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**Are there ethnic inequality traps in  
education?**

Empirical evidence for Brazil and Chile\*

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## **Abstract**

This study searches for suggestive evidence of an ethnic inequality trap in educational attainment in Brazil and Chile. The research aims to cover an existing gap in the literature on inequality traps and proposes an empirical approach to assess certain conditions which might imply its existence. The main results indicate that while average education and upward mobility have risen in both countries, ethnic disparities remain significant. In particular, the evidence is suggestive of an educational inequality trap for Afro-Brazilians, while the findings are less conclusive of a trap for indigenous individuals in Chile. These results reflect the need for targeted education policies for ethnic groups in two ways: compensation (or affirmative action) mechanisms to lower current inequality, and increasing demand and supply at higher educational levels to prevent the persistence of low level outcomes and disparities throughout the educational distribution.

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*Key words:* inequality trap, education, ethnicity, opportunities, mobility, Brazil, Chile

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# 1 Introduction

Latin America is considered one of the most unequal regions in the world in terms of its income distribution (Gasparini *et al.*, 2011). However, the region is not only characterized by high income inequality but also by large disparities in access to education, land, basic services, and other dimensions of well-being. Moreover, the literature has suggested that this unequal situation may be traced back for decades and possibly even centuries (Edwards, 2009), despite burgeoning periods of economic growth and significant changes in the demographic, economic, social and political environment. This context is worrisome since persistent inequality has been documented as an underlying source of adverse effects on growth and development prospectives (Aghion *et al.*, 1999; Bourguignon and Dessus, 2009; Galor, 2011).

Recent research has suggested that at least some of this persistent inequality may be due to the existence of inequality traps (Rao, 2006; Bourguignon *et al.*, 2007a). An inequality trap is a circular process in which initial unequal opportunities (using Roemer's definition, 1998) lead to different outcomes between social groups, and also contribute to the persistence of those inequities through intergenerational transmission mechanisms (Bourguignon and Dessus, 2009). This situation reflects the persistent lack of opportunities associated with the most familiar concept of poverty traps, but it is affected by the entire distribution of outcomes, reflecting the unequal (economic, political and socio-cultural) interactions among groups.<sup>1</sup> Inequality traps thus capture horizontal inequality concerns, which have been noted to have considerable relevance since they affect individual well-being directly and other objectives instrumentally (Stewart, 2009).

This research aims to search for evidence suggestive of inequality traps in educational attainment between ethnic groups, using Brazil and Chile as case studies.<sup>2</sup> The analysis will focus on traps in educational achievements for a number of reasons. First, Latin American countries exhibit substantial inequalities in educational outcomes (Gasparini *et al.*, 2011), and have the highest degree of educational persistence worldwide (Hertz *et al.*, 2007). Second, investment in education is considered one of the main pathways to development, mobility and

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<sup>1</sup> In an inequality trap even when the available opportunities for the disadvantaged group (i.e. the poor in a poverty trap) increase over time, the patterns of unequal relative advantage persist in the long run due to the non-egalitarian nature of the society, which makes inequality traps a more general concept than poverty traps.

<sup>2</sup> The analysis is aware that studying attainment may not capture the entirety of the educational dimension since it does not account for quality and other factors. However, the inequities in attainment and quality seem to be relatively similar in Latin America (Gasparini *et al.*, 2011).

poverty reduction, due to its strong correlation with future earnings (Breen and Jonsson, 2005; Peragine and Serlenga, 2008). Furthermore, education is a stock variable which is measured with lower degree of error (compared to income) and subject to less volatility, especially when observing adults who have already completed their educational process as will be the case here (Hertz *et al.*, 2007). Finally, education is a key area for policy interventions from governments and donors, since there is a broad range of potential demand and supply policy interventions in this area (Birdsall *et al.*, 1995; Behrman *et al.*, 2000).

The selection of ethnic groups as the primary partition reflects the stylized fact that ethnicity has been and remains to be a significant source of disparity in Latin American countries (Justino and Acharya, 2003; Busso *et al.*, 2005; Chong and Ñopo, 2007). In particular, two of the nations where ethnic inequalities continue to be relevant are the case studies used in this research: Brazil (between Afro-Brazilians and White-Brazilians) and Chile (between Indigenous and non-Indigenous). In general, ethnic groups in these countries are characterized by worse overall conditions in access to land, housing, health, poverty, political representation and, in particular, schooling (Gandelman *et al.*, 2007). For instance, illiteracy rates and the schooling gap are worse for the ethnic minority groups. Additionally, while enrollment is similar in primary school, the disparities in secondary and tertiary are striking. In fact, Busso *et al.* (2005) find evidence of increasing ethnic discrimination across the educational distribution throughout Latin America and, particularly, in the countries considered in this paper.

However, there remains no comprehensive methodological framework to empirically diagnose the presence of an inequality trap in a country or region at the individual level. Hence, following the suggestions in Bourguignon *et al.* (2007a), this study proposes an approach which evaluates certain conditions compatible with an educational inequality trap, mainly: (i) persistent inequality of opportunity in education between the selected groups; and (ii) that educational mobility patterns between both groups are different and not becoming similar over time (non-convergence). The measurement of these conditions will be based on heterogeneity indices proposed by Yalonzky (2009, 2010). These indices capture horizontal inequality of opportunities and allow comparing intergenerational mobility regimes between groups (represented by transition matrices) under an alternative specification. The empirical analysis will be performed on household survey microdata and conducted across birth-cohorts in order to capture historical trends and observe persistence.

This study constitutes a preliminary inquiry into the research agenda proposed by Bourguignon *et al.* (2007a) to diagnose inequality traps. The findings aim to generate an

academic discussion on the methods used for assessing inequality traps and serve as a backdrop to pursue further examination of its determinants. For policymakers, the evidence provides a starting point for designing equitable educational policy and serves as a way to identify disadvantaged groups for targeting purposes and promote short and long-term interventions which address both compensation for unequal initial conditions and policies to prevent the perpetuation of unequal low-level outcomes for trapped groups.

The main findings indicate that while average education and upward mobility have risen for the general population, ethnic disparities remain significant. On the one hand, there is statistical evidence of persistent disparities in educational opportunities between ethnic groups in both countries; i.e. ethnic differences in schooling show no signs of reduction. On the other hand, while upward mobility is higher in both countries (more individuals surpass their parent's level of education), the disadvantaged ethnic group seems to lag behind. This implies that higher mobility does not change the relative positions of the groups, and there is no evidence that they might be converging. However, the resulting empirical estimates lead to different final conclusions in both countries. For Brazil, the results suggest that the disadvantaged ethnic group (Afro-Brazilians) seems to be caught in an educational inequality trap. In turn, the results for Chile are less clear since ethnic differences remain stable, but average education and mobility increase.

The rest of this study is organized as follows. The next section develops the general framework of inequality traps and accommodates this notion to the case of educational attainment and ethnic groups. Section 3 describes the data and methodology, while Section 4 describes the institutional educational context in Brazil and Chile and some descriptive statistics. Section 5 presents the main empirical results. Finally, the last section concludes by providing a discussion of the findings and their relevance for designing equitable and efficient policies.

## **2 Inequality Traps**

### **2.1 Conceptual framework**

An inequality trap may be broadly defined as a situation in which a disadvantaged group persistently faces an opportunity set (defined by the group's outcome distribution) that is worse than the set of another (advantaged) group (Bourguignon *et al.*, 2007a).<sup>3</sup> It describes

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<sup>3</sup> The conceptualization of equality of opportunities used in this paper follows the initial contribution from Roemer (1998), which is in line to those proposed by political philosophers such as Dworkin (1981a and

a situation of permanent inequality of opportunity between social groups transmitted across generations. In this context, inequality of opportunity refers to differences in the opportunity sets between social groups (or in Roemer's terms, circumstance types). Equality of opportunity is achieved when the opportunity sets become the same for every group, meaning that this view focuses on inequality between groups and is neutral with respect to inequality within these types, i.e. horizontal inequality (Stewart, 2009).<sup>4</sup>

According to Bourguignon *et al.* (2007a), an inequality trap can be formally defined throughout a reduced form which represents the dynamic process of outcome or advantage. Let  $i$  represent individuals who belong to a specific group  $j$  and  $u_t^{ij}$  represent a given outcome at time  $t$ . This outcome is generated by the following process:

$$u_t^{ij} = u(c_t^j, e_t^{ij}, \phi_t) \quad (1)$$

Equation (1) assumes that outcomes depend on three components at time  $t$ . First, there is an effect which comes from the circumstances faced by those belonging to a certain social group (or type) denoted by  $c_t^j$ . Second, outcomes also depend on the level of individual effort exerted at time  $t$ ,  $e_t^{ij}$ . Finally,  $\phi_t$  represents policies which may affect the outcome directly or indirectly.

