Secondary school attendance in Montevideo: A territorial perspective from an equality of opportunities approach

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1. Introduction

The study of the determinants of educational performance has been widely addressed by the academic literature. The relevance of analyzing educational inequalities lies in the importance of education as a determinant of people's future income and labor market trajectory (Card, 1999; Checchi, 2006, Heckman et al., 2008).

Differences in educational attainment explain an important part of household income inequality and constitute one of the main channels that enable social mobility, so the search for educational equity can lead to a reduction of social inequalities in general (Checchi, 2001, 2006; Gregorio and Lee, 2002). Education is considered a key component of well-being, a basic human right, and a tool for critical thinking, so expanding educational coverage and quality could be an end in itself.

On the other hand, educational inequalities can generate economic inefficiencies, leading to a suboptimal level of growth (Alesina and Perotti, 1996; World Bank, 2005), and educational dropout at early ages is associated with higher rates of crime and delinquency (Hanushek and Woessman, 2007; Loncher, 2011). In this sense, reducing educational inequalities could be considered a desirable goal for society.

In Uruguay education is compulsory from the age of 4 until the completion of high school[1]. Although since the 1960s there has been a strong expansion of schooling levels, reaching almost universal primary school graduation, it is estimated that in 2019 only 42.7% of young people between 21 and 23 years of age will have completed secondary education (INEEd, 2020).

Several reports by the Instituto Nacional de Evaluación Educativa de Uruguay (INEEd) analyze the evolution of the coverage of the education system and compare Uruguay's results with other countries in the region (INEEd 2018, 2020). These reports document that the coverage of the education system at its different levels managed to increase significantly between 2006 and 2017, although large differences persist by household income quintiles for adolescent attendance, particularly in the ages of 15 to 17 years (INEEd, 2018).

Regarding regional comparisons, Uruguay is positioned within the first places in educational attendance of children from 4 to 11 years old, but when considering adolescents from 15 to 17 years old, it is in the average levels of Latin America, below Chile, Brazil, and Argentina[2] (INEEd, 2018). In addition, when analyzing high school graduation rates, worse results are found in the regional comparison. Although INEEd estimates indicate that the high school graduation rate of 21-23-year-olds grew 10.5% between 2006 and 2019, it is still positioned considerably below the average for Latin America (21.2 percentage points for 2018, according to CEPAL estimates) (INEEd, 2020).

[1] Compulsory education consists of two years of preschool education, six years of primary education, three years of basic secondary education, and three years of higher secondary education (Ley General de Educación N°. 18437).

[2] The report presents educational coverage for 4 and 5, 6 to 11, 12 to 14, and 15 to 17 age groups for Argentina, Brazil, Chile, Uruguay, Paraguay, and the average for Latin America.

Several studies have delved into the search for the determinants of educational achievement in Uruguay. In this sense, there is vast literature highlighting the importance of socioeconomic characteristics of the home of origin as relevant variables when explaining differences in the educational performance of children and adolescents (Bucheli and Casacuberta, 2000, 2010; de Melo et. al., 2015, de Melo and Machado, 2018). Other studies find that cognitive and non-cognitive skills -which in turn are shaped by parental inputs-, personality development, gender, and ethnic background are also relevant (Bucheli and Casacuberta, 2010; de Melo et. al., 2015; de Melo and Machado, 2018; Méndez and Ramos, 2022).

On the other hand, several studies conclude that the context of the area of residence is significantly linked to people's performance (Kaztman, 1999; Kaztman and Retamoso, 2007). The neighborhood of residence is correlated with educational attainment, the age at which motherhood and fatherhood begin, the age of entry into the labor market, potential occupation, earnings, among others (Kaztman, 1999; Arim, 2008).

Studies for the United States have shown that the socioeconomic context of the neighborhood has a significant impact on children's educational performance and effects on intergenerational mobility (Chetty et. al., 2016; Chetty and Hendren, 2018a, 2018b). These investigations find, moreover, that these effects are greater when exposure to neighborhoods with a favorable socioeconomic context occurs from an early age.

The neighborhood context becomes relevant when the socioeconomic composition among them is different, which is known in the economic literature as residential segregation. Theory indicates that the neighborhood environment operates through peer effects, role models, generation of contact networks, and transmission of cultural norms, among others (Benabou, 1996; Jencks and Mayer, 1990; Katzman, 1999; Mayer, 2002; Brooks-Gunn et al., 1993).

Residential segregation is defined by Massey and Denton as the degree to which two or more socioeconomic population groups reside in different areas within a city (Massey and Denton, 1988). Residential segregation occurs when individuals of the same social group are concentrated in a particular area of the city. In this literature, some researchers have been interested in analyzing the possible impact that residential segregation processes may have on current and future income inequality, partly due to differentials in educational attainment (Mayer, 2002; Fogli and Guerrieri, 2019).

The main reason for focusing on inequalities between neighborhoods in this analysis has its origin in the vast evidence that Montevideo is segregated according to the socioeconomic characteristics of households (Kaztman, 1999; Cervini and Gallo, 2001; Calvo et. al., 2002; Veiga, 2005; Kaztman and Retamoso, 2005, 2007; Aguiar and Filardo, 2015). In turn, several studies find that the 1980s and 1990s showed a trend toward an increase in these levels (Kaztman, 1999; Cervini and Gallo, 2001; Calvo et al., 2002).

More recent studies find that residential segregation by income in Montevideo had a slight increase from 2006 to 2012, with a considerable drop from 2012 and at least until 2017 (Vázquez, 2018). However, when analyzing variables with more structural characteristics, residential segregation follows different trends. Particularly, residential

segregation increases in the case of adults who accredit a completed secondary education level and for households with high-status labor occupations (Rodríguez Vivas, 2019).

Several studies have found significant evidence of the influence of the neighborhood on the opportunities to which individuals have access in Montevideo. The immediate social environment is relevant to explain the differentials in children's performance in standardized tests (Katzman and Retamoso, 2007), in attendance, and in school repetition of children and adolescents (Katzman, 1999; Bracco, 2019).

In view of the growth of high school graduation rates, in which large inequalities between socioeconomic levels persist, it is relevant to investigate how the inequality of educational opportunities among adolescents has evolved. Inequality of opportunity is interpreted in this paper based on Roemer's theoretical framework (Roemer, 1998), assuming that individuals' achievements are determined by two factors: their circumstances - exogenous factors - and their individual effort. In this context, inequality of opportunity is defined as that part of inequality that arises from circumstances for which individuals are not responsible.

This paper seeks to place special emphasis on inequalities in secondary education attendance considering the neighborhood as a circumstance for adolescents. One of the main assumptions is that the decision of which neighborhood to live in is made by the parents or guardians and does not depend on the will of the adolescents.

Although previous studies highlight the relevance of the neighborhood environment on adolescent educational dropout, there is no national evidence that studies this link from an equal opportunity approach. This paper seeks to contribute to the national literature by combining elements of the equal opportunity approach and the literature that studies the effect of the neighborhood on the performance of individuals. On the other hand, it is expected to provide evidence of the evolution of equal opportunities in a relevant outcome for the national agenda, such as the attendance of adolescents to secondary education.

This paper has two specific objectives. The first is to analyze the evolution of inequality of opportunities in secondary education attendance among adolescents aged 12 to 17 in Montevideo. Second, to estimate how much of this inequality is explained by the adolescents' neighborhood of residence.

We use the databases of the Continuous Household Surveys (ECH) of the Instituto Nacional de Estadística (INE) from years 2006 to 2019. Through the calculation of Human Opportunity Indexes (HOI) proposed by the World Bank (Barros et al., 2008), we analyze the evolution of the equality of opportunity in the attendance of adolescents to secondary education. The importance of each of the circumstances considered in inequality is estimated using the Shapley decomposition of the Dissimilarity Index.

We find that the equality of opportunity increases between 2006 and 2019, mainly driven by an increase in coverage and by a reduction -of a lesser magnitude- in inequality between groups. Attendance at a private educational center, educational level of the head of household, household income quintile, and neighborhood of residence stands out as the variables that explain inequality to a greater extent. We find that the neighborhood explains about a quarter of the inequality in high school attendance among adolescents.

This document is structured as follows. The second section is devoted to bring a brief description of the Uruguayan educational system, particularly regarding secondary education. The third section presents the theoretical framework. The fourth section presents the antecedent international and national literature. Subsequently, the empirical strategy is detailed, explaining the data sources, the methodology, and the definition of the variables to be used. The sixth section presents the main descriptive statistics. The seventh section shows the results, while the eighth section presents the robustness checks carried out. The ninth section discusses the implications and possible explanations of the results. Finally, the conclusions of the study are presented.

2. Secondary education in Uruguay

The objective of this section is to describe the structure of the educational system in Uruguay and, in particular, how students, teachers, and resources are allocated in secondary education. Finally, it is briefly described how public and private supply is distributed and the territorial differences between neighborhoods in Montevideo.

Uruguay's education system is organized into four levels: initial education, primary, secondary (divided into basic and higher education), and tertiary education. Compulsory education comprises initial education from the age of 4 (2 years), primary education (6 years), basic secondary education (3 years), and higher education (3 years), with a total of 14 years of compulsory education (INEEd, 2016). Basic secondary education has been compulsory since 1973, while higher secondary education became compulsory with the Ley Nacional de Educación of 2008 (INEEd, 2016).

Within the public provision of secondary education, students can choose between two sub-systems: Secondary Education (public high schools) or Technical Vocational Education - UTU (technical and agricultural schools). Both are regulated by the Administración Nacional de Educación Pública (ANEP): public and private high schools are regulated by the Dirección General de Educación Secundaria (DGES), while technical schools are regulated by the Dirección General de Educación Técnico Profesional (DGETP).

According to INEEd, in basic secondary education, public provision accounts for 86% of those attending, and within this, only 18% attend technical school courses. In the case of higher secondary education, 89% of those attending attend public centers, with 72% attending high schools and 28% attending technical schools.

Regarding the theoretical ages for compulsory education cycles, compulsory initial education corresponds to the ages of 4 and 5 years, at 6 years old is assumed to start primary education, and start secondary at 12 years old. Thus, basic secondary education would (theoretically) take place between the ages of 12 and 14, and higher secondary education between the ages of 15 and 17[3] (INEEd, 2016).

The criteria and processes for assigning students to public schools are scarcely analyzed. A recent report by INEEd (2022) provides an initial historical systematization of the

[3] These are the theoretical ages as of April 30 of the school year for each educational cycle.

regulations governing the processes of enrolment and assignment to public schools and analyses the links between these mechanisms and school segregation.

The report argues that Uruguay has moved in recent decades from a criterion of allocation by territorial distance to one of free choice between schools (INEEd, 2022). In the current provision (Circular No. 399 of 1999), the allocation of students to schools is based on the distance to the school, defining a "school radius" for each school. However, this regulation has become more flexible in practice to consider families' preferences.

Enrolment in the first year of basic secondary education has been carried out since 2017 through a centralized 'early enrolment' process so that all students are assigned to a school before the end of primary education. Families choose three technical (UTUs) or general (high schools) education centers in order of preference, while the centers analyze the availability of places for first grade considering the projection of repeaters. Students are then allocated using a computer algorithm that seeks the highest possible number to be assigned to their first option, or at least to the best possible one, considering an order of priority based on socio-educational vulnerability.

It is allocated by prioritizing: i. To students who come from Associated Educational Centers.[4] ; ii. Those who come from special schools or prioritized programs; iii. Based on an index of vulnerabilities[5] ; iii. Students coming from rural schools; iv. Those over 18 years of age. Finally, once all students from the public education system have been assigned, the cases of students from private schools and from abroad are processed.

In a recent study, Rivero and Viera (2021) qualitatively analyze the trajectories of adolescents and young people through secondary education in Uruguay. This study finds that proximity to home seems to be a fundamental factor in the choice of educational center in basic secondary education; however, in higher secondary education, more priority is given to the center's offer, the neighborhood where it is located and the availability of transportation (Rivero and Viera, 2021).

In public schools, teachers choose annually and centrally the hours they wish to take from a stock of available groups and schools. The order in which they choose is defined firstly by grade[6] -teaching seniority- and secondly by qualification -an indicator based on class and attendance scores-[7]. This order leads to teachers with more experience and higher scores being the first to choose the school in which they want to work and the course they want to teach.

