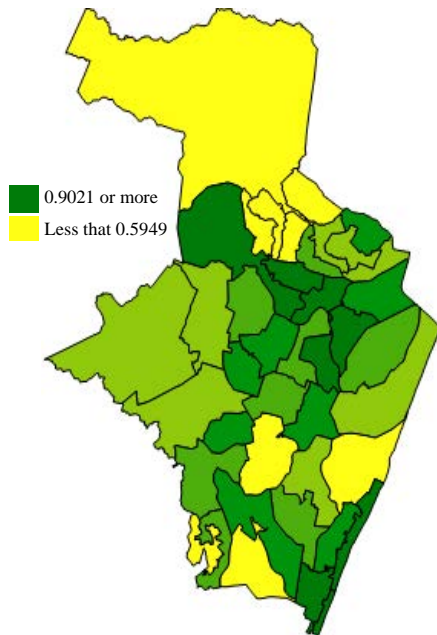


Fig. 2: HOI to sanitation access for the neighborhoods of Recife (Generate to researcher)

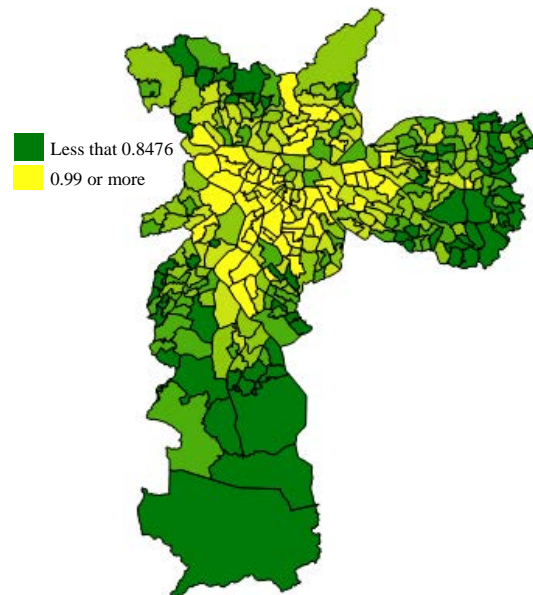


Fig. 4: HOI to sanitation access for the neighborhoods of Sao Paulo (Generate to researcher)

Still, when we examine the dimension of sanitation in Sao Paulo (Fig. 4), we see a grouping pattern for neighborhoods with low equality of opportunity for this type of service. Among these neighborhoods are: Marsilac, Parelheiros, Cidade Tiradentes, Guaianases, Perus and Tremembe.

Most neighborhoods of Sao Paulo with greater inequality of opportunity are located in the suburbs and those with greater equality are at the center of the capital, in both the sanitation and education dimensions (Fig. 3 and 4). In contrast is Recife, the capital of Pernambuco which lacks the center-periphery

Table 5: Decomposition of changes in the Human Opportunity Index: neighborhoods with best and worst results in Sao Paulo and Recife

Scales	Recife		Sao Paulo	
	Coverage ( $\Delta p$ )	Dissimilarity ( $\Delta d$ )	Coverage ( $\Delta p$ )	Dissimilarity ( $\Delta d$ )
Education	0.9425	0.0574	0.8318	0.1681
Sanitation	1.0516	-0.0516	0.3203	0.6796
Water	0.8705	0.1294	0.5136	0.4863
Garbage collection	1.7309	-0.7309	0.9420	0.0579

Researchers' calculations from Census 2010

pattern in the distribution of opportunities, so Recife has neighborhoods with high equality of opportunity that are near neighborhoods or areas with low equality of opportunity.

**Decomposition of the HOI within neighborhoods:** As shown in study, there is variation in the Human Opportunity Index (HOI) within a neighborhood. Because the HOI takes into consideration both average coverage and unequal access to services, a policy analyst can wonder about the source of its variation within a neighborhood.

We want to answer the following question: is the HOI variation between the worst and best neighborhoods in the cities of Sao Paulo and Recife due to increased coverage, decreased inequality or a combination of them?

According to Barros *et al.* (2009), any change in the index can be attributed to an increase in the coverage (scale effect) or change in the inequality index (d-index). For the researchers, the index could be decomposed ( $\Delta p = p^{\text{final}}(1-d^{\text{initial}}) - p^{\text{initial}}(1-d^{\text{initial}})$ ) and  $\Delta d = p^{\text{final}}(1-d^{\text{final}}) - p^{\text{final}}(1-d^{\text{initial}})$  for more detail about this technic (Barros *et al.*, 2008)) as follows:

$$\text{Change} = O^{\text{final}} - O^{\text{initial}} = \Delta p + \Delta d$$

In this study,  $O^{\text{final}}$  is the index value for equality of opportunity in the neighborhood with the best outcome in Recife and Sao Paulo and  $O^{\text{initial}}$  is that for the neighborhood with the lowest observed result. Finally,  $\Delta p$  is scale effect (coverage) and  $\Delta d$  is distribution effect.

Table 5 shows the scale and distribution effects for Recife and Sao Paulo. We realize that the difference between the largest and smallest districts with equal opportunity in Recife is basically derived from the scale effect (>90% of the variation comes from this effect). In the case of Sao Paulo, the situation is quite similar in the Northeast: the variation between the largest and smallest neighborhoods with equal access to basic education stems from the scale effect (about 83%).

## CONCLUSION

The aim of this study was to analyze equal opportunity for capital metropolitan regions of Brazil in

2010. Inequality of opportunity is considered a situation in which personal characteristics of the individual or family influence access to services such as clean water, education, sanitation and garbage collection.

We estimated the Human Opportunity Index (HOI) for the capitals of Brazil and their neighborhoods. We also identified the main factors correlated with inequality of opportunity through Shapley's Model for neighborhoods of the cities with the best and worst HOI ratings.

The HOI results showed that the capital with better coverage rates and lower disparity of opportunities are in Southern and Southeastern Brazil. And for the case of the North and Northeast, both coverage and the distribution of educational and residential services are worse compared to those observed in the capitals of the South-Southeast.

The educational dimension (school delay) and sanitation require special attention from social policies, since both combine low availability of the service with high inequality in access, especially for the cases pertaining to Belem and Recife.

When we studied the case of Recife and estimated the HOI for neighborhood, finding that in fact there is a strong correlation for the neighborhoods with high or low equality of human opportunity. There is probably an effect of location for access to educational and services in the city of Recife.

Sao Paulo was the Brazilian city with the best calculated values for HOI but it is still possible to identify a pattern of disparity of opportunities among neighborhoods, judging by access to education. The test for spatial correlation showed a strong spatial correlation for neighborhoods with high equality of opportunity.

We realized the decomposition of inequality of opportunity (d-index) for capitals with the best and one of the worst result to HOI, Sao Paulo and Recife. In Sao Paulo to education dimension the inequality resulting from difference in parents' education is larger than those from gender, location, presence of both parents and number of siblings. The results of the decomposition of HOI for Recife was similar that found to Sao Paulo.

Despite progress in access to opportunity in education, family background is still a strong factor that influences children's possibilities of access to school, the causes of low intergeracional mobility are powerful.

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