However, since an inequality trap aims to capture persistence, the above model needs to incorporate dependence on previous outcomes (own or of a previous generation). For instance, the circumstances enjoyed by group  $j$  in the present depend in part on the outcome levels faced by the preceding generation (e.g. their parents). Moreover, it allows incorporating the effect of characteristics of the overall distribution which reflect the historical inequalities in group relations.

To include these concerns, present circumstances may be rewritten to depend on previous outcome levels as  $c_t^j = c_t^j(u_{t-1}^j, \zeta_t)$ , where  $\zeta_t$  represents an innovation at time  $t$ . In similar fashion, the level of individual effort today could also depend both on past outcomes and on their distribution ( $F_{t-1}(u)$ ). Therefore,  $e_t^{ij} = e_t^{ij}(u_{t-1}^{ij}, F_{t-1}(u), \xi_t)$ , where  $\xi_t$  denotes

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1981b), Arneson (1989) and Cohen (1989). See Fleurbaey (2008) for an overview of the philosophical considerations of equality of opportunities.

<sup>4</sup> This view is known as the *ex ante approach* to the measurement of opportunity inequality (Aaberge *et al.*, 2011). The other common framework is the *tranches approach*, which focuses on differences within effort types. The *ex ante* concept used here is related to Sen's capability approach, with the main difference that individual responsibility (or effort) plays a different role in Sen's (1992) theory.

another innovation.<sup>5</sup> Similarly, the existing policy at time  $t$  may also depend on the prevailing distribution of outcomes or power at  $t-1$  and on innovations at time  $t$ . Thus,  $\phi_t = \phi_t(F_{t-1}(u), \varepsilon_t)$ .

Substituting these into (1), a general reduced form for the outcome of individual  $i$  who belongs to group  $j$  may be rewritten as:

$$u_t^{ij} = \Phi(u_{t-1}^{ij}, F_{t-1}(u), \omega_t) \quad (2)$$

where  $\omega_t$  represents a vector of innovations at time  $t$ . Equation (2) captures a dynamic process which reflects the dependence of the current outcomes of individuals in group  $j$  with past outcomes and their distribution (and previous inequalities). Moreover, the time subscripts may be interpreted as representing generations, which makes (2) capture intergenerational transmission of inequities.

Therefore, this dynamic process defines an inequality trap as a specific low-level equilibrium where inequality in outcomes is driven by persistent differences in opportunities between social groups that are transmitted across generations, although there may be a feasible alternative equilibrium in which this situation is not present. The mechanisms which drive this inequality trap are related to the persistence of social, economic and political inequalities that link an individual's circumstances and outcomes to those of previous generations, and to policy choices which might reflect unequal distributions of power (Rao, 2006; Bourguignon *et al.*, 2007a; Bourguignon and Dessus, 2009).

## **2.2 Ethnic inequality traps in educational attainment**

Setting  $u_t^{ij}$  to represent schooling for individuals belonging to a specific social group would describe the following dynamic process. Educational outcomes will depend on previous education (own or of a previous generation) and their distribution. For instance, an individual who has done well in school and has been presented with more available opportunities is expected to accumulate more schooling. Nevertheless, there is also an intergenerational effect, which may be comparatively stronger than the dependence on own outcomes. In fact, Hertz *et al.* (2007) have found that parental education has a striking influence on their children's schooling outcomes, and that this persistence is particularly large in Latin American countries. Furthermore, educational outcomes also respond to how

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<sup>5</sup> A personal election component that distinguishes effort from circumstances should be included in that innovation.



parental outcomes were distributed, since any prevailing group inequalities may also be transmitted. Therefore, the persistence of low-level educational outcomes may have two different origins: intergenerational educational transmission and inherited inequalities from the time an individual's parents made their educational choices.

Finally, educational attainment will also depend on the particular policies implemented to foster education in current and previous periods. For instance, schooling may be increased by providing generalized supply incentives (school construction), demand incentives (scholarships, conditional transfers) and merit-based schemes. While generalized policies of education may improve the situation for all children, it is possible that their main concern is access and not equity. For example, most interventions in the developing world focus on improving access to basic education, but do not address higher levels where inequities are more important between certain social groups (Keane and Roemer, 2009).

These mechanisms will interact to form an educational inequality trap if there is one group that performs persistently worse than another group in terms of education. To illustrate, consider the case of a group which (erroneously) believes that they are in some sense 'inferior' to another group, such as an ethnic minority (e.g. indigenous). As described, in a situation of equal opportunity, ethnic differences should not have an effect on educational outcomes. However, members of the stigmatized group may adopt certain behavior which contributes to a persistence of unequal opportunities in schooling, and leads them into an educational inequality trap. For instance, one rational mechanism is the internalization of future discrimination at the time of investing in human capital: individuals may choose a lower level of schooling since they anticipate lower earnings. On the other hand, less rational mechanisms may also be at work and individuals could adjust their educational ambitions downwards. This last case corresponds to the perpetuation of cultural and social stigmas which dictate historically unequal social relations between groups.

In fact, this ethnic example reflects observed patterns in Latin America, where racial inequities have been historically high and remain an important source of disparity (Justino and Acharya, 2003; Busso *et al.*, 2005; Chong and Ñopo, 2007). Ethnic disparities have been found in dimensions such as: income, access to land, housing, education, health, labor markets and political representation (Gandelman *et al.*, 2007). While ethnic differences are more evident in some countries, especially those with a historical dissociation and conflict between these groups, there is a consensus that ethnic inequalities account for a significant part of observed opportunity inequality in education. For instance, illiteracy and the schooling gap are higher for ethnic groups in most Latin American countries. Moreover, while

enrollment is similar in primary education, the disparities in secondary and tertiary are striking.<sup>6</sup> In fact, Busso *et al.* (2005) find evidence of substantial discrimination higher along the educational distribution.

Therefore, studying ethnic educational traps surfaces as an interesting case study drawn from the general framework, and is additionally motivated by existing empirical evidence of large ethnic inequities. It is important to note that while other groupings might also represent plausible alternatives for the analysis, their case is less compelling. For instance, even though gender concerns have been important in the past, there is a body of evidence which suggests that male-female educational disparities have declined and seem to be disappearing (Zhang and Li, 2002; Harttgen *et al.*, 2010). Additionally, although regional differences may also be considered, migration is imperfectly captured in most data sources which could bias any analysis based on this information (McKenzie and Mistiaen, 2009). Moreover, the regional distribution of ethnic groups is historically linked to the past geography of slavery and European immigration, which leads to a marked correlation between regional and ethnic inequality (Okediji, 2004). Hence, studying ethnic groups may indirectly capture some variation due to the regional dimension.

### **2.3 Assessing educational inequality traps for ethnic groups**

As previously stated, there remains no comprehensive methodological framework to empirically diagnose the presence of an inequality trap in a country or region at the individual level. Surely, there are a number of ways in which the general framework may be adapted to available data and specific research objectives (Bourguignon *et al.*, 2007a, for instance propose several potential research ideas). For the main objectives of this study, an approach which separately tests necessary conditions surfaces as a feasible strategy to obtain suggestive evidence of ethnic educational inequality traps.

Given the analytical framework, an ethnic educational inequality trap is characterized as a situation with persistent inequality of opportunity in educational attainment between those social groups transmitted across generations. Therefore, a first condition requires identifying the level and extent of inequality of opportunities and testing if there is evidence of significant and persistent disparities in those educational opportunities between ethnicities.