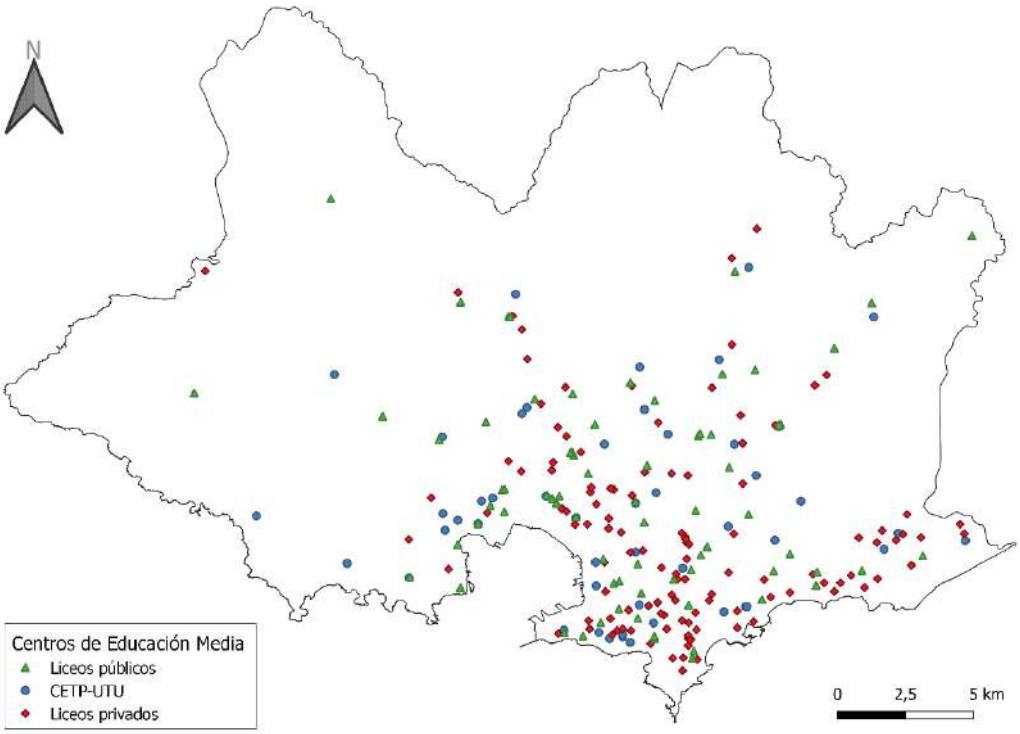
Some studies have pointed out the possible negative effect of the choice mechanism on the equitable distribution of resources and the long-term planning of the school (Pasturino, 2015; Santiago et al., 2016). It has been documented that as teachers move up in the choice list, they tend to concentrate in schools with a more favorable socio-cultural background. Thus, higher secondary schools and schools with higher socio-economic status tend to attract more experienced teachers, while lower seniority teachers are concentrated in basic secondary schools and in more vulnerable contexts (Pasturino,

[4] Centers near the school.
[5] This index considers past absences and grades, access to social plans, among others (INEEd, 2022).
[6] Teaching grades range from first to seventh and it depends on the length of service.
[7] The activity computed is an indicator involving management score, inspection score, attendance and seniority.

2015). Given that salaries increase with the grade, these mechanisms imply a regressive allocation of resources for salaries, which constitute the largest part of the budget.

Figure 1 shows the geographic location of secondary education centers in Montevideo, distinguishing between public high schools, technical schools (CTEP-UTU), and private high schools. The educational offer is concentrated in the most central and densely populated area of the city, while in the more peripheral areas the offer is more spread out in the territory.

Figure 1. Secondary education centers in Montevideo



Source: Compilation based on ANEP's Geographic Information System[8] and ANEP's list of authorized private high schools.[9]

As mentioned in the introduction, INEEd reports find that, although adolescent educational attendance improved in average terms, large differences between socioeconomic levels still remain (INEEd 2018, 2020). As Montevideo is a segregated city in socioeconomic terms, it is expected that this difference in adolescent attendance has a spatial correlation. Figure 2 presents the map of the department of Montevideo with the percentage of adolescents aged 12-17 years attending secondary education, by neighborhood for the years 2017-19.

Figure 2. Percentage of adolescents aged 12-17 attending secondary education by neighborhood for years 2017-19

[8] Available at http://sig.anep.edu.uy/siganep/Mobile/Index
[9] The georeferenced centers correspond to those authorized in 2021.

Source: Own elaboration based on microdata from ECH 2017-2019.

High school attendance among adolescents between 12 and 17 years of age in Montevideo reached an estimated average of 91.8%, according to data from the Continuous Household Surveys (ECH). However, there are important differences between neighborhoods in Montevideo: while all adolescents surveyed in the Cordón, Tres Cruces, Brazo Oriental, La Blanqueada, Parque Rodó, Pocitos and Punta Gorda neighborhoods attended secondary education, about 20% of those residing in Villa García-Manga Rural, Casavalle and Punta de Rieles-Bella Italia were disengaged from the educational system.

The above information justifies the consideration of the neighborhood as a possible source of inequality. The territorial perspective can contribute, in this sense, to analyzing the problem of equal opportunities in health care from a new perspective.

3. Theoretical framework

This section presents the reference approaches used to analyze equal opportunities for adolescents to attend high school. The first subsection introduces the equal opportunity approach. Secondly, Secondly, models linking neighborhood of residence and educational outcomes are presented.

a. Equality of opportunity

Normative concepts of justice and equality have been widely debated, and at the basis of these exchanges is the self-understanding of individuals as equals. In this framework, and under the different interpretations of equality and justice, several authors have put forward theories on equality, in order to answer the question of what we must equalize in order to be treated fairly -welfare, freedom, means, capabilities, opportunities, results, among others- (Arneson, 1989; Cohen, 1989; Anderson, 1999; Dworkin, 1981a; 1981b; Sen, 1992; Roemer, 1998a, Rawls, 1999).

Broadly speaking, it could be argued that the discussion on equality has two main currents: equality of opportunities and equality of results (Gasparini et. al., 2013). Under the first concept, what we must equalize in order to be fair are the opportunities we have to transform resources into achievements. In this context, inequalities in outcomes will be justifiable, as long as individuals start from the same point, and the differences between them are attributable to the effort, while differences in outcomes of individuals who make the same effort would not be morally tolerable. On the other hand, under the notion of equality of outcomes, any level of inequality would be considered unfair (Gasparini et. al., 2013).

The concept of equality of opportunity is usually more accepted than that of equality of results, since some differences in results can be considered morally fair, for example, those derived from talent or effort. However, equality of opportunity is more complex to carry out empirically, because the effort is an unobservable variable.

In the context of this debate, John Roemer presents an approach based on equality of opportunity, conceived as equal access to those goods or services that are considered relevant for the development of life in society. Roemer argues that the achievements of individuals are determined by two factors: their *circumstances*, exogenous factors, which are not under their control -such as the characteristics of the home of origin-; and their *effort*, which is determined autonomously by the individual. The different combinations of circumstances make it possible to differentiate individuals into different *types* (Roemer, 1998a).

Differences in the outcomes of different *types* of individuals are attributed to inequalities in circumstances, while differences in outcomes within each *type* can be attributed to differences in effort. In this sense, it would be considered fair for two people with the same circumstances to achieve different outcomes if their level of effort is different, but inequalities that are due to characteristics beyond their control would not be tolerable. In this context, equality of opportunity is achieved when the distribution of the outcome we observe is independent of the distribution of individuals' circumstances.

Following the notation of Roemer (1998a), it is defined that the outcome of each individual (x_i) can be expressed as a function of circumstances (c_i) and effort (e_i):

$$x_i = \lambda(c_i, e_i)$$

To ensure equal opportunities, the outcome should be independent of circumstances, so there must be stochastic independence between x and c:

$$F(x|c) = F(x) \quad \forall\, c \in C$$

The distinction between variables to be considered as exogenous, independent of individuals' decisions, and variables over which the individual has control, is far from obvious. For example, gender and race are usually accepted as circumstances, but the same is not true for talent or predisposition to effort (Gasparini et. al., 2013). Defining circumstances when we want to analyze equality of opportunity in young children may be simpler -it can be argued that almost everything is circumstance- but when thinking about adults the distinction between what is circumstance and what is effort becomes more diffused. At one extreme, if everything that affects outcomes is considered a circumstance, equality of opportunity is equated with equality of outcomes (Gasparini et al., 2013).

In this same line, a point to highlight with respect to this theory consists in the conception of preferences as exogenous to individuals. In Roemer's theory, preference formation depends on the circumstances and role models to which the individual is exposed, so it would not be possible to directly compare the effort made by individuals of different types (Roemer, 1998a).

This conception of preferences as exogenous is not a consensus in the literature. Dworkin, in his theory of equality of resources, argued that to be fair it was necessary to compensate individuals for those aspects of their situation that did not depend on their individual responsibility, while those differences that arose from the acts or beliefs of individuals were justifiable from the normative point of view. In this context, Dworkin considers that individuals are responsible for their preferences, contrary to Roemer's argument (Dworkin, 1981; Roemer, 1998b).

This distinction regarding how to consider preferences is particularly important if we understand that individuals adapt their preferences to circumstances. In the context of adaptive preferences, individuals in a favorable socioeconomic situation may be more predisposed to set demanding educational goals in the long term, while others in more vulnerable contexts may not consider such alternatives as possible.

Under this normative framework, the role given to skills -understood as the capacity of individuals to transform resources into achievements- is also relevant, a concept very similar to that defined by Sen's theory of equality of capabilities (Sen, 1992). Individuals of different types, with different abilities, can have different achievements even though the resources and the effort allocated are the same, and this would not be considered fair under Roemer's normative framework.

In the case of this paper, we will seek to apply Roemer's theoretical framework of equality of opportunities to analyze the secondary education attendance of adolescents in Montevideo. Based on this approach, certain circumstances are defined -gender, parental education, the neighborhood of residence, among others- on the basis of which individuals of different *types* will be characterized -as many *types* as possible combinations of circumstances will be obtained-, and inequality among them will be analyzed. In particular, it is of interest in this paper to estimate how much the neighborhood contributes to inequality in adolescent attendance, once the other circumstances are controlled.

The definition of the circumstances considered in this paper -which will be explained in more detail in the empirical strategy- is based on the premise that many of the variables that are significantly correlated with the probability of adolescents attending high school are beyond their control. In particular, it is assumed that the residence decision is made by the parents or guardians and that it does not depend on the will of the adolescents.

b. Educational production function and the role of the neighborhood

A variety of theoretical literature has developed models that seek to explain educational outcomes. This subsection aims to link educational production function models with theoretical approaches that explain the channels through which the neighborhood can affect people's educational decisions.

The economic literature that studies the supply and demand for education has developed models that allow explaining the demand for human capital formation as a function of individuals' characteristics and resources. Checchi (2006) proposes an Educational Production Function (EPF) model in which the educational outcome is a function defined as follows:

$$\Delta H_{it} = f\ (A_i, S_{it}, E_{it}, H_{it})$$

The human capital formation of individual i in period t (ΔH_{it}) is a function of four main inputs: the -unobservable- ability of individuals (A_{it}), the time spent by the individual to be educated (S_{it}), the per capita resources invested in education -teachers, class size, characteristics of educational centers- (E_{it}), and the initial stock of human capital of individual i in period t -household educational climate, peer effect- (H_{it}) (Checchi, 2006).

On the other hand, several studies have found that the environment of the neighborhood influences the education and future income of individuals. One of the main models of the effect of the neighborhood on these outcomes is Benabou's (1993) model, which formalizes the links between location decisions, investment in education and production. In this model, individuals choose whether to be skilled workers, unskilled workers -which are complementary in production- or to remain outside the labor market and where in the city to reside. Education is considered a local public good, which has a decreasing cost the higher the fraction of individuals in the neighborhood who invest in education. This is justified by the possibility of fiscal externalities -assuming that workers with higher skills earn higher wages-, or by human capital externalities -by the effect of peers or social networks-. In the equilibrium, individuals from different social classes decide to segregate themselves in the city in response to local externalities (Benabou, 1993).

In the framework of the educational production function proposed by Checchi, and in line with the model proposed by Benabou, it can be argued that parents' decision of where to live conditions the context or environment in which the children develop, thus impacting their educational outcomes. Thus, the neighborhood is considered part of the determinants of the family context, incorporating it as a factor (*input*) within the educational production function.

One of the main mechanisms mentioned in the literature to explain the effect of the social composition of the neighborhood on the educational outcomes of individuals is the peer

group effect (Benabou, 1996; Jencks and Mayer, 1990; Brooks-Gunn et al., 1993; Katzman, 1999; Mayer, 2002; Checchi, 2006). The theoretical underpinning of the peer effect is the assumption that an individual's behavior is affected by the attitudes and decisions made by others with whom he or she interacts and who belong to his or her reference group (Jencks and Mayer, 1990; Katzman, 1999; Checchi, 2006). Peer relationships in the neighborhood of residence lead to the social composition of the environment and the characteristics of these peers affecting individuals' decisions and outcomes (Jencks and Mayer, 1990; Brooks-Gunn et al., 1993; Katzman, 1999).

On the other hand, the neighborhood environment can affect educational outcomes through the effect that adults have on children and youth who are not their children, known in the literature as role models (Jencks and Mayer, 1990; Brooks-Gunn et al., 1993; Katzman, 1999; Leventhal and Brooks-Gunn, 2000). Adult support networks and the quality and structure of the family environment can generate resources and networks that improve educational outcomes (Brooks-Gunn et al., 1993; Leventhal and Brooks-Gunn, 2000).

Another mechanism mentioned in the literature is the neighborhood's institutional resources, including the availability, access and quality of public spaces, medical centers, daycare centers, supply of schools and high schools, among others (Jencks and Mayer, 1990; Brooks-Gunn et al., 1993; Katzman, 1999; Leventhal and Brooks-Gunn, 2000). Finally, several authors point out that cultural norms, formal and informal community institutions, also constitute a channel through which the social composition of the neighborhood affects educational outcomes (Jencks and Mayer, 1990; Katzman, 1999; Leventhal and Brooks-Gunn, 2000).

The models presented justify the relevance of incorporating the neighborhood as one of the determinants of individuals' demand for human capital formation. In the context of this study, and linking this theory with Roemer's equal opportunity approach, the neighborhood will not only be considered as a factor within the educational production function, but will also be considered as a circumstance for adolescents.

4. Background

This section presents the main background information found in the international and national economic literature. In each subsection, we first present the studies that investigate non-spatial determinants of educational attendance, and then those that incorporate the neighborhood of residence in the analysis. Finally, we present background studies that analyze educational outcomes from an equal opportunity approach.

a. International literature

Diverse studies agree on the importance of parental educational level and household socioeconomic characteristics in explaining educational attainment in general, and dropout in particular (Rumberger, 1983; Carins et. al., 1989, Haveman et. al., 1991; Manski et. al., 1992; Cameron and Heckman, 2001; Cunha et. al., 2006; Jordan et. al. 2012, Huisman and Smits 2015). Other variables considered in the literature and generally

agreed to be relevant are family structure characteristics, gender and ethnic ancestry (Rumberger, 1983; Carins et. al., 1989; Manski et. al., 2002; Branson et. al. 2014).

Other authors have delved into the link between dropout and less observable variables, such as cognitive and non-cognitive skills (Carins et. al., 1989; Bowls and Gintis, 2001, 2002; Heckman and Rubinstain, 2001), personality development or expectations (Dekkers and Driessen, 1997; Rumberger, 1983; De Witte and Rogge, 2013).

Other studies on educational determinants have emphasized the need to incorporate the territorial dimension in the analysis. Many studies have been concerned with the link and the possible effect of the environment of the place of residence on the dropout of adolescents from secondary education, finding that the socioeconomic environment of the neighborhood is a relevant determinant of dropout (Crane, 1991; Brooks-Gunn et al., 1993; Harding, 2003; South et al., 2003).

Chetty (2016) and Chetty and Hendren (2018a, 2018b) exploit randomization in Moving To Opportunity allocation in the United States to explore the neighborhood effect causally. These studies find that neighborhood socioeconomic context has a significant impact on children's educational performance and effects on intergenerational mobility and that these effects are larger when exposure to neighborhoods with favorable socioeconomic context occurs early in life (Chetty, 2016; Chetty and Hendren, 2018a, 2018b).

Some studies have analyzed the differential effects that the neighborhood may have among individuals of different ancestry and economic level (Creane, 1991; Crowder and South, 2003). These studies have found that the effects of neighborhood environment on dropout are not linear: the magnitude of the effect varies depending on the group considered. In this sense, it is found that adolescents who are more vulnerable are more affected by unfavorable neighborhood environments (Creane, 1991; Crowder and South, 2003).

On the other hand, many studies have analyzed inequality in educational outcomes using the equality of opportunity approach. These studies usually consider as an outcome variable the educational attendance of children and adolescents (Hoyos and Narayan, 2011), academic results in standardized tests (Gignoux and Crespo, 2008; Gamboa and Waltenberg. 2012), or years of education attained by adults (Carneiro, 2008).

A 2008 World Bank study introduces a Human Opportunity Index (HOI) to provide an objective measure of children's and adolescents' opportunities to access basic services (Barros et al, 2008). This index measures the average availability of basic services, discounted by the inequality with which services are distributed among the population.

The report analyzes five basic opportunity variables - on-time completion of sixth grade, school attendance of children aged 10 to 14, access to water, electricity and sanitation - for 19 countries in Latin America and the Caribbean[10], using data from households

[10] The countries considered by the report are Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.

surveys for each country. The report considers gender, age, area of residence (urban or rural), years of schooling of the head of household, and household income, among others.

The study finds that equality of opportunity increased for the average of the region in the five indicators considered (by approximately one percentage point). Uruguay is in a relatively good position in the regional comparison: it ranks fifth in education (with an index value of 85 points, after Chile, Jamaica, Argentina and Mexico) and fourth according to housing conditions (with 85 points, after Costa Rica, Chile and Venezuela) (Barros et al., 2008).

While several empirical papers find that the neighborhood of residence affects educational opportunities and outcomes, most studies from the equal opportunity approach do not incorporate this dimension in the analysis. Türk and Östh (2019) link these two approaches to study the contribution of the neighborhood to inequality of opportunity in educational outcomes and earnings in Sweden. In addition to being among the first papers to link this literature, this study has the strength of using a longitudinal record base, which makes it possible to follow the trajectory of individuals and to distinguish between the neighborhood in which individuals currently live and the neighborhood in which they grew up.

Using multilevel regression analysis, they decompose total and neighborhood inequality into inequality arising from individuals' circumstances and inequality attributable to individual effort. They divide the explanatory variables of the model between non-spatial variables -gender, education, and parental employment status, among others- and spatial variables -of the parents' neighborhood in 2001 and of the individuals' neighborhood in 2010-. For neighborhood characterization, they use the closest neighbors and consider the proportion of peers of similar age, visible minorities, single-parent families and families with 3 or more children.

Despite Sweden's low levels of inequality, a significant part of inequality of opportunity can be attributed to neighborhood differences. The characteristics of parents' neighborhood of residence positively impact children's earnings more than their own neighborhood: the decomposition of circumstances shows that parents' neighborhood explains about 16% of inequality of opportunity, while individuals' neighborhood as adults explains less than 2% of differences in effort (Türk and Östh, 2019). Parents' neighborhood has a strong impact on educational attainment and this effect persists years after exposure influencing children's earnings.

b. National background

Regarding the national literature, several studies reaffirm that educational outcomes and youth dropout are affected by socioeconomic context and household structure, gender, ethno-racial ancestry (Bucheli and Casacuberta, 2000, 2010; Manacorda, 2012; Cid and Stokes, 2013), cognitive and non-cognitive skills (Méndez and Ramos, 2022), nutritional levels in childhood, and personality development (Failache et. al., 2018). Educational performance in primary education, motivational factors -self-perception of skills, preferences and study expectations- and school repetition also stand out as relevant

variables to explain adolescent dropout from secondary education (De Melo et. al. 2015; De Melo and Machado, 2018).

One of the first studies on the link between the neighborhood and educational performance in Montevideo is the one by Katzman (1999). This study analyzes the link between the social composition of the neighborhood of residence - measured as the proportion of households with heads in high-status occupations - and three indicators of *risk* behaviors, among which are lagging or dropping out of the educational system among children between 8 and 15 years of age. It is found that the social composition of the neighborhood is significantly correlated with the probability of falling behind or dropping out of the educational system. The evidence also shows that children from households with lower educational levels are those most affected by the composition of the environment.

More recent literature has provided evidence that reinforces the importance of neighborhood context in explaining adolescent educational dropout. Bracco (2019) analyzes the effects of the neighborhood on the performance of youth and adolescents in Montevideo, on educational repetition and permanence, using data from the Longitudinal Study of Well-being in Uruguay (ELBU). To operationalize neighborhood quality, the author estimates a spatial model based on purchase and sale prices and structural attributes of real estate. This study finds evidence suggesting that neighborhood quality is a relevant determinant of school repetition, with the main mechanism being the school peer effect. The author concludes that the neighborhood effect on permanence in the educational system does not operate directly, but is channeled through its influence on repetition.

Regarding the analysis of equality of opportunities in secondary education in Uruguay, one of the background studies is that of Llambí, Perera and Messina (2009). First, the authors analyze the evolution of equal opportunities in various educational outcomes for young people between 1991 and 2007, using data from the Continuous Household Surveys (ECH) and the methodology proposed by Barros et al. (2008). Within the circumstances of adolescents, they consider an indicator of the educational climate of the household -average years of education of adults-, the per capita income quintile of the household, the occupation of the head, the type of household, the region of residence - Montevideo or other departments- and gender. Circumstances associated with educational climate and household income, region of residence and gender are those that most influence the educational achievement analyzed. The evidence found by the authors indicates that the highest levels of inequality of opportunities are found in the dropout and on-time completion rates of secondary education.

Secondly, Llambí, Perera and Messina (2009) replicate the analysis using data from the 2006 PISA tests, and taking the learning test score as the outcome variable. In this case, the circumstances include a set of variables related to the school, such as the student-teacher ratio, quality indexes of educational resources, proportion of qualified teachers, among others. We find a high intergenerational transmission of inequality and that school-related variables do not contribute to inequality, once individual characteristics are controlled for. Regarding the contribution of each circumstance, it is observed that gender and region of residence do not have a significant magnitude, while the income of

the household of origin stands out as one of the circumstances that most influences inequality.

The various studies mentioned above demonstrate the relevance of the neighborhood as a relevant variable when analyzing inequality in adolescents' secondary education attendance. However, there is no evidence for Montevideo that studies the inequality of opportunities in educational attendance, considering the territorial dimension in the analysis. This paper seeks to provide evidence in that sense. It is expected to contribute to the discussion on equal opportunities in a relevant outcome for the national agenda, such as adolescent attendance in secondary education.

5. Empirical strategy

This section presents the empirical strategy. First, the data source used is detailed. In a second subsection, the methodology is explained, presenting the way of estimating the indexes and their decompositions, properties and disadvantages. Finally, the dependent and independent variables to be included in the analysis are defined.

a. Data

This paper uses the databases of the Continuous Household Surveys (ECH) of the Instituto Nacional de Estadística (INE) for the years 2006 to 2019. These databases contain microdata with information at the household level -such as access to durable goods, housing characteristics and tenure-; and of its members -personal characteristics, employment status, information on educational trajectory and income, among others-.

These surveys have been conducted by INE annually since 1964, and are representative of households at the national level as of 2006. Although inequality of educational opportunities is a structural phenomenon, so taking a long period of time would be enriching for the analysis, it was decided to limit the base year of the study to 2006, because from that year onwards there is a sample size that allows for greater disaggregation of the data.

This study will focus on the department of Montevideo. The decision to delimit the study to this area is due to its status as the capital of the country, where approximately half of the population resides, and to the availability of disaggregated data. In particular, working with Montevideo allows for a higher level of territorial disaggregation -at the neighborhood level-, with boundaries that have not been modified[11]. To increase the sample size, the ECHs are grouped with three-year moving averages -2006 to 2008, 2007 to 2009 and so on-.

Although it can be argued that when analyzing educational performance it may be better to use administrative records, the ECHs have the advantage of providing information on the place of residence and demographic and socioeconomic information on adolescents, particularly household data, which are not found in the registries. Beyond the lack of

[11] Montevideo's neighborhoods were defined by INE in 1985, and their boundaries have not changed to date.

complementary information, the main drawback to using administrative records is that they only have information from the public education system, and no data from the private system. This generates two potential problems. First, having only adolescents who attend the public system would leave out of the analysis those who belong to higher-income households, which would affect the measurement of inequality. Second, through administrative records it is not possible to distinguish whether adolescents who drop out of the database do so because they left the education system or for another reason -for example, if they emigrated to another country or if they went to a private school-.

b. Methodology

In order to analyze the inequality of opportunities in adolescents' attendance to secondary education, we estimate the Human Opportunity Indexes (HOI) proposed by the World Bank (Barros et. al., 2008). This index measures the average availability of basic services -such as access to vaccines or education attendance- discounted by the inequality with which the services are distributed among the population. Using the Shapley decomposition of the HOI index, it is estimated how much each set of circumstances contributes to the inequality of opportunities.

Following Barros et. al. (2008), the Human Opportunity Index (HOI) is defined as:

$$\widehat{HOI} = \bar{p} * \left(1 - \widehat{D}\right)$$

Where $\bar{p}$ is defined as the service coverage and $\widehat{D}$ is the Dissimilarity Index. As a first step to compute the HOI, the following logit model is estimated:

$$P(y_i = 1 \mid \boldsymbol{X}) = \frac{\exp\left(\beta_0 + \boldsymbol{X\beta}\right)}{1 + \exp\left(\beta_0 + \boldsymbol{X\beta}\right)}$$

Where the dependent variable $y_{i,}$ is a binary variable that indicates, in this study[12], the adolescents' attendance to secondary education, and the vector $\boldsymbol{X}$ contains the variables that are considered as circumstances. The definition of the outcome and circumstance variables is presented in the following subsection.

Once the model parameters have been estimated, the predicted probability of attending high school is calculated for each adolescent: $\hat{p}_j$. Subsequently, the coverage -the average probability of attending high school- and the Dissimilarity index are calculated, defined as follows (Barros et al., 2008):

Coverage:

$$\bar{p} = \sum_{1}^{n} w_j \, \hat{p}_j$$

Dissimilarity Index:

[12] Hereafter, the outcome variable is referred to as high school attendance, in order to facilitate explanations.

$$\widehat{D} = \frac{1}{2\bar{p}} \sum_{1}^{n} w_j \left| \hat{p}_j - \bar{p} \right|$$

Where $w_j = \frac{1}{n}$ or the sample expansion factors, and *n* is the total number of observations.

The Dissimilarity Index (D) measures how dissimilar are the probabilities of attending secondary education among the groups defined by the circumstances -the different types-, with respect to the average probability of attendance of the population. The D index is a weighted average of the differences in the absolute value of the probabilities of attendance of each type ($\hat{p}_j$) and the average probability of attendance ($\bar{p}$). The value of the index ranges from 0 to 100, where 0 represents an equal distribution of opportunities -all *types* have the same probability of attending education- and 100 represents a completely unequal distribution. The value of the index D can be interpreted as the percentage of opportunities that must be redistributed among groups to achieve equal opportunities (Barros et. al, 2008).

The HOI index also has a range from 0 to 100. In this index, coverage is penalized by the unequal distribution of opportunities - measured through the dissimilarity index. The maximum value of the HOI index is reached when all individuals, regardless of their circumstances, have access to the good or service being analyzed.

Following the methodology proposed by Barros et al. (2008), changes in the HOI index can be decomposed into a scale effect -change in the endowment of a certain opportunity- and a distributional effect -how the opportunity is distributed among individuals-. Taking two points in time (*t* and *t+1*) we can estimate the change in coverage ($\Delta_{\bar{p}}$) and the change in the dissimilarity index (Δ_D).

$$\Delta HOI = HOI^{t+1} - HOI^{t} = \Delta_{\bar{p}} + \Delta_D$$

$$\Delta_{\bar{p}} = \bar{p}^{t+1}(1 - D^{t}) - \bar{p}^{t}(1 - D^{t})$$

$$\Delta_D = \bar{p}^{t+1}(1 - D^{t+1}) - \bar{p}^{t+1}(1 - D^{t})$$

Thus, an increase in the HOI index may be due both to an increase in average secondary education attendance -an increase of $\bar{p}$- as well as an improvement in the distribution of the probability of attendance among the different types -fall of $\widehat{\bar{D}}$-. It may happen that the two components of the index move in the same direction, and in that case the net effect on the HOI will depend on the magnitude of the change in each component.