However, although the persistence of inequality of opportunity is required, this condition is necessary but insufficient to suggest the existence of an educational inequality

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<sup>6</sup> See Figures 3.1, 3.2 and 3.4 in Busso *et al.* (2005).

trap. This is because analyzing inequality of opportunities at any given moment only reveals a static picture. Since the definition of an inequality trap requires exploring the dynamic processes that perpetuate unequal outcomes over time, the analysis must somehow focus on intergenerational transmission of educational attainments for each ethnic group. Thus, a second component of the approach lies in analyzing intergenerational educational mobility and, in particular, testing convergence in the groups' mobility patterns (or regimes). In this case, the main finding of this step is whether educational mobility patterns between groups have become more similar (convergence) or not (non-convergence).

It is important to note that analyzing these conditions makes inequality and mobility, as well as their relationship, central to studying inequality traps. However, while these concepts by themselves have a ample theoretical base, their association is not straightforward to pinpoint, since their dependence and interaction with various other dimensions complicate isolating the effect of one over the other (Couch and Morand, 2005). In general, previous literature has suggested an inverse relationship between inequality and intergenerational mobility. On the one hand, lower inequality is expected to increase social mobility (Andrews and Leigh, 2009). On the other hand, higher mobility is also consistent with more equality (Rodriguez *et al.*, 2008).

This expected relationship may be considered particularly stronger when the discussion focuses on inequality of opportunity, which captures differences from 'unfair' sources over which individuals have no control (Roemer, 1998). However, not all situations of higher mobility indicate less inequality of opportunity (Jencks and Tack, 2006; Galiani, 2010). For instance, even while an increase in mobility might indicate better access to opportunities by definition –improving the ability of each generation of the disadvantaged group to overcome its historical disadvantages–, it does not imply that this improvement will change the relative positions of the groups.

Consider a potential scenario where intergenerational educational mobility increases for both groups, but does not modify the ethnic gap, persistently leaving the disadvantaged ethnic group in a lower level of educational achievement despite the generalized improvement. In this case, the disadvantaged may remain in a low-level outcome because the advantaged group improves more markedly. This better relative performance of the more advantaged group may be due to their use of superior resources to preserve their position and therefore the gap between groups (Morgan and Kim, 2006). In this case, higher mobility does not imply equal opportunity. Therefore, testing one condition does not imply the other, and therefore the analysis must jointly observe both concepts.

In this sense, while inequality of opportunity may be more straightforward to measure, analyzing intergenerational mobility requires additional decisions. For instance, which background variable may best capture intergenerational transmission? Although educational mobility is determined by several factors related to an individual's socioeconomic environment (Becker and Tomes, 1986; Behrman *et al.*, 1998), this study will focus on the intergenerational transmission of education from parents to children. The reason for this focus is the widespread evidence that parental education is one of the most important determinants of educational outcomes.<sup>7</sup> In particular, Hertz *et al.* (2007) –who analyze intergenerational educational mobility for 42 countries around the world– find that Latin American countries present the highest degree of parental dependence in schooling; this is particularly evident in the cases of Brazil and Chile. One explanation behind this high dependence on parental education is its correlation with other potential circumstances that capture many aspects of an individual's family background. However, while the influence of education levels achieved by the previous generation is an important determinant of schooling, this relationship should not be interpreted as identifying a causal relationship.

Finally, Bourguignon *et al.* (2007a) require that a third condition be satisfied to guarantee the existence of an educational inequality trap across ethnic groups: the existence of a feasible alternative equilibrium in which there is no conclusive evidence of the second step. A plausible method for testing this condition may be performing counterfactual exercises. For instance, Bourguignon *et al.* (2007a) suggest using a dynamic structural model to simulate distributions of educational attainments for the selected groups under alternative scenarios. However, testing this step is far from straightforward, requires many (strong) assumptions and it remains unclear how a feasible test may be performed to obtain this result. While this condition fully establishes the existence of an inequality trap, testing the first condition (persistent inequality of opportunities between groups) and the second (non-convergence in mobility patterns between groups) is suggestive of an inequality trap. Therefore, the analysis will focus on assessing the first two conditions, under the limitation that this evidence does not undoubtedly confirm the existence of an inequality trap, but it does present an interesting lesson on the dynamics of group outcomes and may be used to inform and direct equitable policy.

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<sup>7</sup> See for instance, Bowles (1972), Knight and Sabot (1990), Lillard and Willis (1994), Thomas (1994), Couch and Dunn (1997), Hertz *et al.* (2007).

In summary, if the following two conditions are empirically verified: (i) persistent inequality of opportunity in education between ethnic groups, and (ii) that educational mobility patterns between both groups are different and not becoming similar (non-convergence) over time, then it would be suggestive –but not conclusive– that the disadvantaged ethnic group is trapped in an educational inequality trap. The measurement framework applied to test these conditions on the data for Brazil and Chile will be presented in Section 3. The remainder of this section presents a brief review of the available evidence on educational inequality of opportunities and intergenerational educational mobility, highlighting the most relevant literature consistent with the analytical framework.

## **2.4 A review of the available evidence**

As mentioned in the Introduction, there are no available studies which directly test for inequality traps at the individual level.<sup>8</sup> Hence, this survey focuses on the most relevant findings on educational inequality of opportunity and intergenerational educational mobility separately, highlighting important findings in Latin America and when available, for ethnic groups in the selected case studies.

The empirical literature on inequality of educational opportunities in Latin America has been mostly applied to observe inequities in primary or basic education. For instance, Barros *et al.* (2009) estimate educational inequality of opportunity in the access to primary education for 20 countries in Latin America, and find equalization over time.<sup>9</sup> These general findings are confirmed for the specific case of Brazil by Cogneau and Gignoux (2005), Bourguignon *et al.* (2007b) and Fontes *et al.* (2009). Furthermore, they attribute the observed improvement to changes in the educational composition of the Brazilian population, which has been steadily shifting towards higher attainment due to the expansion of the educational system. Torche (2005, 2010) arrives at the same conclusions when studying primary education in Brazil, and also presents results for Chile. For the latter, she finds that equality of opportunity

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<sup>8</sup> While Daymon and Gimet (2010) study inequality traps, their focus lies on comparing income inequality dynamics in countries which depart from different initial conditions, which the authors define as opportunities. Their results show that inequality is closely correlated to these initial conditions, and that there seems to be evidence of persistence over time. Therefore, according to these authors, there is evidence of an inequality trap at the international level.

<sup>9</sup> Inequality of opportunities has been a rapidly expanding empirical field since the initial theoretical contribution by Roemer (1998), with a number of applications for both developed and developing countries mostly studying the opportunity distribution of income. Some of these include: Londoño and Székely (2000), Morley (2001), Gasparini (2001), Roemer *et al.* (2003), World Bank (2004), Bourguignon *et al.* (2007b), Anand (2008), Le Franc *et al.* (2008, 2009), Barros *et al.* (2009), and Checchi and Peragine (2010). For Brazil see: Figueireido and Ziegelmann (2010); and for Chile: Contreras *et al.* (2009), Acuña and Zúñiga (2009) and Nuñez and Tartakowsky (2011).

in primary education has improved, a finding also presented by Larrañaga and Telias (2009) and Contreras *et al.* (2009). In general, these studies arrive at the conclusion that younger generations' educational attainment seems to be less unequal (or conversely, less bound to circumstances) in basic education, mostly due to the (near) universalization of primary school. However, a limitation of the available literature is that evidence for higher educational levels is less abundant. In one of the available studies, Torche (2010) observes that inequality of opportunity increases at the secondary and university levels in Brazil and Chile, which suggests that opportunities are distributed quite differently further along the educational ladder.<sup>10</sup>

Studies about intergenerational educational mobility have been relatively scarce in developing countries due to the lack of longitudinal data and limited availability of family background information in cross-sectional surveys.<sup>11</sup> The existing mobility research in Latin America finds that parental education is a powerful determinant of schooling outcomes for children (see Dahan and Gaviria, 1999; Behrman *et al.*, 2000; Andersen, 2001; Behrman *et al.*, 2001; Binder and Woodruff, 2002; Conconi *et al.*, 2008).<sup>12</sup> Most notably, Hertz *et al.* (2007) report that out of 42 countries, the highest dependence between parental and child education is found in Latin America – Brazil and Chile sticks out at the top of this ranking.<sup>13</sup>

However, existing studies find evidence of increasing educational mobility during the last decades. For instance, Sapelli (2009), Celhay *et al.* (2010), Núñez and Miranda (2010) and Sanromán (2010) find higher mobility in Brazil and Chile across time. Behrman *et al.* (1998) rank the countries and conclude that Chile has higher mobility than Brazil, the latter considered among the least mobile. These results are corroborated by several other studies, as shown in the survey by Azevedo and Bouillon (2010).