In order to identify how much of the inequality is explained by each circumstance, the Dissimilarity Index is decomposed using a Shapley decomposition. This decomposition is derived from the Shapley Value, which arises as an equilibrium solution in n-player games (Shapley, 1953). Shorrocks manages to derive theoretically, from this value, the decomposition of various poverty and inequality indices (Shorrocks, 2013), which were applied in subsequent studies (Deutsch et al, 2018).

Particularly, the World Bank uses the Shapley Value to decompose the HOI Index (Barros et al, 2008), and several studies have employed this decomposition in empirical work

(Hoyos and Narayan, 2011; Pal, 2016; Méndez, 2020; Sanoussi et al, 2020). In this case the Shapley decomposition is used to estimate how much inequality of opportunity varies when one more circumstance is added to the initial set of circumstances.

Formally for the Dissimilarity Index, the impact of adding a circumstance C_A is given by:

$$D_{C_A} = \sum_{S \subseteq N \setminus \{C_A\}} \frac{|s|!\,(n-|s|-1)!}{n!} \left[D(S \cup \{C_A\}) - D(S)\right]$$

Where N is the set of circumstances, which includes n circumstances in total, S is a subset of N (containing s circumstances, and including all but C_A). D(S) is the Dissimilarity Index value of the set of circumstances S. D(S∪{C_A}) is the dissimilarity index of the set S and the circumstance C_A.

The contribution of circumstance C_A to the Dissimilarity Index is given by:

$$K_{C_A} = \frac{D_{C_A}}{D(N)}$$

Finally, the sum of the contribution of each circumstance equals unity:

$$\sum_{i \in N} K_i = 1$$

To decompose the Dissimilarity Index using this method, we iterate by taking out the circumstances one by one and thus estimate what percentage of the index is explained by each of them. In the results section we present the estimates of this decomposition for each of the dissimilarity indexes calculated.

c. Definition of variables

The outcome variable analyzed in this paper is the secondary education attendance of adolescents aged 12 to 17 years. The HOI index will report the probability of adolescents attending secondary education, discounted by the inequality between different *types* of adolescents -that is, between adolescents with different combinations of circumstances-. The HOI indicators are calculated at the Montevideo level, for each tree-year period from 2006-2008 to 2017-2019.

As mentioned above, the first step in computing the index is to estimate a logit model. In this case, the dependent variable ($y_{i,}$) is a binary variable defined as:

$$y_i = \begin{cases} 1 & if\ attend\ secondary\ school \\ 0 & if\ do\ not\ attend\ secondary\ school \end{cases}$$

First, the model is estimated considering as explanatory variables age, gender, ethno-racial ancestry, the educational level attained by the head of household and the neighborhood of residence. In a second set of estimations we add controls for having attended preschool education and for attending a private educational center. These estimates are made from 2011 onwards, since these questions are included in the survey form from that year.

In the case of the etno-racial ancestry variable, a binary variable will be considered, with a value of 1 if the adolescent is afro-descendant. Questions on ancestry have been included in the ECH since 2006 and are collected on a self-perceived basis. Following the Bucheli and Cabella (2007) and INMujeres (2010) criteria, people who responded that they were of afro-descendant are identified as afro-descendant, regardless of whether they declared other ancestries.

Regarding the educational level of the household of origin, much of the literature tends to use the father's or mother's education directly. Although the ECH data make it possible to distinguish between father and mother when both reside in the household and one of them declares him/herself the head of household, this cannot be distinguished in the case of most extended households or in those cases where the adolescent's father or mother does not reside in the house. Because of this, it was decided to consider the education of head of household, defining three categories: less than 9 years of education, between 9 and 12 years, and 12 years or more.

In addition, to control for the economic level of the household, the per capita income quintile of the household to which the adolescent belongs is included. As a robustness check, the estimates were repeated using deciles, as detailed in the seventh section.

In the case of preschool education, the variable is defined as binary and takes 1 when the adolescent declares having attended this level of education. A distinction is also made between the type of educational center (public or private) in the last year attended.

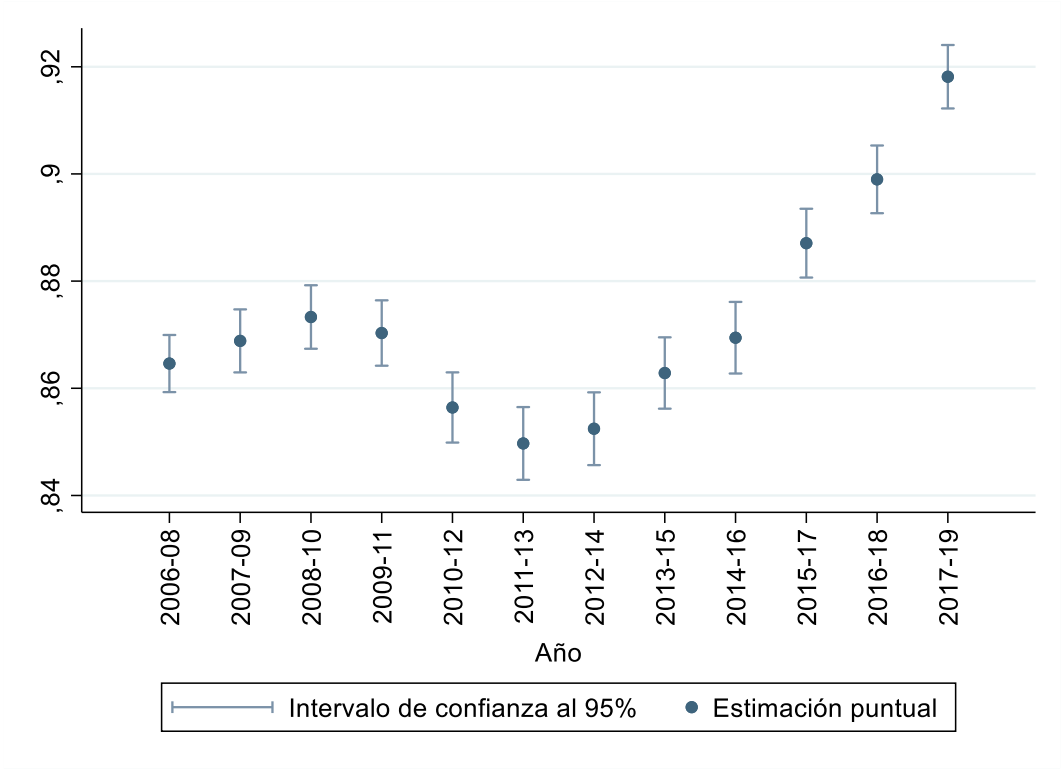
Finally, the neighborhood of residence will be incorporated into the model as a fixed effect, adding binary variables for each of the 62 neighborhoods of Montevideo. The inclusion of the area of residence within the circumstances is based on the assumption that adolescents cannot autonomously decide where to live, and this decision is generally made by their parents or adult caregivers. The vast literature on the effects of the neighborhood of residence on the educational performance of young people justifies and makes relevant the inclusion of this variable in the analysis.

6. Descriptive statistics

Since we are working with data from household surveys, we will have a sample of the target population. As mentioned above, the database is restricted to adolescents between 12 and 17 years of age who have completed primary education and reside in the department of Montevideo. To expand the number of cases within each set of circumstances, the ECHs are grouped by three mobile years, bringing the number of observations to a range of between 8,238 and 15,830, depending on the trio of years.

Figure 3 presents the percentage of adolescents attending secondary education in Montevideo for the period from 2006-08 to 2017-19, with upper and lower 95% confidence intervals.

Figure 3. Secondary education attendance rate of adolescents aged 12 to 17 years residing in Montevideo. Period 2006-08 to 2017-19.



Source: Own elaboration based on microdata from the 2006-2019 ECH.

It is observed that attendance fluctuates between the years 2006-08 (starting from 86.5%) and 2011-13 (where it reaches the minimum point of 85.0%), and subsequently shows an increasing and significant trend until the end of the period. In 2017-19 91.8% of adolescents aged 12-17 years residing in Montevideo attend formal secondary education.

The analysis of adolescent attendance percentages shows substantial differences according to the variables considered as circumstances. Table 1 presents the percentage of attendance according to age, gender, ethnic-racial descent, educational level of the head of household, household income quintile, preschool attendance and type of educational center, for the period 2006-2019.

Table 1. Adolescents' attendance to secondary education according to their circumstances (in %). Period 2006-2019.

Years	2006-08	2007-09	2008-10	2009-11	2010-12	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Age (in years)												
12	96,07	95,88	95,63	97,57	96,91	96,70	96,85	97,13	97,81	98,58	99,35	99,43
13	95,57	95,28	95,41	96,72	97,26	97,70	97,39	97,35	97,29	97,97	97,97	98,55
14	92,45	92,29	93,25	93,84	93,63	93,62	93,61	94,03	94,17	95,32	95,92	96,88
15	87,27	87,95	88,24	87,64	86,00	85,61	85,76	87,73	88,05	90,06	90,80	93,07
16	80,64	81,43	82,41	80,66	78,29	76,02	77,77	78,52	79,34	80,94	83,86	87,05
17	73,47	74,38	74,54	72,61	69,69	68,90	68,40	70,51	71,96	76,20	77,59	81,04
Gender												
Males	85,00	85,21	86,13	85,17	83,57	82,35	83,04	84,80	85,77	87,79	88,78	90,58
Women	87,90	88,54	88,54	88,96	87,84	87,69	87,52	87,81	88,15	89,65	91,02	93,05
Ethnic-racial ancestry												
No afro-descendents	87,95	88,41	88,79	88,50	86,98	86,29	86,63	88,03	88,49	89,95	90,91	92,71
Afro-descendents	77,50	78,33	79,55	78,99	78,71	78,44	78,89	78,07	78,72	81,77	84,07	86,98
Years of education of head of household												
Less than 9	77,74	79,32	80,62	80,14	78,35	77,09	77,06	77,95	79,17	81,58	83,12	85,87
Between 9 and 12	90,54	90,67	90,58	90,00	88,14	87,30	87,70	89,38	90,05	91,00	91,52	92,98
12 or more	97,79	97,84	97,97	97,80	97,25	97,09	97,35	97,66	97,73	98,28	98,76	98,92
Income quintiles												
1st	72,81	75,49	76,82	76,40	74,46	74,14	74,65	76,25	76,93	80,03	81,58	85,14
2nd	84,15	86,51	87,46	87,29	85,68	84,75	84,69	85,96	87,59	89,83	91,35	92,77
3rd	90,77	91,47	92,58	92,60	92,51	92,12	93,31	94,19	93,90	94,64	95,86	97,14
4th	96,30	96,63	96,89	96,99	96,52	96,03	96,45	96,91	97,56	97,65	98,32	98,56
5th	98,75	98,78	98,74	99,04	98,63	98,56	98,50	98,97	98,95	99,25	99,03	99,08
Preschool assistance												

Did not attend						64,24	65,09	66,54	70,62	72,88	78,24	75,11
Attended						85,43	85,66	86,62	87,12	88,84	89,96	91,90
Educational center type												
Public						80,04	80,37	81,72	82,61	84,78	86,24	88,81
Private						97,66	97,92	98,08	98,04	98,64	98,98	99,17
Media	86,46	86,88	87,33	87,03	85,64	84,97	85,25	86,29	86,94	88,71	89,90	91,81
Observations	15830	12655	12123	11642	11011	10652	10481	10253	9776	9341	8740	8238

Source: Own elaboration based on microdata from the ECH 2006-2019.

It can be observed that the average attendance decreases as age increases. While 12-year-old adolescents attend almost universally throughout the period analyzed, the attendance of 17-year-old adolescents ranges from 73.5% in 2006-2008 to 81% in 2017-2019. On the other hand, it is observed that females and adolescents of non-african origin have higher secondary education attendance rates throughout the entire period.

As expected, the higher the educational level of the head, the higher the attendance rate of adolescents. It is also observed that the gaps between adolescents in households with less educated heads and those in highly educated households appear to have narrowed during the study period. The percentage of adolescents attending secondary education according to income quintiles has a similar pattern to that observed for the education of the head of household: the higher the income quintile, the higher the percentage of adolescents attending.

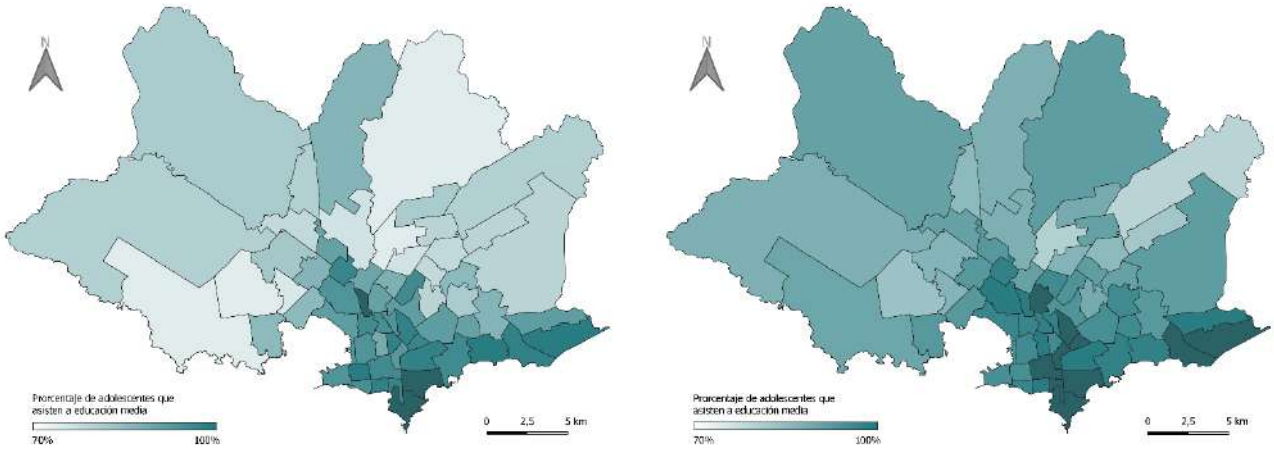
Regarding preschool education, almost all adolescents attended that educational level (97.8% in 2011-2013 and 99.5% in 2017-2019). Although attendance at preschool education is almost universal, it is observed that those who did not attend have considerably lower percentages of attendance at middle school than those who did. The attendance percentage ranges from 64% in 2011-13 to 75% in 2017-19 for those who did not attend preschool education, while for those who did the percentages are 85% and 92%, respectively.

On the other hand, the percentage of adolescents attending private schools was around 27%-29% throughout the period. However, important differences are found depending on the age of the adolescents: while 12-year-olds attend private education at an average of 38%-40%, for 17-year-olds this percentage drops to 20%-21%. Substantial differences between public and private education are found in the percentage of attendance: most adolescents who drop out of secondary education attend public schools.

Regarding the differences according to the area of residence, Figure 2 represents the percentage of adolescents' secondary education attendance distinguishing by neighborhood for 2006-2008 and 2017-2019.

Figure 2. Percentage of adolescents aged 12 to 17 years attending high school by neighborhoods

a) 2006-2008 b) 2017-2019



Source: Own elaboration based on microdata from ECH 2006-2008 and 2017-2019.

It can be observed that there are important differences in secondary school attendance depending on the neighborhood of residence. The neighborhoods in the southeast of Montevideo concentrate the highest levels of adolescent attendance, and as we move away to the north and west, attendance rates begin to drop.

However, the differences in the percentage of adolescents attending school seem to narrow at the extremes of the analysis period. Given that the neighborhoods with the highest levels of attendance were already at around 100% in 2006-2008, it is to be expected that an increase in the overall rate would lead to a reduction in the gaps between neighborhoods.

The neighborhoods with the highest percentages of secondary education attendance in 2006-08 were Atahualpa (100%), Punta Carretas (99.7%) and Pocitos (99.5%), while among those with the lowest percentages were Casabó-Pajas Blancas (74.2%), Casavalle (74.5%) and Manga-Toledo Chico (74.6%). In 2017-2019, the lowest attendance percentages were in Villa García-Manga Rural (79.5%), Casavalle (80.9%) and Punta de Rieles-Bella Italia (82.8%). At the other extreme, by the end of the period, all adolescents surveyed by the ECHs who resided in the Cordón, Tres Cruces, Brazo Oriental, La Blanqueada, Parque Rodó, Pocitos and Punta Gorda neighborhoods were attending secondary education.

7. Results

This section presents the main results of the estimations of the equal opportunity indexes and the Shapley decompositions between the different circumstances. In addition, the decompositions of the changes in the HOI indexes proposed by Barros et al. (2008) are performed, distinguishing how much of the variation in the index is attributable to a change in coverage and how much is due to a change in inequality.

Table A1 in the Appendix shows the results for the estimation of the logit model for the probability of adolescents attending high school, with the marginal coefficients and the significance levels of the variables. As mentioned above, this first set of estimates included controls for age, gender, ancestry, educational level of the head of household, income quintile and neighborhood of residence.

The coefficients of the variables have the expected sign and are in line with the results of previous studies. The higher the age, the lower the probability of attending high school. The results show that women are more likely to remain in the educational system: the coefficients are significant at 99% and positive for the estimates for all years. In the case of the ancestry variable, the coefficient associated with being of afro-descendant is always negative, but it is only significant in seven of the twelve years estimated.

The variables associated with the education of the head of household and household per capita income quintile also have the expected sign. Both variables are positively

associated with the probability of adolescent attendance and the coefficients are significant at 99% confidence for all estimated years.

Finally, neighborhood fixed effects are significant only for some neighborhoods and in some years. Among those with positive and significant effects are Parque Rodó, Punta Gorda, Carrasco, Atahualpa, La Blanqueada and Tres Cruces. On the other hand, Casavalle, La Paloma-Tomkinson, Tres Ombúes-Victoria, Paso de la Arena, Colón Centro and Noroeste are negatively associated with the probability of adolescents attending high school.

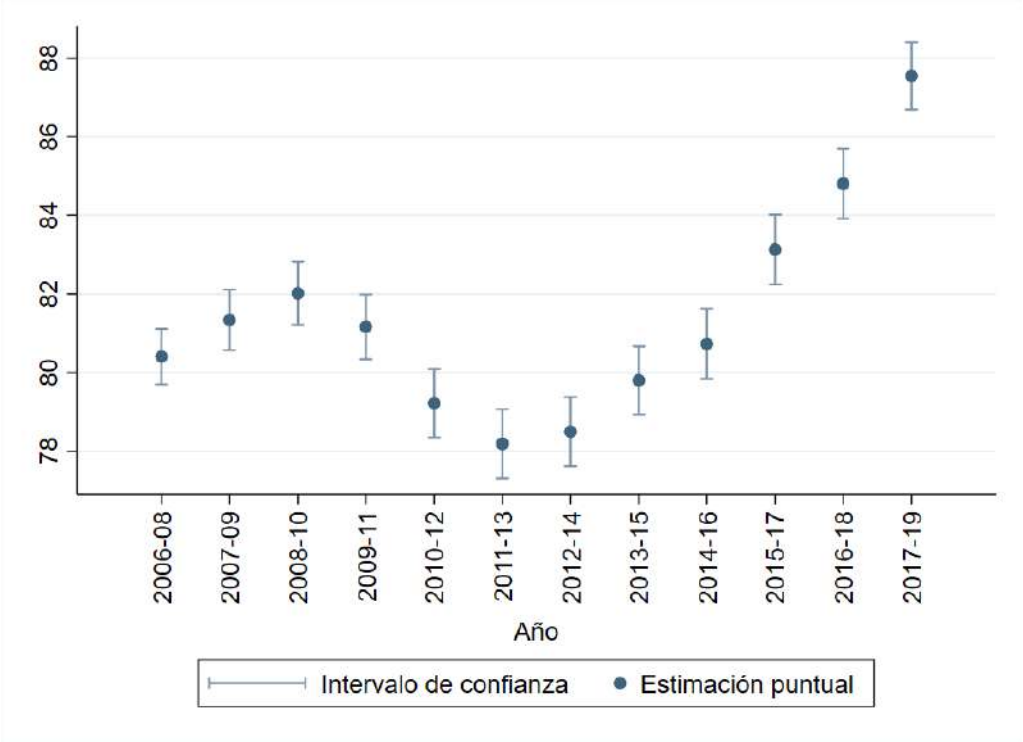
Table 2 shows the point estimates for the Dissimilarity, Coverage and HOI indexes for each three-year period analyzed. Figure 5 shows the evolution of the HOI Index, including the 95% confidence intervals.

Table 2. Dissimilarity, Coverage and HOI indexes for the period 2006-08 to 2017-19.

Years	Dissimilarity index	Coverage	HOI
2006-08	7,01	86,46	80,40
2007-09	6,39	86,88	81,34
2008-10	6,09	87,33	82,01
2009-11	6,74	87,03	81,16
2010-12	7,50	85,64	79,22
2011-13	7,98	84,97	78,19
2012-14	7,92	85,24	78,49
2013-15	7,52	86,28	79,80
2014-16	7,15	86,94	80,73
2015-17	6,29	88,71	83,13
2016-18	5,67	89,90	84,80
2017-19	4,65	91,81	87,55

Source: Own elaboration based on microdata from the ECH 2006-2019.

Figure 5. Evolution of the HOI Index for the period 2006-08 to 2017-19.



Source: Own elaboration based on microdata from the ECH 2006-2019.

The results found indicate that the HOI Index increases from 2006-2008 (where it takes the value of 80.40) to 2008-2010 (82.01), then falls until 2011-2013 (78.19), and then increases significantly until the end of the analysis period, reaching the value of 87.55 in 2017-19. The increase in equality of opportunity is driven by two forces: a significant increase -at 95% confidence- in coverage (of 5.35 points) and a slight drop -not significant at 95%, but significant at 90% confidence- in the Dissimilarity Index (of 2.36 points).

In order to distinguish how much of the variation in the index is explained by each component, we decompose the changes in the HOI index by considering three points in time: the first estimated year (2006-08), the period of lower index value (2011-13) and the last year (2017-19). The results are presented in Table 3. This table shows, first, the point estimates for the coverage, dissimilarity and HOI indices, for 2006-08, 2011-13 and 2017-19. Second, the decomposition of the changes in the HOI index comparing 2011-13 and 2017-19, with respect to the base year (2006-08), is presented.

Table 3. Decomposition between scale effect and distribution effect of the HOI index

	Years		
	2006-08	2011-13	2017-19
	(I)	(II)	(III)
Coverage (C)	86,46	84,97	91,81
Dissimilarity index (D)	7,01	7,98	4,65
Human Opportunity Index (HOI)	80,40	78,19	87,55
Decomposition	I - I	I - II	I - III
Change in HOI index	0	-2,22	7,14

Scale effect (%)	62,52	69,68
Distribution effect (%)	37,48	30,32

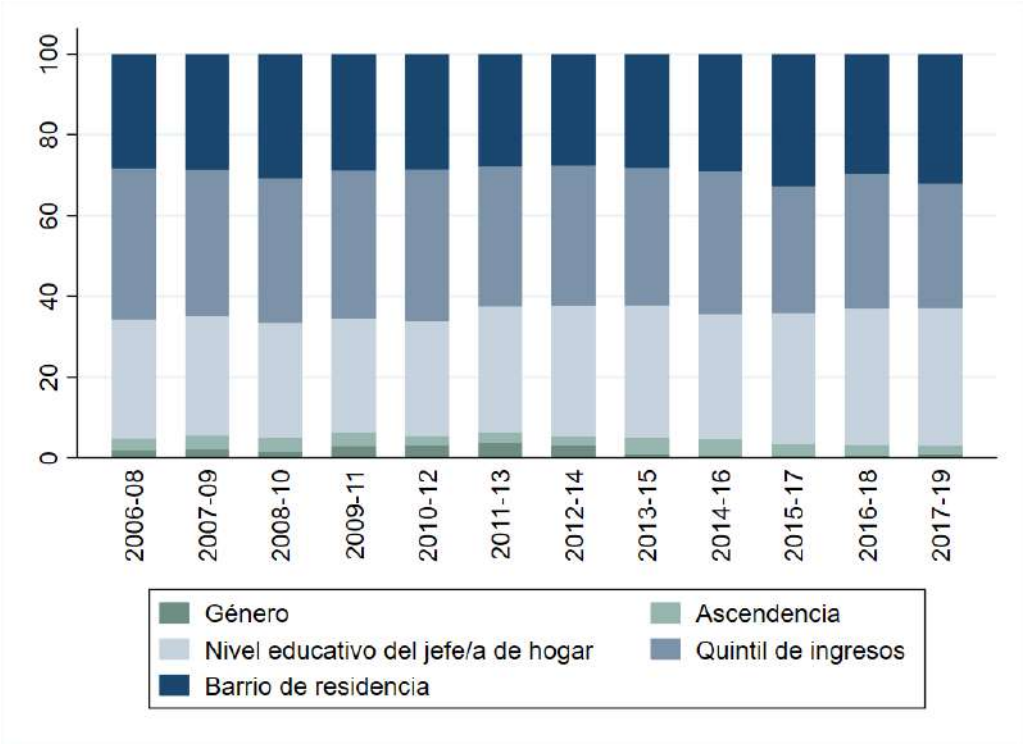
Source: Own elaboration based on microdata from ECH 2006-08, 2011-13 and 2017-2019.

Comparing 2006-08 with 2011-13, we observe a reduction in the HOI index (of -2.2 points), which is driven by a drop in coverage and an increase in inequality. The results of the decomposition between the components of the index show that the scale effect explains 62.52% of the reduction in the HOI between 2006-08 and 2011-13, while the increase in the dissimilarity index explains the 37.4%.

The third column of the decomposition presents the results for the change in the HOI index for 2017-19, with respect to 2006-08. Between these years, the index had an increase of 7.14 points, due to an increase in coverage and a fall in inequality. The decomposition estimates show that the scale effect explains 69.7% of the increase in the HOI index. On the other hand, the reported drop in the dissimilarity index also increases the value of the HOI index, but its effect on the variation is of smaller magnitude: it accounts for 30.3% of the change between 2006-08 and 2017-19.

Figure 6 presents the Shapley decomposition of the Dissimilarity Index for each group of years[13]. The Shapley decomposition between the sources of inequality is presented in a range from 0 to 100 and the percentage of the Dissimilarity Index that is explained by each of the circumstances is plotted.

Figure 6. Shapley Decomposition of the Dissimilarity Index



Source: Own elaboration based on microdata from the ECH 2006-2019.

[13] Table A2 in the appendix shows the values estimated by this decomposition.

The results suggest that the educational level of the head of household, the income quintile and the neighborhood of residence are the most important circumstances in explaining inequality in adolescents' secondary education attendance. The percentage explained by each circumstance remains fairly stable during the period, but some changes are observed: the income quintile loses weight (from 37.4% at the beginning of the period to 30.9% in the last three years), while the percentage explained by the educational level of the head of household and the neighborhood increases (from 29.4% to 34.1% and from 28.4% to 32.1%, respectively). In contrast, gender and ethnic-racial ancestry explain relatively little of the inequality in attendance (between 1% and 4% of the index, approximately).