Less evidence is available comparing mobility between social groups, as the analysis intends to do here.<sup>14</sup> Moreover, those studies with a group perspective have usually focused

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<sup>10</sup> These results are also confirmed by Gignoux and Crespo (2008), who use results from the standardized PISA test for secondary students and estimate the level of inequality of opportunity in secondary schooling. In this context, differences in opportunities represent a third of total educational disparities. Larrañaga and Telias (2009) present similar findings.

<sup>11</sup> See Solon (1999) for a wider discussion about the measurement of intergenerational mobility.

<sup>12</sup> See Holmlund, Lindahl and Plug (2011) for a deep review about the empirical literature that aims to estimate the effect of parent's educational achievements on child's schooling.

<sup>13</sup> For both countries these patterns are repeated in the intergenerational income mobility literature. See for instance, Guimarães and Veloso (2006), Dunn (2007) and Andrews and Leigh (2009). See also Fields *et al.* (2007), Fields (2009) and Cuesta *et al.* (2011) for studies of income mobility in Latin America.

<sup>14</sup> Hertz (2005), Nguyen *et al.* (2005) and Kearney (2006) analyze intergenerational income mobility between black and white families in the United States. Hertz finds that black children experience less upward mobility

on gender and less so on ethnicity.<sup>15</sup> Gang and Zimmermann (2000) is one of the earliest papers for developed countries which compares mobility patterns between second generation immigrants and natives in Germany. They find that educational persistence is only significant for the former but not the latter. Nimubona and Vencatachellum (2007) study ethnic groups in South Africa, where segregation was extreme due to the apartheid. Not surprisingly, they find that intergenerational educational mobility is higher for whites than blacks.<sup>16</sup> Nevertheless, younger cohorts of black South Africans have improved their average level of education compared to their parents, mostly due to increased school supply policies since the mid 1980s. Louw *et al.* (2007) also analyze ethnic groups in South Africa, testing for evidence of convergence in educational attainments. Their results suggest that differences in educational mobility within blacks and whites improved over the 1970-2001 period, which they believe will soon lead to convergence in attainment between blacks and whites at the basic educational level. However, the gap between ethnic groups remains persistent at higher educational levels.

In Latin America, Guerreiro (2008) provides some of the scarce existing evidence on intergenerational mobility by ethnic groups, finding that the educational gap between afro-Brazilians and white Brazilians remains high in the present and shows persistence over time. In other work, Hermida (2008) presents the case of Guatemala and finds lower mobility for indigenous people. González and Sanromán (2010) study educational mobility for African descendants and non-African descendants in Uruguay, and find that mobility is lower for the former than the latter. Moreover, their estimates indicate that the ethnic gap remained mostly unchanged over time and that more than half of the differences may be explained by the ethnic inequality in education among parents, or conversely, historical patterns of inequality.

This brief literature review reveals some general patterns in terms of inequality of opportunities and social mobility in the region and selected case studies. On the one hand, educational inequality of opportunities has fallen somewhat but remains a significant concern

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than white children, conditional on parental income. This ethnic gap is found to be significant at all percentiles, but primarily at the upper end of the distribution, where racial disparities are larger. Kearney (2006) also finds a significant ethnic gap in mobility and suggests that black children are much more likely to remain in the lower percentiles of income distribution and white children to remain in the upper quintiles.

<sup>15</sup> Binder and Woodruff (2002) is one of the first attempts to measure intergenerational educational mobility in Latin America by social groups. In particular, they concentrate on gender disparities in Mexico. They find that mobility and attainment were higher for women over the analyzed period.

<sup>16</sup> The authors also disaggregate their findings by gender and income level. These further refinements suggest that, among blacks, females show higher mobility and educational attainments than males. Also, the poor (in both ethnic groups) exhibit the lowest observed levels of intergenerational educational mobility.

beyond primary education. On the other hand, parental education remains a strong determinant of children's outcomes in Latin America, even in the context of rising mobility. Additionally, the few studies which assess mobility patterns between groups indicate that mobility may differ markedly. Therefore, while these dimensions are considered as separately relevant, their interaction may shed some light into the workings of persistent inequality by determining the existence of educational inequality traps.

### **3 Data, definitions and methodology**

#### **3.1 Data**

The main source of information for the empirical application will be microdata from the 1996 *Pesquisa Nacional por Amostra de Domicílios* (PNAD) and pooled data from the 2006 and 2009 *Encuesta Nacional de Caracterización Socioeconómica* (CASEN) for Brazil and Chile, respectively. Both are nationally representative household surveys carried out periodically by the National Statistics Institutes in each country and include extensive demographic and socioeconomic information for individuals. Furthermore, each survey is based on large sample sizes and collects information on ethnicity and parental education, the latter which is essential to capture the dynamic aspect of inequality traps. Ethnicity is identified differently in both surveys: for Brazil, ethnic membership is self-reported, while Chile identifies indigenous individuals based on their native tongue.

Naturally, there are some limitations with this data. The Brazilian PNAD was conducted in 1996 which implies that despite its informational benefits, the findings may not depict the current state of Brazilian society. Additionally, a single Chilean CASEN survey might under-represent the indigenous population because it does not recollect information in some remote regions in which specific indigenous groups live (Agostini *et al.*, 2010), so pooled data will be used instead.<sup>17</sup> These caveats must be taken into account when interpreting the results.<sup>18</sup>

The sample used throughout the analysis is comprised of adults aged 25 years or older, since it is a likely assumption that these individuals have completed their education. In addition, the sample excludes survey respondents with incomplete information on their own

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<sup>17</sup> It should be noted that even with pooled data from the CASEN, the number of observations from the Ethnic Minority in Chile is relatively small making it hard to obtain meaningful inferences about group differences in mobility. In fact, this group represents nearly 6% of the total pooled sample (see Table 2).

<sup>18</sup> These surveys have been employed in several studies of inequality of opportunity and mobility despite these potential drawbacks.



educational attainment, that of their parents and/or ethnicity. Finally, all statistics and estimates obtained from the data are weighted unless otherwise noted.

### **3.2 Definitions**

In what follows, the main outcome variable will be educational attainment defined in categories. This variable is defined homogeneously in both surveys to promote comparability, but respects the particularities of each country's educational system.<sup>19</sup> In particular, three mutually exclusive categories are defined in each country.<sup>20</sup> The *low* education category includes individuals with complete primary schooling or less (including those with no formal education). The *medium* education category is made up of individuals who have at least some secondary schooling (incomplete or complete). Finally, the *high* education category consists of individuals with at least some technical, tertiary, university or post-graduate degrees.

Parental education is defined using the same categorization, and the maximum education between mother and father is imputed to each individual.<sup>21</sup> Ethnic membership is defined as a binary variable in a manner consistent with the afro or indigenous population in each country. Since the specific groups vary between countries, they will be referred to as the ethnic *minority* and *majority* groups to simplify the exposition. Strictly speaking, the ethnic majority in Brazil corresponds to individuals descendent from European immigrants (white Brazilians), while Afro-Brazilian individuals are included in the minority group.<sup>22</sup> In Chile, the minority includes indigenous individuals and the majority will refer to the non-indigenous group (Contreras *et al.*, 2009; Agostini *et al.*, 2010).

Since one of the main objectives in analyzing inequality traps is to capture a dynamic process, the analysis exploits the potential to construct birth-cohorts since the available data is a single cross-section. Tracking cohorts allows analyzing long-term behavior of certain groups, in this case of adults who have completed their educational process, using a single point in time. Additionally, following cohorts has additional advantages such as the minimization of measurement error and of the biases from attrition (Navarro, 2010).

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<sup>19</sup> In particular, the official educational definitions for primary, secondary and university (including tertiary education) are used to classify each individual into the selected categories.