In a second set of estimations, preschool attendance and type of school (public/private) are added to the controls. As in the previous estimations, Table A3 in the Annex shows the results for the estimation of the logit model. Broadly speaking, the significance and sign of the coefficients of the variables considered in the previous estimations are maintained. The coefficients associated with having attended preschool education are positive, but significant only for some of the estimated years. On the other hand, attendance to private education is positively and significantly associated -at 99%- in all years.

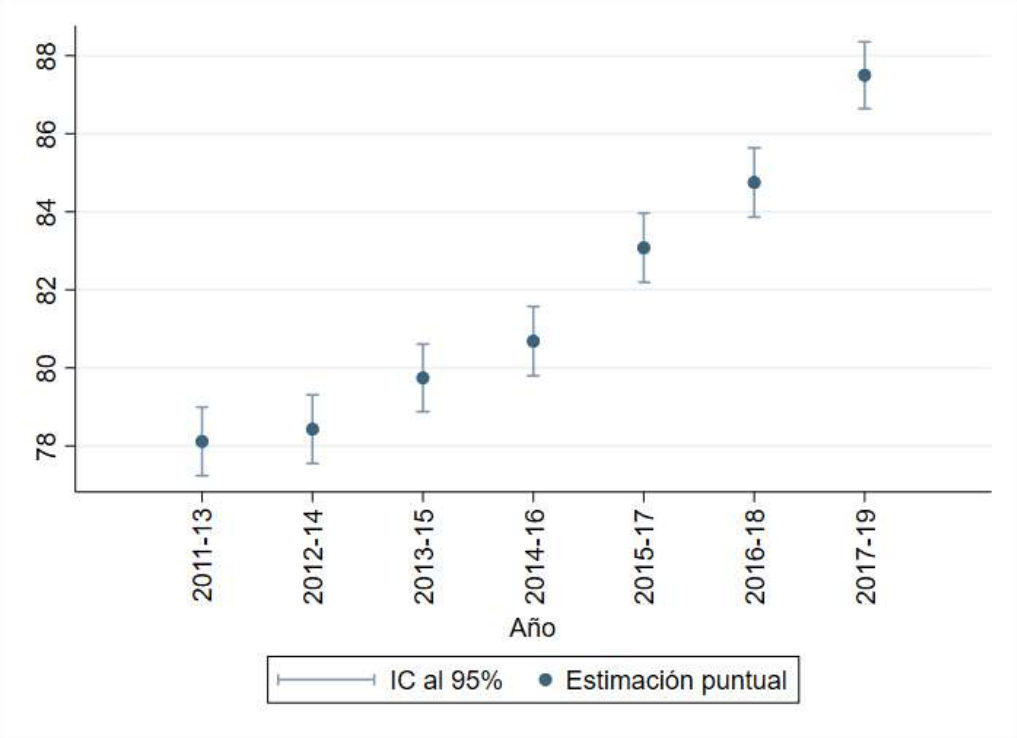
Table 4 shows the estimates for the Dissimilarity, Coverage and HOI indices, and Figure 5 shows the evolution of the HOI Index, including the 95% confidence intervals.

Table 4. Estimation of Dissimilarity, Coverage and HOI indexes

Years	Dissimilarity index	Coverage	HOI
2011-13	8,07	84,97	78,12
2012-14	7,99	85,24	78,43
2013-15	7,58	86,28	79,74
2014-16	7,20	86,94	80,68
2015-17	6,35	88,71	83,08
2016-18	5,72	89,90	84,75
2017-19	4,70	91,81	87,50

Source: Own elaboration based on microdata from ECH 2011-2019.

Figure 7. Evolution of the HOI Index



Source: Own elaboration based on microdata from ECH 2011-2019.

The results found are in line with those previously found. From 2011-2013 there is a significant increase in the HOI index, driven by a significant increase -at 99%- in coverage and a smaller reduction in inequality -significant only at 90%-. The levels in the Dissimilarity Index are higher than those of the first estimates, which is consistent with the way the index is calculated: as more circumstances are added the index is maintained (if the circumstance is irrelevant), or increases -it can never decrease-.

Table 5 presents the decomposition between scale and distribution effects for the HOI index between the years 2011-2013 and 2017-19, this time including the preschool attendance and private educational center variables.

Table 5. Decomposition between scale effect and distribution effect of the HOI index

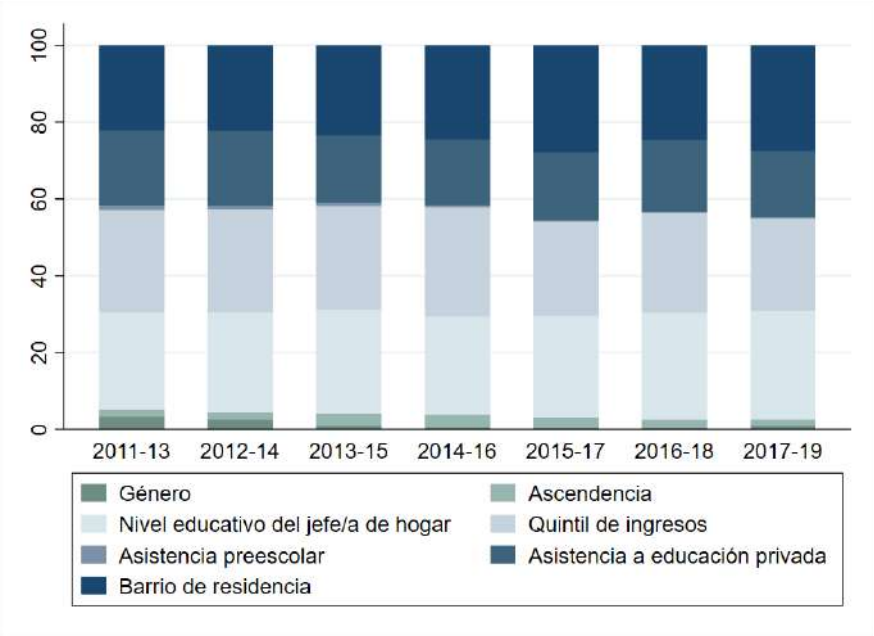
	Years	
	2011-13	2017-19
Coverage (C)	84,97	91,81
Dissimilarity index (D)	8,07	4,70
Human Opportunity Index (HOI)	78,12	87,50
Decomposition		
Change (in percentage points)	0	9,38
Scale effect (%)		67,05
Distribution effect (%)		32,95

Source: Own elaboration based on microdata from ECH 2011-2019.

The results of the decomposition are very similar to those found in the first set of estimates. Between 2011-13 and 2017-19 the HOI index increases by 9.38 points, and this is explained by 67.05% change in scale -in an increase in the percentage of adolescents attending secondary education- and 32.95% can be attributed to changes in inequality -a reduction in inequality in the probability of attendance between groups-.

Finally, Figure 8 presents again the Shapley Decomposition of the Dissimilarity Index, including preschool attendance and attending the private education system[14] .

Figure 8. Shapley Decomposition of the Dissimilarity Index



Source: Own elaboration based on microdata from ECH 2011-2019.

As in the previous estimates, the educational level of the head of household, the income quintile, and the neighborhood of residence are relevant variables to explain inequality, and this set of variables is added to private education attendance. Private education attendance explains between 17%-19% of inequality, while the educational level of the head of household explains 25%-28%, the income quintile between 24%-28% and the neighborhood of residence 22%-27%.

Likewise, and as in the previous estimates, gender and ethnic-racial ancestry explain very little of the inequality in the probability of attendance. Similarly, the percentage explained by having attended preschool education is very close to zero.

In summary, the results found show that equality of opportunity - measured through the HOI Index - in attending secondary education for adolescents in Montevideo increased significantly during the period of analysis. This increase was driven by the two components of the index: an increase in the level of coverage, which explains about 67% of the variation, and a reduction in inequality between groups, measured through the Dissimilarity Index -explaining almost 33% of the variation in the index-.

[14] Table A4 in the appendix shows the values estimated by this decomposition.

In both estimates we find evidence that the neighborhood of residence explains a substantial part of the Dissimilarity Index, once we control for the educational level of the household, income quintile and type of school. The neighborhood of residence explains about a quarter of the inequality in the probability of attending secondary education for adolescents in Montevideo. These results show that the neighborhood of residence is a relevant component in explaining inequalities in attendance.

8. Robustness checks

To test the validity of the results, the estimations were repeated with some changes in the independent variables of the model. In particular, the definitions of the household income variables and the area of residence were modified.

One of the possible questions to the estimates presented arises from the sensitivity of the index to the definition of the variables and the arbitrariness that may exist in the number of groups to be considered. It could be argued that by considering more categories within the same circumstance, the variability between groups increases, and this leads to a greater part of the inequality being explained by this variability.

To check the robustness of the results, estimates were made by changing the territorial disaggregation criterion and income categories. In particular, the neighborhood was replaced by the Zonal Community Centers[15] (CCZ) of residence, which have a different territorial division criterion and are territorially bigger. On the other hand, household per capita income was divided into deciles -instead of quintiles-. Finally, the estimates were repeated combining both changes -estimates with CCZ and deciles, instead of neighborhoods and income quintiles-.

The results for the estimation of coverage, the dissimilarity index, the HOI index, and the Shapley decomposition between circumstances, for each set of estimates, are presented in the appendix. Tables A7 and A8 contain the results for the estimates substituting neighborhoods for CCZs, A9 and A10 have the estimates with income deciles, and A11 and A12 present the results using CCZs and income deciles.

Using the CCZs, we find that the coverage, dissimilarity and HOI indices follow the same trend as for the estimates with neighborhoods. The HOI index (Table A3) starts from a value of 80.5 in 2006-08, reaches its minimum point in 2011-13 (78.26) and increases until the end of the period reaching the value of 87.6. Regarding the decomposition by circumstances (Table A8, which includes preschool attendance and type of center), CCZs explain a smaller percentage of the dissimilarity index (between 18%-21%) than what was found for the estimates with neighborhoods (between 22%-27%). This result may be due to the fact that, being larger in size, CCZs are expected to have greater heterogeneity within them -by grouping areas, often of varied socioeconomic characteristics, the

[15] The Zonal Communal Centers (CCZ) constitute another territorial disaggregation of Montevideo that is available in the microdata of the ECH, and which has a different division criterion than that of the neighborhoods. The departmental government of Montevideo is subdivided into five Municipal Governments, and these, in turn, are divided into Zonal Communal Centers (in total there are 18 CCZs in Montevideo). The CCZs are decentralized agencies in charge of administrative management, procedures and services. Annex A6 shows a map with the CCZs in Montevideo.

variability between them decreases- compared to neighborhoods, which have a smaller surface area. In this sense, it is to be expected that the use of CCZs will reduce the weight of place of residence as a circumstance that explains inequality.

Estimates with income deciles -rather than quintiles- can be found in tables A9 and A10 in the appendix. The decomposition of the dissimilarity index has a very similar distribution to the main estimates. Income deciles account for about 24%-30% (Table A10), while the quintiles in the ones accounted for about 24%-28% (Table A4). The percentage of inequality explained by neighborhood is virtually unchanged: between 22%-27% with quintiles and 21%-27% with deciles.

9. Discussion

The purpose of this section is to analyze the results presented in the previous section and discuss their possible explanations and implications.

a. Evolution of equality of opportunity

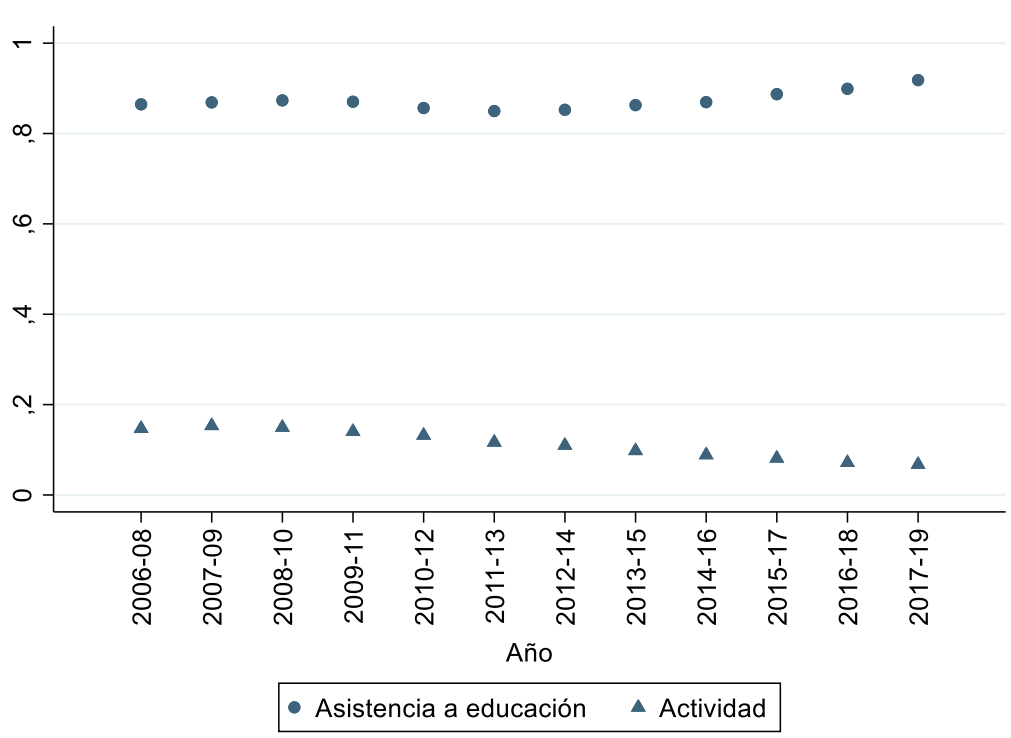
The results of the estimations presented in the last section show that equality of opportunities for adolescents to attend high school increased during the study period. Particularly, it is observed that equality of opportunity fluctuate between 2006-08 and 2011-13 -where it reached its minimum point- and then increased significantly until the end of the period.

Decompositions of the changes in the index show that these movements were driven by two forces: an increase in coverage and a fall in inequality, with the former explaining most of the magnitude of the change (approximately 67%).

In this context, it is worth asking what may be behind the increased probability of adolescents attending secondary education. Bucheli and Casacuberta (2000) analyzed the relationship between school attendance and labor participation of adolescents aged 14 to 17 in Uruguay. The authors conclude that decisions to invest in education and labor market participation are determined by individual characteristics and family context variables that have significant and opposite effects on each other (Buchelli and Casacuberta, 2000).

Figure 9 shows the estimated attendance and activity rates for adolescents between 14 and 17 years of age in Montevideo for the period 2006-2019.

Figure 9. Attendance and activity rates for adolescents aged 14 to 17 years in Montevideo. Period 2006-2019.



Source: Own elaboration based on microdata from the 2006-2019 ECH.

The series of both variables seem to be mirrored, as is observed for the 1986-1997 period (Buchelli and Casacuberta, 2000). It could be expected that part of this increase is influenced by movements in the labor market: with a lower demand for young labor, the opportunity cost of remaining in the educational system may fall, leading to an increase in attendance rates.

On the other hand, ANEP has sought to expand the educational offer, mainly in the periphery of the city, with the objective of universalizing access and permanence of students in secondary education (INEEd, 2022). In this sense, it would be opportune to have more detailed information on the process of expanding the supply and to be able to analyze the effects that this may have had on the attendance of adolescents residing in the most vulnerable areas.

Another point of discussion arises from observing that the outcome variable is capped: when universal attendance is achieved, inequality between groups mechanically disappears. Given this, it is to be expected that with progress in schooling levels, the index of equality of educational opportunities will increase.

However, in a situation in which universality has not yet been achieved, it is relevant to analyze the inequalities between groups and how much each of the different circumstances contributes to this inequality. This can be substantial for the development of specific public policies to increase the attendance and completeness of adolescents in compulsory education.

b. The importance of the neighborhood of residence

The estimates show that the neighborhood of residence explains a substantial part of the inequality in adolescents' secondary education attendance, after controlling for gender, ethnic-racial ancestry, income, educational level of the head of household, preschool attendance and type of educational center. In particular, the neighborhood seems to explain about a quarter of the inequalities in the probability of attendance, and its importance is maintained throughout the period of analysis. This section aims to discuss the implications of this result, how it can be interpreted, and the channels through which the neighborhood could affect the probability of adolescents attending secondary education.

At this point, it is important to note that the neighborhood captures various effects, which this study fails to differentiate: the supply of the area -availability and distance to educational centers, peer effects, role models, differential quality of educational centers -class sizes, number of teachers-, building infrastructure beyond the centers -sanitation, availability of community centers with libraries, activities in sports squares-, among others.

A channel that has not yet been explored in the literature for the case of Montevideo is the differential educational offer between the various neighborhoods, particularly the availability of centers in the periphery. Although the geo-referencing of secondary education centers shows that they are concentrated in the most central area of the city - which is to be expected from the point of view of population density - it is not known what the relationship is between student demand and supply of centers, and even less about how this has evolved. If the centers in the periphery are insufficient for the demand of students in the area, it may be that these students have higher travel costs -in time and/or money- to the educational centers than those who live in more urbanized areas and that this is affecting their probability of remaining in the system.

On the other hand, residential segregation and educational segregation are linked due to how students are selected in educational centers. According to an INEEd analysis, socioeconomic and territorially targeted policies have served to increase access but have led to this linkage becoming more entrenched (INEEd, 2022). Homogeneity within neighborhoods and within schools leads to peers coinciding in both areas of socialization, reducing the possibilities for adolescents to interact with others of different socioeconomic status. High schools in vulnerable neighborhoods, with educational centers attended by adolescents from lower socioeconomic levels, may be negatively affected by being surrounded by peers who are also in a context of vulnerability. At the other extreme, the homogeneity of high schools in more favorable areas can positively enhance educational outcomes. Thus, segregation can lead to an increase in inequality in educational achievements.

Another point to discuss arises from the consequences of the mechanism for the selection of teaching hours on differences in the quality of educational centers. As mentioned above, some studies show that the criteria for the selection of teaching hours lead to a concentration of teachers with more experience in secondary schools with a more favorable socioeconomic context (INEEd, 2021b). In this sense, it is worth asking about the effects that this unequal distribution among schools may have on the probability of adolescent attendance.

The two previous points -the link between residential segregation and educational segregation and the mechanism of teacher choice- can feed on each other. If more experienced teachers avoid choosing high schools in more vulnerable contexts, parents with more educational aspirations for their children will have incentives to choose other high schools, in more favorable contexts and with more experienced teachers. This leads to an increase in educational segregation that, once again, polarizes high schools with favorable contexts on the one hand and vulnerable ones on the other.

Finally, other resources, infrastructure and interactions that arise in the neighborhood may be affecting the educational attendance of young people, beyond those that occur specifically in the educational center. The presence of infrastructure that provides a good place to study -such as community centers or libraries-, sanitation and street lighting, the availability of extracurricular activities in sports centers, among others, may also be influencing the likelihood of attendance. The interaction that arise in extracurricular activities, community centers or sports centers nurture peer effects, information networks between young people and adults and favor the presence of role models outside the family environment, which can also influence educational decisions.

10. Conclusions

The educational dropout of adolescents throughout secondary education is a relevant problem and is currently on the agenda of public discussion in Uruguay. Although children's access to primary education has been practically universal since the middle of the last century, it is estimated that in 2019 only 42.7% of young people between 21 and 23 years-old have completed secondary education (INEEd, 2020).

In this context, it is important to rethink whether the increase in adolescent secondary education attendance observed in recent years has been accompanied by a reduction in inequalities among young people. In this sense, the theoretical framework of equal opportunities provides an approach from which to try to elucidate what part of the differences in results is determined by the circumstances of individuals, that is, by characteristics for which they are not responsible.

The vast literature on residential segregation and neighborhood effects on the educational performance of children and young people justifies considering the neighborhood as a relevant variable that can determine the opportunities of individuals. This argument is also supported by the long-term growing trend of residential segregation in Montevideo.

The results found by this study allow us to conclude that equality of opportunity in secondary education attendance among adolescents in Montevideo increased significantly during the period of analysis. This increase was driven by the two components of the index: an increase in the level of coverage and a reduction in inequality, with coverage explaining this movement to a greater extent.

Conclusive evidence is found that the neighborhood of residence explains a substantial part of the inequality -about a quarter of the dissimilarity index-, once the educational level of the household, the income quintile and the type of educational center are

controlled for. These results show that place of residence is a relevant component in explaining inequalities in adolescents' secondary education attendance.

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Annex

Tabla A1: Logit estimation of the probability of attending secondary education among adolescents aged 12-17 in Montevideo.

Variables	(1) 2006-2008	(2) 2007-2009	(3) 2008-2010	(4) 2009-2011	(5) 2010-2012	(6) 2011-2013	(7) 2012-2014	(8) 2013-2015	(9) 2014-2016	(10) 2015-2017	(11) 2016-2018	(12) 2017-2019
Age (in years)												
13	-0,001	-0,003	0,009	-0,011	0,031	0,056**	0,036	0,022	-0,007	-0,02	-0,078**	-0,053*
14	-0,049***	-0,048***	-0,026	-0,072***	-0,055***	-0,049**	-0,053**	-0,052***	-0,075***	-0,086***	-0,127***	-0,100***
15	-0,108***	-0,099***	-0,086***	-0,148***	-0,144***	-0,145***	-0,148***	-0,134***	-0,150***	-0,151***	-0,194***	-0,153***
16	-0,169***	-0,157***	-0,139***	-0,203***	-0,207***	-0,218***	-0,210***	-0,204***	-0,219***	-0,225***	-0,250***	-0,201***
17	-0,220***	-0,208***	-0,192***	-0,256***	-0,260***	-0,264***	-0,265***	-0,254***	-0,261***	-0,253***	-0,280***	-0,230***
Female	0,033***	0,036***	0,028***	0,038***	0,038***	0,050***	0,042***	0,032***	0,024***	0,020***	0,020***	0,022***
Afro-descendent	-0,014**	-0,018***	-0,021***	-0,024***	-0,012	-0,006	-0,008	-0,031***	-0,032***	-0,022***	-0,012	-0,009
Years of education of head of household												
Between 9 and 12	0,062***	0,056***	0,046***	0,043***	0,040***	0,049***	0,050***	0,052***	0,051***	0,044***	0,040***	0,032***
12 or more	0,121***	0,122***	0,114***	0,104***	0,101***	0,121***	0,128***	0,124***	0,112***	0,111***	0,119***	0,100***
Income quintile												
2do	0,056***	0,055***	0,051***	0,055***	0,058***	0,059***	0,053***	0,049***	0,051***	0,046***	0,048***	0,037***
3er	0,098***	0,085***	0,087***	0,092***	0,109***	0,110***	0,118***	0,110***	0,100***	0,079***	0,083***	0,073***
4to	0,145***	0,130***	0,128***	0,145***	0,153***	0,141***	0,138***	0,126***	0,142***	0,109***	0,115***	0,083***
5to	0,197***	0,183***	0,171***	0,207***	0,200***	0,187***	0,161***	0,163***	0,159***	0,141***	0,106***	0,067**
Neighborhood fixed effects	Sí	Sí	Sí	Sí	Sí	Sí	Sí	Sí	Sí	Sí	Sí	Sí
Observations	15.829	12.654	12.122	11.640	11.010	10.651	10.480	10.252	9.774	9.340	8.737	8.236

*** p<0.01, ** p<0.05, * p<0.1

Source: Own elaboration based on microdata from ECH 2006-2019.

Table A2: Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indexes

	2006-08	2007-09	2008-10	2009-11	2010-12	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	86,46	86,88	87,33	87,03	85,64	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	7,01	6,39	6,09	6,74	7,50	7,98	7,92	7,52	7,15	6,29	5,67	4,65
Human Opportunity Index (HOI)	80,40	81,34	82,01	81,16	79,22	78,19	78,49	79,80	80,73	83,13	84,80	87,55
Shapley Decomposition (%)												
Gender	1,84	2,23	1,47	2,91	3,03	3,90	3,03	1,03	0,72	0,58	0,66	0,97
Ethnic-ratial ancestry	2,93	3,34	3,67	3,22	2,47	2,30	2,41	4,06	3,97	3,05	2,52	1,99
Education of head of household	29,43	29,59	28,38	28,27	28,35	31,36	32,34	32,75	30,86	32,21	33,76	34,09
Income quintile	37,40	36,10	35,76	36,74	37,48	34,65	34,63	34,00	35,41	31,33	33,49	30,89
Neighborhood	28,40	28,74	30,73	28,86	28,68	27,79	27,59	28,17	29,04	32,82	29,57	32,06

Source: Own elaboration based on microdata from ECH 2006-2019

Table A3: Logit estimation of the probability of attending secondary education among adolescents aged 12-17 in Montevideo.

Variables	(1) 2011-2013	(2) 2012-2014	(3) 2013-2015	(4) 2014-2016	(5) 2015-2017	(6) 2016-2018	(7) 2017-2019
Age (in years)							
13	0,058**	0,039	0,024	-0,004	-0,018	-0,076**	-0,051
14	-0,046**	-0,050**	-0,049**	-0,072***	-0,083***	-0,124***	-0,097***
15	-0,140***	-0,143***	-0,130***	-0,146***	-0,147***	-0,190***	-0,149***
16	-0,211***	-0,203***	-0,198***	-0,213***	-0,218***	-0,243***	-0,196***
17	-0,256***	-0,256***	-0,247***	-0,255***	-0,247***	-0,274***	-0,224***
Female	0,048***	0,041***	0,032***	0,024***	0,020***	0,020***	0,022***
Afro-descendent	-0,005	-0,006	-0,029***	-0,030***	-0,021***	-0,011	-0,007
Years of education of head of household							
Between 9 and 12	0,048***	0,047***	0,050***	0,049***	0,043***	0,039***	0,031***
12 or more	0,111***	0,118***	0,115***	0,104***	0,101***	0,109***	0,092***
Income quintile							
2do	0,054***	0,048***	0,044***	0,047***	0,042***	0,044***	0,034***
3er	0,097***	0,104***	0,101***	0,090***	0,070***	0,072***	0,063***
4to	0,111***	0,109***	0,105***	0,124***	0,090***	0,093***	0,064***
5to	0,145***	0,113***	0,123***	0,125***	0,106***	0,067**	0,029
Pre-school assistance	0,053***	0,050***	0,055***	0,048*	0,03	0,017	0,053**
Private education centre	0,081***	0,086***	0,071***	0,064***	0,072***	0,079***	0,069***
Neighborhood fixed effects	Sí	Sí	Sí	Sí	Sí	Sí	Sí
Observations	10.651	10.48	10.252	9.774	9.34	8.737	8.236

*** p<0.01, ** p<0.05, * p<0.1

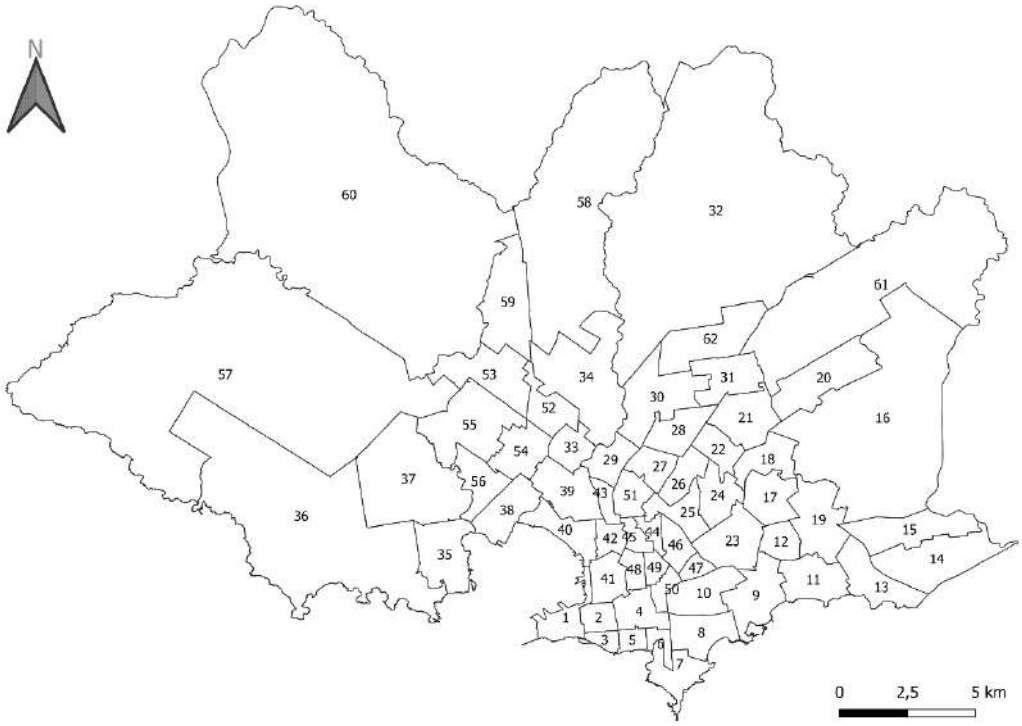
Source: Own elaboration based on microdata from ECH 2011-2019

Table A4: Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indices with pre-school attendance, private education attendance.