<sup>20</sup> Ideally, a greater disaggregation of educational level would have been desirable. However, educational categories were clustered due to sample size concerns.

<sup>21</sup> Several tests were carried out to test sensitivity to this decision, but the results remain qualitatively unchanged.

<sup>22</sup> Following Guerreiro (2008), the descendents of Asian people and indigenous are excluded in the analysis. This responds mainly to a small relative size of these ethnic groups in Brazil, evident from the survey data. Their omission does not significantly affect the estimates.

However, there are also some limitations to cohorts which are discussed in detail by Deaton (1997). In this study, the benefits from analyzing cohort trends outweigh the potential (and mostly unobservable) limitations. Hence, the sample is grouped into five successive birth-cohorts each separated by a ten-year span. Tables 1 and 2 summarize the definition of each cohort, their aging patterns and composition for the Brazilian and Chilean data, respectively.

### 3.3 Methodology

As mentioned, two conditions must be evaluated to determine if there is suggestive evidence of an educational inequality trap between ethnic groups: (i) persistent differences in educational opportunities between ethnic groups, and (ii) assessing whether or not the group trajectories in mobility patterns are converging over time. In this case, since the available data is not longitudinal, persistence is assessed by tracking cohorts.

To empirically test the above conditions this study uses two indices proposed by Yalonetzky (2009, 2010), which are drawn from a family of heterogeneity indices based on the statistics from homogeneity tests for multinomial distributions (Hogg and Tanis, 1997). (Slightly) different specifications of this family may be used for analyzing inequality of opportunities and comparing mobility regimes (represented by discrete-time transition matrices) between social groups. Moreover, the indices perform well with ordinal discrete variables, unlike other potential indices available in the literature for continuous outcomes.

#### *Heterogeneity index to assess inequality of opportunities*<sup>23</sup>

Following Yalonetzky (2010), assume that the population can be partitioned into a number of *social groups*,  $g = (1, 2, \dots, G)$ . Each group or type is defined by a vector of circumstances. This means that all individuals with the same set of circumstances belong to the same group; for example, every Afro-Brazilian belongs to the same type in a case where ethnicity is the only circumstance. In a similar fashion, define a vector of outcomes (or advantages),  $\alpha = (1, 2, \dots, O)$ . An example of a possible element of  $\alpha$  would be to have a low, medium or high level of education, in the case in which the only outcome considered is educational level as defined above.

The heterogeneity index applied to assess inequality of opportunities measures between-group inequality as the degree of association between groups and outcomes, by

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<sup>23</sup> For more details on the derivation of these indices and their properties, see Yalonetzky (2009, 2010).

comparing the distribution of outcomes conditional on belonging to a specific group.<sup>24</sup> Formally, this index can be expressed as:

$$H^{IO} = \frac{1}{\min(G-1, O-1)T} \sum_{g=1}^G \sum_{\alpha=1}^O \frac{(p_{\alpha}^g - \tilde{p}_{\alpha})^2}{\tilde{p}_{\alpha}} \quad (3)$$

where  $p_{\alpha}^g$  is the probability of attaining a particular level of advantage  $\alpha$ , conditional on belonging to group  $g$ ;<sup>25</sup>  $\tilde{p}_{\alpha}$  is the arithmetic average of the group-specific probabilities for the advantage level  $\alpha$ ; that is,

$$\tilde{p}_{\alpha} = \frac{1}{G} \sum_{g=1}^G p_{\alpha}^g \quad (4)$$

The denominator of the first term in (3),  $\min(G-1, O-1)T$ , normalizes the index so it ranges between zero and one. For the analysis here,  $H^{IO}$  would be equal to zero if and only if the conditional distribution of educational attainments across ethnic groups is identical. This is consistent with a situation of literal equality of opportunity in a Roemerian sense (i.e. equal opportunity sets between groups). In turn,  $H^{IO}$  would be equal to one if and only if there is complete association between ethnic groups and educational attainments, which would reflect a situation of ‘perfect’ inequality of opportunities. Thereby, this index measures the degree to which the conditional distribution of the outcome differs across selected groups, that is, it captures horizontal inequality of opportunities.<sup>26</sup>

This study uses this index to measure the evolution of ethnic differences in educational opportunities across cohorts and to evaluate whether the ethnic gap has improved or persists for the youngest generations. Confidence intervals for the point estimate of  $H^{IO}$  are constructed using bootstrap methods in order to infer if the trends present statistically significant variations across cohorts.<sup>27</sup> In addition, differences in the index between the

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<sup>24</sup> Note that we are considering conditional distributions of discrete variables.

<sup>25</sup> This probability is defined as:  $p_{\alpha}^g = \frac{N_{\alpha}^g}{N^g}$ , where  $N_{\alpha}^g$  is the frequency of people that belong to group  $g$  and have a level of outcome  $\alpha$  and  $N^g$  is the absolute frequency of people belonging to group  $g$ .

<sup>26</sup> Even though this might be a shortcoming in a general study on inequality of opportunities that aims to consider a complete notion of inequity (both within and between), the inequality trap analysis seeks to capture only between-group differences, which makes this particular methodology useful for the present research.

<sup>27</sup> Standard errors might be affected by the small sample sizes of cohorts within the indigenous in Chile. Lee and Solon (2009) show the problems that arise when estimating intergenerational income mobility using small samples of the PSID, which is associated with large standard errors.

cohorts (and their respective confidence intervals) are also estimated to determine if observed differences are located between the oldest and youngest cohorts, or in contiguous generations.

### *Heterogeneity index to compare mobility across groups*

A slightly different specification of  $H^{IO}$  may be applied to compare intergenerational mobility patterns, represented by transition matrices.<sup>28</sup> In this case, transition matrices present the probability of an individual attaining a particular level of socioeconomic status conditional on their parents having achieved a particular level in that variable.<sup>29,30</sup> In this context, a conditional probability vector is one of the matrix's columns (or rows, depending on the assortment) which contains the probabilities of an individual reaching each possible level of the outcome controlling for the particular level reached by the individual's parents. Formally, define this vector as  $V_j = (P_{1j}, P_{2j}, \dots, P_{Oj})$ .

The heterogeneity index applied to compare mobility processes represented by transition matrices is a summary measure which quantifies the differences or "distance" between these matrices for different groups by comparing them element-by-element. That is, the heterogeneity index computes the differences between the conditional probability vectors ( $V_j$ ) of transition matrices across groups individually and then aggregates the respective statistics into a global indicator which has an asymptotic chi-square distribution with  $(G-1)O(O-1)$  degrees of freedom. Formally, an index of heterogeneity for transition matrices based on the multinomial distribution test and fulfilling certain basic axioms<sup>31</sup> is given by:

$$H^M = \frac{1}{O} \sum_{j=1}^O H_{V_j} \quad (5)$$

where

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<sup>28</sup> For details see Yalonetzky (2009, 2010).

<sup>29</sup> Formally,  $P_{ij} = \Pr(\alpha_t = i | \alpha_{t-1} = j)$ , where  $\alpha$  represents the outcome variable and the subscripts  $t$  and  $t-1$  refer to the level of outcome showed by the individual and his parents, respectively. In this way,  $P_{ij}$  is the conditional probability of an individual to have a level  $i$  of the outcome conditioned on his parents having attained a level  $j$  in that same advantage.

<sup>30</sup> Transition matrices might also show two moments in time for the same person, when the objective is to study mobility along the life cycle.

<sup>31</sup> See Yalonetzky (2009).

$$H_{V_j} = \frac{\sum_{g=1}^G \sum_{i=1}^O N_{.j}^g \frac{(p_{ij}^g - p_{ij}^*)^2}{p_{ij}^*}}{\min(G-1, O-1) \sum_{g=1}^G N_{.j}^g} \quad (6)$$

$p_{ij}^*$  is defined as in (4) for  $G$  groups of conditional probability vectors conditioned on a parental level of advantage  $j$ , and  $N_{.j}^g$  is the absolute frequency of the conditional probability vector of group  $g$  conditioned on a parental level of advantage  $j$ .

This index also ranges between zero and one. In this case, it would be equal to zero if and only if the conditional distributions of educational achievements across the compared matrices are identical – i.e.  $H_{V_j} = 0, \forall j$ , which indicates perfect homogeneity among group/matrices. This suggests that the mobility regimes represented by the transition matrices of different ethnic groups would be equal. In turn, it would be equal to one if and only if there is maximum heterogeneity (dissimilarity) among matrices – i.e.  $H_{V_j} = 1, \forall j$ .

Formally, a statistic  $Q$  which has an asymptotic chi-square distribution with  $(G-1)O(O-1)$  degrees of freedom can be used to perform a homogeneity test (see Anderson and Goodman, 1957).<sup>32</sup> The null hypothesis of the test is that the conditional distributions across groups/matrices are homogenous, that is, they are identical in a statistical sense:  $H_0 : p_{ij}^1 = \dots = p_{ij}^g = \dots = p_{ij}^G, \forall i, j = 1, \dots, O$ . If the null hypothesis of homogeneity among matrices was rejected, the alternative hypothesis that  $H_{V_j} \neq 0$  would be accepted, indicating that the degree of association among conditional probability vectors statistically differs between groups/matrices.

While the index  $H^M$  provides useful information about the extent to which the mobility regimens between groups are similar –the main interest in this study–, it does not provides information about the mobility pattern of each group and its trends (which group/matrix presents the major level of association between outcomes of parents and children), which is also relevant to better understand the persistence or not of disparities between them. A transformation of the  $H^M$  index can be used for this purpose but in this case, instead of computing the heterogeneity between the transition matrices of each group, it will calculate the heterogeneity between each groups' transition matrix and an “ideal” matrix with perfect independence between parental and children education (a matrix in which each cell shows

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<sup>32</sup> Note that  $H^M$  is based upon such statistic.

identical probabilities). This transformation of  $H^M$ , denoted as the  $H(g)^M$  index, will indicate how far each group is from perfect independence to parental education (see Long and Ferrie, 2007, for a similar approach).

In summary,  $H^M$  is used to compare transition matrices linking parents and children's educational outcomes between ethnic groups. This group comparison provides information on whether educational mobility regimes are different between ethnicities for each cohort in the sample. The evolution of this index across cohorts provides information on whether these mobility regimes are becoming similar ( $H^M$  closer to zero) or not. In order to formally explore the evidence suggestive of convergence between those regimes across cohorts, the homogeneity test is performed for the point estimates of  $H^M$ . In addition,  $H(g)^M$  is calculated to evaluate each ethnic group's level of educational mobility across cohorts, as well as to analyze the evolution on mobility patterns within each ethnic group.

It is worth noticing that both  $H^{IO}$  and  $H^M$  are just one possible methodological approach of many that could be used to measure inequality of opportunities and compare mobility regimes. Different methodologies have been proposed to separately address these two topics. For instance, Barros *et al.* (2009) present the *Human Opportunity Index* (HOI) to measure inequality of opportunities applied to dichotomous outcomes.<sup>33</sup> However, although this index seems to be useful in some cases, a large debate has risen regarding its potential biases and its inability to fulfill certain desirable properties (Peragine, 2011).

In a similar way, the  $H^M$  index used in this paper is one of several potential approaches to compare mobility regimes between groups. For instance, some studies compare mobility patterns of different groups based on parametric models of educational intergenerational mobility (Gang and Zimmerman, 2000; Nimubona and Vencatachellum, 2007).<sup>34</sup> Even when those models have several advantages (e.g., allow controlling for several variables), they might not be well suited for comparing differences in mobility between groups because often they do not properly capture all the heterogeneity between groups (Hertz, 2005 and 2008).<sup>35</sup> Therefore, the  $H^M$  index described above seems to be better suited to conduct comparisons across groups.

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<sup>33</sup> As was mentioned in Section 2.4, Barros *et al.* (2009) applied this index to estimate inequities in the access to basic education and other outcomes in several countries of Latin America.

<sup>34</sup> For instance, by compare slope coefficients of estimated models for different groups.

<sup>35</sup> Measuring within-group intergenerational elasticity or correlation is only informative about mobility within each group but not about mobility of those groups across the overall outcome distribution. Hertz (2008) proposes an estimator to overcome this caveat.

On the other hand, some studies directly compare summary indices derived from transition matrices (for instance, Formby *et al.*, 2004). The  $H^M$  index has a particular advantage over that approach since it provides a single summary measure for differences in mobility regimes across groups as the heterogeneity between transition matrices –which can be interpreted as a “distance”–, and with a minor transformation it also provides a measure of mobility for each group/matrix. Finally, although some studies use other measures which show similar properties as described above (e.g. Long and Ferrie, 2007) the approach suggested in this study has the additional advantage that both indices are (slightly) different specifications from the same family of heterogeneity measures, which provides a common methodological framework to analyze the joint conditions suggestive of an inequality trap.

## **4 Educational context in Brazil and Chile**

### **4.1 Evolution of the educational systems**

Before proceeding to the estimates, this section provides a context of the main policies and reforms in the Brazil and Chile’s educational systems, illustrating the changing educational context by means of descriptive statistics. This analysis provides a picture of the situation in each country and also serves as a validity control to ensure that the data properly capture the changing educational context in each of the selected case studies.

Since 1950, the Brazilian educational system has been in continual expansion. One of the main challenges at that time was reducing children’s late start to school and grade repetition, addressed by encouraging enrollment and incorporating children into school at the mandated age. This led to an increase in primary and secondary enrollment between 1920 and 1970 which surpassed the observed population growth. Therefore, during this period, many children were incorporated into the formal schooling system, and repetition and delayed start dropped significantly. Jointly with this expansion, the Brazilian Ministry of Education developed initiatives to increase the duration of compulsory education, incorporated early childhood education (pre-primary education) and built more schools, especially in rural and marginal areas (Ministry of Education of Brazil, 2003).

The current organization of the educational system was set by the Constitution of 1988, with the approval of the National Education Guidelines and Framework Law (*Lei de Diretrizes e Bases da Educação* 1996). This reform changed the organization of the school

system, by extending compulsory education,<sup>36</sup> encouraging the professionalization of teachers (especially at secondary education) and introducing other forms of schooling, such as special and ethnic education, which became an important part of the educational system. Since this latest reform, illiteracy has dropped substantially, enrollment continued to increase at all levels and the population's average education has steadily risen. The changing educational structure is denoted by the drop in the proportion of population with only basic education (which in 1970 accounted for almost 90% of total enrollment), and the continuous expansion at higher educational levels.

However, while there were encouraging efforts in basic education, the overall level of public income restrained the system from guaranteeing public access at the secondary and university levels. This made the system highly selective at these stages: for example, only 5.6 percent of those who began primary were able to attend secondary school in Brazil (UNESCO, 2006). Therefore, while secondary enrollment did increase, this selectiveness increased inequities at this level, mainly affecting disadvantaged groups. The situation at university levels was even more unequal.

Unlike Brazil, education in Chile had a much more pronounced advancement in the past decades. Between 1960 and 1990, the average level of schooling doubled and illiteracy dropped to less than 5%. In general, the educational situation continually improved since then, with primary education becoming almost universal. Additionally, secondary enrollment is one of the highest in Latin America, due in part to its gratuity and the compulsory requirement which is set at 12 years. Moreover, quality has also improved, since over 98% of teachers have some sort of formal qualification (UNESCO, 2010).

However, UNESCO (2006) also recognizes that there are still some fundamental problems in Chile's educational system. Mainly, they argue its '*poor and uneven quality*', which makes the system inequitable and inefficient, especially for groups such as the poor. Furthermore, the system is based on the Spanish language, which is not spoken in certain regions and by some ethnic groups. The most important groups in these categories are the Mapuche, the Aymara and the Rapa Nui.<sup>37</sup> According to UNESCO (2006), educational attainment for these groups is significantly lower compared to the general population. On the one hand, they live in secluded areas where supply of schooling is fairly limited (even though

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<sup>36</sup> For instance, day care (for children 0 to 3) and pre-school (from 4 to 6) became the National Childhood Education. The first 4 years of pre-school and low high school became primary, while the last three years became secondary.