	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	8,07	7,99	7,58	7,20	6,35	5,72	4,70
Human Opportunity Index (HOI)	78,12	78,43	79,74	80,68	83,08	84,75	87,50
Shapley Decomposition (%)							
Gender	3,42	2,54	0,93	0,61	0,54	0,55	1,01
Ethnic-ratial ancestry	1,84	1,91	3,31	3,29	2,51	1,98	1,55
Education of head of household	25,20	26,08	27,03	25,61	26,63	27,90	28,25
Income quintile	26,67	26,83	26,99	28,43	24,58	26,21	24,17
Pre-school assistance	1,18	0,91	0,82	0,41	0,20	0,06	0,35
Private education centre	19,42	19,40	17,46	17,05	17,65	18,53	17,17
Neighborhood	22,27	22,32	23,47	24,59	27,89	24,76	27,51

Source: Own elaboration based on microdata from ECH 2011-2019

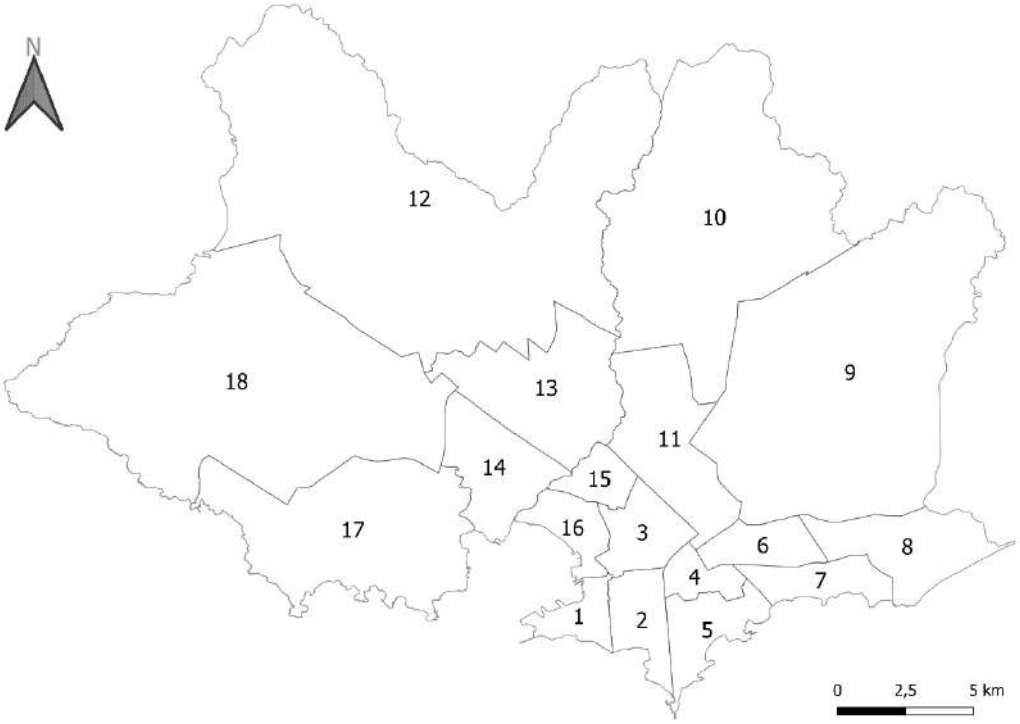
Figura A5: Neighborhoods of Montevideo



1	Ciudad Vieja	22	Ituzaingó	43	Atahualpa
2	Centro	23	Unión	44	Jacinto Vera
3	Barrio Sur	24	Villa Española	45	La Figurita
4	Cordón	25	Mercado Modelo, Bolívar	46	Larrañaga
5	Palermo	26	Castro, P. Castellanos	47	La Blanqueada
6	Parque Rodó	27	Cerrito	48	Villa Muñoz, Retiro
7	Punta Carretas	28	Las Acacias	49	La Comercial
8	Pocitos	29	Aires Puros	50	Tres Cruces
9	Buceo	30	Casavalle	51	Brazo Oriental
10	Parque Batlle, Villa Dolores	31	Piedras Blancas	52	Sayago
11	Malvín	32	Manga, Toledo Chico	53	Conciliación
12	Malvín Norte	33	Paso de las Duranas	54	Belvedere
13	Punta Gorda	34	Peñarol, Lavalleja	55	Nuevo París
14	Carrasco	35	Cerro	56	Tres Ombúes, Victoria
15	Carrasco Norte	36	Casabó, Pajas Blancas	57	Paso de la Arena
16	Bañados de Carrasco	37	La Paloma, Tomkinson	58	Colón Sureste, Abayubá
17	Maroñas, Parque Guaraní	38	La Teja	59	Colón Centro y Noroeste
18	Flor de Maroñas	39	Prado, Nueva Savona	60	Lezica, Melilla
19	Las Canteras	40	Capurro, Bella Vista	61	Villa García, Manga Rural
20	Punta Rieles, Bella Italia	41	Aguada	62	Manga
21	Jardines del Hipódromo	42	Reducto		

Source: INE

Figure A6: Zonal Community Centres (CCZ) of Montevideo



Source: INE

Table A7: Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indexes with CCZ

	2006-08	2007-09	2008-10	2009-11	2010-12	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	86,46	86,88	87,33	87,03	85,64	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	6,91	6,32	5,99	6,66	7,43	7,90	7,84	7,44	7,02	6,16	5,55	4,54
Human Opportunity Index (HOI)	80,49	81,40	82,10	81,23	79,27	78,26	78,56	79,86	80,83	83,25	84,90	87,64
Shapley Decomposition (%)												
Gender	1,71	2,22	1,46	2,86	3,16	3,86	3,10	1,19	0,62	0,50	0,53	0,97
Ethnic-ratial ancestry	3,17	3,62	3,92	3,49	2,63	2,42	2,50	4,25	4,33	3,33	2,76	2,16
Education of head of household	31,59	31,73	30,15	30,46	29,81	33,38	33,89	35,11	33,90	35,75	37,05	37,14
Income quintile	40,46	39,08	38,42	40,23	40,08	37,61	36,99	36,48	38,83	34,71	36,76	34,11
CCZ	23,07	23,36	26,05	22,96	24,33	22,73	23,52	22,97	22,33	25,70	22,90	25,62

Source: Own elaboration based on microdata from ECH 2006-2019

Table A8: : Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indices with pre-school attendance, private education attendance and CCZ

	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	7,99	7,92	7,50	7,07	6,21	5,61	4,60
Human Opportunity Index (HOI)	78,18	78,49	79,81	80,79	83,20	84,85	87,59
Shapley Decomposition (%)							
Gender	3,36	2,64	1,09	0,52	0,44	0,51	1,05
Ethnic-ratial ancestry	1,91	1,97	3,42	3,58	2,71	2,17	1,68
Education of head of household	26,62	27,22	28,92	28,05	29,45	30,48	30,60
Income quintile	28,57	28,50	28,97	31,24	27,15	28,57	26,63
Pre-school assistance	1,16	0,94	0,86	0,39	0,24	0,06	0,31
Private education centre	20,66	20,25	18,25	18,23	19,14	19,96	18,68
CCZ	17,72	18,49	18,48	17,98	20,87	18,25	21,05

Source: Own elaboration based on microdata from ECH 2011-2019

Table A9: Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indexes with income deciles

	2006-08	2007-09	2008-10	2009-11	2010-12	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	86,46	86,88	87,33	87,03	85,64	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	7,04	6,44	6,16	6,79	7,55	8,02	7,95	7,55	7,18	6,32	5,68	4,66
Human Opportunity Index (HOI)	80,38	81,29	81,95	81,12	79,17	78,16	78,47	79,77	80,70	83,10	84,79	87,53
Shapley Decomposition (%)												
Gender	1,79	2,26	1,38	3,07	3,16	4,25	3,07	1,09	0,68	0,49	0,60	1,02
Ethnic-ratial ancestry	2,87	3,23	3,38	3,17	2,45	2,26	2,34	3,82	3,78	3,00	2,49	1,95
Education of head of household	28,37	28,29	26,91	27,51	27,25	30,33	31,56	32,23	30,48	31,47	33,34	33,67
Income decile	39,24	38,40	39,05	38,19	39,52	36,18	36,09	35,06	36,69	32,93	34,56	31,67
Neighborhood	27,73	27,82	29,28	28,06	27,62	26,99	26,94	27,79	28,36	32,11	29,01	31,69

Source: Own elaboration based on microdata from ECH 2006-2019

Table A10: : Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indices with pre-school attendance, private education attendance and income deciles

	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	8,09	8,02	7,61	7,23	6,37	5,74	4,71
Human Opportunity Index (HOI)	78,09	78,40	79,72	80,66	83,05	84,74	87,49
Shapley Decomposition (%)							
Gender	3,62	2,61	1,00	0,63	0,51	0,63	1,15
Ethnic-ratial ancestry	1,82	1,85	3,12	3,11	2,44	1,96	1,53
Education of head of household	24,43	25,48	26,66	25,38	26,09	27,66	27,98
Income decile	28,17	28,26	28,09	29,70	26,08	27,13	24,85
Pre-school assistance	1,12	0,83	0,76	0,36	0,17	0,06	0,34
Private education centre	19,11	19,12	17,22	16,73	17,29	18,19	16,89
Neighborhood	21,74	21,85	23,16	24,09	27,41	24,39	27,26

Source: Own elaboration based on microdata from ECH 2011-2019

Table A11: Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indexes with income deciles and CCZ

	2006-08	2007-09	2008-10	2009-11	2010-12	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	86,46	86,88	87,33	87,03	85,64	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	6,96	6,38	6,08	6,71	7,50	7,95	7,88	7,47	7,06	6,18	5,57	4,56
Human Opportunity Index (HOI)	80,45	81,34	82,02	81,19	79,22	78,22	78,53	79,84	80,80	83,22	84,89	87,62
Shapley Decomposition (%)												
Gender	1,87	2,36	1,36	3,13	3,38	4,33	3,15	1,25	0,78	0,54	0,63	1,21
Ethnic-ratial ancestry	3,08	3,44	3,61	3,38	2,59	2,36	2,41	4,01	4,07	3,27	2,72	2,11
Education of head of household	30,36	30,24	28,43	29,45	28,39	32,17	33,08	34,55	33,36	35,01	36,56	36,67
Income decile	42,23	41,36	41,80	41,72	42,16	39,12	38,45	37,55	40,08	36,25	37,78	34,79
CCZ	22,47	22,60	24,79	22,32	23,49	22,03	22,91	22,65	21,71	24,92	22,31	25,22

Source: Own elaboration based on microdata from ECH 2006-2019

Table A12: : Estimation of Dissimilarity, Coverage, HOI and Shapley decomposition indices with pre-school attendance, private education attendance, income deciles and CCZ

	2011-13	2012-14	2013-15	2014-16	2015-17	2016-18	2017-19
Coverage (C)	84,97	85,24	86,28	86,94	88,71	89,90	91,81
Dissimilarity Index (D)	8,02	7,95	7,53	7,10	6,24	5,63	4,61
Human Opportunity Index (HOI)	78,15	78,47	79,79	80,76	83,17	84,84	87,58
Shapley Decomposition (%)							
Gender	3,64	2,67	1,14	0,72	0,53	0,58	1,29
Ethnic-ratial ancestry	1,88	1,90	3,24	3,36	2,65	2,13	1,66
Education of head of household	25,75	26,61	28,50	27,66	28,96	30,18	30,32
Income decile	30,13	29,96	30,09	32,53	28,59	29,53	27,32
Pre-school assistance	1,09	0,84	0,79	0,34	0,21	0,06	0,29
Private education centre	20,22	19,96	18,01	17,84	18,73	19,60	18,30
CCZ	17,29	18,05	18,22	17,55	20,32	17,92	20,82

Source: Own elaboration based on microdata from ECH 2011-2019