<sup>37</sup> The Mapuches are grouped in the rural south of the country and account for around half a million people. The Aymaras inhabit mainly the area of the Andean highlands and the Rapa Nuis live in Easter Island.



there are policies aimed at expanding access to education in marginal areas). On the other hand, indigenous groups also employ traditional education outside the formal system which emphasizes their cultural roots. However, in recent years the Ministry of Education has tried to attract children from indigenous groups by offering a multicultural education, which contemplates their own language and traditions (UNESCO, 2010). Currently, most of these ethnic groups are now bilingual and adhere to the national education system.

## **4.2 Main educational trends**

Figure 1 summarizes the individual educational distribution for each birth-cohort and Figure 2 plots the observed distribution for their parents in Brazil and Chile (panels A and B in each graph, respectively). These two graphs help paint a picture of the evolution in educational attainment and support certain trends consistent with the educational reforms and policies described above.

In Brazil, the educational structure shows an upward trend for the individuals in the sample, especially when compared to their parents, and compatible with the expansion of the system. Particularly, the growth in medium and high levels of schooling is 15 and 6 percent between cohort 1 (eldest) and cohort 5 (youngest), respectively. However, the majority of Brazilians in the youngest cohort (approximately, 70 percent) remain with low educational attainment. In contrast, educational improvement is more evident in Chile. The proportion of individuals with low education fell from over 60 percent from the eldest cohort to less than 20 percent in the youngest. The figure shows that for the youngest cohort, more than 60 percent of individuals attain at least medium schooling (equivalent to some secondary) and almost 30 percent have obtained high education (at least tertiary schooling), also in accordance with the previous description of the educational system.

Comparing the educational distribution in both countries reflects the difference pointed out previously, mainly that Chile is better-off in terms of education than Brazil. Therefore, the interpretation of the main results must keep in mind that both countries begin from different initial situations, with Brazil characterized by low overall educational attainment and Chile by a much higher one.

Even though both countries have improved average education across cohorts, a question arises: are there still significant differences in attainment between ethnic groups? Figure 3 plots the educational distribution by ethnic groups to answer this question. The graphs depict several marked trends. On the one hand, and congruent with Figure 1, average educational achievements have improved for both ethnic groups. On the other hand, the ethnic gap shows

no signs of reduction in both countries. For instance, in Brazil (panel A of Figure 3), while the proportion of individuals with low education has fallen for both ethnic groups, this reduction has been proportionally higher for the ethnic majority group (White- Brazilians). Consequently, the ethnic gap in low educational attainment becomes larger for the youngest cohort when compared to the eldest. The same situation is observed at high achievement levels, where the White-Brazilians seem to be improving at a faster rate than the Afro-Brazilian group. These findings are qualitatively similar for Chile (panel B of Figure 3) where, even though average schooling rises for both groups, ethnic differences do not seem to be fading. As found for Brazil, disparities are more salient at the low and high educational levels, due to a higher relative improvement of the majority (non-indigenous) when compared to the minority (indigenous).

In general, this descriptive evidence shows that the process of educational restructuring and reforms have generated a higher average level of schooling in Brazil and Chile. However, there seem to be persistent ethnic differences within this distribution, primarily when observing educational outcomes at medium and high education levels. These findings suggest that there remain important disparities in education between these social groups, as has also been suggested by UNESCO (2006, 2010). However, to find suggestive evidence of a trap, these inequities must be both persistent and non-converging.

## 5 Results

To test for inequality traps, the analysis begins by presenting estimates for the heterogeneity index for inequality of opportunities,  $H^{IO}$ , as the first of two conditions suggestive of this trap. The patterns of this index will help determine if one ethnic group has persistently lower opportunities than the other. As a point of comparison, the analysis also includes a broader estimation of this index considering a wider set of groups which results from combining three categorical variables: ethnicity (2), gender (2) and parental education (3), for a total of 12 groupings. These estimates are then used to compare the trend using only ethnicity to observe whether this grouping captures the general patterns of inequality of educational opportunity.

Table 3 presents the values of the heterogeneity index for inequality of educational opportunities and their corresponding confidence intervals (obtained by bootstrap with 300 replications). In both cases, the differences in educational opportunities between ethnic groups are statistically different from zero, implying that ethnicity is a determining factor for educational achievement and, more interestingly, that it is a source of disparity. In addition,

while the trends show slight differences between countries, they both indicate that there is no sign of equalization in opportunities between ethnic groups from the eldest to the youngest cohort; that is,  $H^{IO}$  is statistically different from zero for every birth-cohort, and its value remains almost unchanged between extreme cohorts. Specifically, the findings for Brazil reflect that inequality of educational opportunities from ethnicity mildly increases from 0.18 to 0.21, although the change is relatively small. Nevertheless, this signals that the ethnic gap in opportunities is not closing across generations (Panel A of Figure 4), suggesting that ethnic disparities in schooling remain relevant even for younger cohorts. Chile shows a slight reduction in educational inequity between ethnicities across cohorts, however, that change is statistically non-significant when comparing the first and last cohorts (Panel B of Figure 4). These trends are maintained when considering the broad case with more groups (Table 3), suggesting that ethnic group differences reflect the general pattern of educational opportunities.<sup>38</sup>

This analysis is complemented by the results in Table 4, which shows the difference in the  $H^{IO}$  index between two given cohorts and their bootstrapped confidence intervals (e.g. the cell in which cohort 2 crosses cohort 1 refers to the difference in the estimated index between these two cohorts). From the table, most differences in Brazil appear to be statistically different from zero, with the exception of some between contiguous cohorts. In particular, the changes are significant when comparing the eldest and youngest generations. Consistently with the aforementioned results, differences are positive, indicating an increase in the index (i.e. worsening in educational opportunities). In turn, the differences between cohorts in Chile cannot be considered significantly different from zero, which suggests that the distribution of opportunities remains unequal and unchanged across cohorts.

These results are related to the observed differences in Figure 3 (in Section 4), which showed that there seems to be a persistent ethnic gap in educational attainment. In particular, this effect appears to be driven by a higher relative improvement of the majority group in comparison to the minority in both countries. This effect ensures the persistence of the ethnic gap in schooling even in the context of rising average education, and is consistent with documented educational trends by ethnic groups in Brazil by Guerreiro (2008) and in Chile

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<sup>38</sup> While these results may seem to contradict previous estimations by the existing literature (for instance Barros *et al.*, 2009; Contreras *et al.*, 2009), the analysis here evaluates educational inequities across *the entire educational distribution*, whilst the former studies focus on access to primary education or higher. Other work which has concentrated on higher levels of schooling finds that opportunities remain unequal or might be worsening, which is in line with the results obtained here (see Gignoux and Crespo, 2008; Larrañaga and Telias, 2009; Torche, 2010).

by Agostini *et al.* (2010). In this application, while the analysis finds evident benefits from educational expansion (higher average achievement), ethnicity still influences these outcomes, leading the minority groups into persistently lower educational opportunities.

Nevertheless, while these findings imply that there is a persistent ethnic inequality in educational attainment, the analysis is static and does not capture the dynamic aspects which perpetuate these inequities and which might be driven by an inequality trap. For this purpose, the next step is to compare intergenerational mobility patterns between ethnic groups to assess whether the persistent ethnic gap has an intergenerational component.

As already mentioned, the  $H(g)^M$  index provides this information, comparing each group's transition matrix to the perfect independence matrix. Table 5 shows the estimation of this index for the ethnic majority and minority, for both countries. The estimated indices are always statistically different from zero, indicating a departure from perfect independence to parental education.<sup>39</sup> However, in the case of Brazil both ethnic groups show a decrease in these values. In particular, the Afro-Brazilians have experienced a greater increase in mobility than the White-Brazilians, which ultimately implies the same level of (statistically significant) independence to parental education for both ethnic groups, for the younger cohorts (Figure 5).

Chile, on the other hand, exhibits an increased mobility only in the minority ethnicity, while the majority presents a higher  $H(g)^M$  index for younger generations (larger distance between the transition matrix and perfect independence). However, as shown in Figure 5, the difference in the degree of mobility between ethnicities is not statistically significant for most cohorts, indicating a similar level of independence to the parental level of education. Tables 6 and 7 complement the analysis with the estimation of the difference of the index between cohorts and the confidence intervals for Brazil and Chile, respectively.

Even though these findings are relevant to identify the mobility pattern of each ethnicity, they do not provide a notion of “distance” between them, i.e. the underlying heterogeneity between these groups, which is the core interest of this study. Table 8 and Figure 6 tackle this issue by presenting the estimates of the heterogeneity index for transition matrices,  $H^M$ . The Table also includes the results of the homogeneity test  $P_{ij}^{Majority} = P_{ij}^{Minority}, \forall i, j = 1, \dots, O$ , by cohorts. Results indicate a rejection of the null hypothesis of homogeneity between the transition matrices of the ethnic majority and

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<sup>39</sup> Table 5 also includes the results of the homogeneity test  $P_{ij}^{Ethnic\ group\ g} = P_{ij}^{Perfect\ independence}, \forall i, j = 1, \dots, O$ , by cohorts.

minority for all cohorts, in both countries. In addition, there is no statistically significant reduction of the  $H^M$  between the eldest and youngest cohorts in the case of Brazil, suggesting that the heterogeneity between the mobility regimes of each ethnic group have persisted over time and remain a significant issue for the youngest generation. In other words, even though both groups seems to show a reduction in the association between parent's and sons' educational attainments over time (as described above), the *pattern* of intergenerational mobility might be different for each of them, resulting in an  $H^M$  index which is different from zero.

In the case of Chile, the heterogeneity index shrinks across cohorts, but this decrease is not statistically significant, indicating once again that the gap between ethnicities remained unchanged across generations. These trends are further confirmed in Table 9, which presents the differences in  $H^M$  index between cohorts and their confidence intervals, for both countries.<sup>40</sup>

What is behind these trends? To address these questions the analysis now turns to some summary statistics and also observes the main input used to compute these mobility indices, the transition matrices. These tools will help interpret the findings obtained from the indices and further understand their changes.

The first panel of Table 10 presents summary statistics on directional movements computed from the transition matrices. Consistently to the results mentioned above, mobility has increased for younger generations in comparison to older cohorts in both Brazil and Chile. This is denoted by the reduction of educational immobility (i.e. the percentage of people who have the same level of education as their parents) and by the evidence of rising upward mobility. Although the estimates also show some degree of downward mobility in both countries, this percentage is quite low (between 4 and 7 percent).

The rest of Table 10 presents these results disaggregated by ethnic group. In Brazil, increasing mobility is still observed for younger cohorts for both groups, but the patterns differ. In particular, Afro-Brazilian show a similar level of downward mobility and lower upward mobility compared to White-Brazilian. Moreover, the gap in upward mobility has widened from the oldest to the youngest cohort (Panel C in Figure 7), and could be attributed once again to a more than average educational improvement for the advantaged ethnic

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<sup>40</sup> Comparisons between contiguous cohorts are not statistically different from zero in some cases but the difference between extreme generations is statistically significant for Brazil, implying an increase in the  $H^M$  index between them.

majority (White Brazilians) relative to the disadvantaged group (Afro-Brazilians). In other words, the disadvantaged group is not able to ‘catch up’ to the other group in terms of upward mobility which, combined with the far below educational attainments (already presented in Figure 3)<sup>41</sup>, explain their condition as a disadvantaged group.<sup>42</sup> This is partly due to the fact that the Afro-Brazilian’s initial conditions (i.e. parental education) are worse than for the White-Brazilians. Thus, being born into a household where parents have a low level of education results in a high probability for individuals of the ethnic minority to also attain low education. On the other hand, the individuals belonging to ethnic majority are characterized by being raised in households with better educated parents and higher mobility which leaves them with better educational outcomes. Together, these two opposing effects prevent the reduction of the gap between ethnic groups.

In the case of Chile, the findings also reveal that the indigenous group has lower mobility than the non-indigenous group. Educational immobility is higher among the indigenous, although this gap has fallen for the youngest generations, and actually seems to be converging (Figure 8). However, this does not mean that educational achievements are becoming identical between ethnicities, but instead that the groups are likewise mobile and dependent in a similar degree on parental education (as previously derived from the estimation of the  $H(g)^M$  index). In fact, as already shown in Section 4, the ethnic minority group in Chile has significantly lower schooling than the majority for every cohort (even the youngest). The results from the transition matrix (Table A.2 from the Appendix) show that while differences at lower levels of education have been falling for younger cohorts, they increase at the highest educational level. These movements also correspond to opposing effects which cause the heterogeneity index to remain statistically unchanged, and leads the mobility index to show no evident change.

In summary, the main findings indicate that while average education and upward mobility have risen for the general population, ethnic disparities remain significant. On the one hand, there is statistical evidence of persistent disparities in educational opportunities between ethnic groups in both countries; i.e. ethnic differences in education show no signs of

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<sup>41</sup> Figure 3 shows that the proportion of parents with low education is higher for the ethnic minority, for every cohort. In the case of medium and high education, the ethnic majority is the one showing greater percentages.

<sup>42</sup> These results can also be derived from the transition matrix in the Appendix (Table A.1). That is, the Afro-Brazilian group shows a higher proportion of individuals with low or basic education than the White-Brazilians for every cohort, while the opposite is true for medium and high educational levels. In addition, although both groups have experienced a decrease in the proportion of individuals with low education, this reduction has been even greater for the White-Brazilians; deepening the ethnic gap.

reduction. On the other hand, while upward mobility is higher in both countries, the disadvantaged ethnic group seems to lag behind, in particular for Brazil. However, the overall conclusion for the two countries is different. In Brazil, even when the results seem to indicate a reduction in the association between parents' and offspring's educational achievements within each ethnic group, the disparities in educational mobility between ethnicities remain roughly unchanged across time. This path of non-convergence in mobility patterns suggests that the disadvantaged ethnic group (Afro-Brazilians) seems to be caught in an educational inequality trap. In turn, the results for Chile are less suggestive that indigenous individuals are in this situation, given the closing gap in mobility patterns between this group and the non-indigenous.

## 6 Discussion and Conclusions

This paper searched for suggestive evidence of an ethnic inequality trap in educational attainment in Brazil and Chile. The findings are a contribution to existing literature since this topic has not been studied for a region or country at the individual level. Moreover, since there is no comprehensive methodological framework to diagnose inequality traps, the study proposed assessing certain conditions compatible with an educational inequality trap, mainly: (i) persistent inequality of opportunity in education between ethnic groups, and (ii) dissimilar mobility patterns between both groups that do not become similar over time (non-convergence).

In general, the main findings indicate that while average education and upward mobility have risen for the population in both countries due to more predominant access to schooling at all levels, ethnic group dynamics show less encouraging results.

For Brazil, there is statistical evidence of persistent disparities in educational opportunities between Afro-Brazilians and White-Brazilians that show no signs of reduction. In addition, even though the level of association between educational achievements of fathers and sons seems to have fallen for the youngest cohorts *within* each ethnic group, the gap in intergenerational mobility *between* ethnicities remained unchanged across generations. This pattern of non-convergence appears to be explained by the greater relative improvement in upward mobility for White-Brazilians, while Afro-Brazilians lag behind. Together, these results suggest that Afro-descendants seem to be caught in an educational inequality trap in Brazil.

Similarly, there also seems to be persistence in the differences in opportunity sets of indigenous and non-indigenous individuals in the case of Chile, jointly with a statistically

unchanged heterogeneity between their mobility regimes. This denotes that mobility patterns between ethnic groups have not grown similar, although mobility in general has risen substantially, closing the gaps in upward mobility between both ethnic groups. Therefore, in this context, the evidence is not entirely conclusive on whether there is non-convergence. However, ethnic disparities remain a significant concern in this country, especially at the medium and high levels. Nevertheless, the estimates do not suggest that a trap is driving the low-level equilibrium of indigenous individuals.<sup>43</sup>

These results shed light on some aspects in which policies may be aimed to enhance equity among ethnic groups in educational attainment. In particular, there is concern for future generations, since educational opportunities remain lower for disadvantaged ethnic groups. Therefore, particular attention must be placed on improving opportunities for younger generations. And while broad policies have been useful to reduce the intergenerational dependency of each ethnic group over time (as shown in the results of this paper), the ethnic gap have persisted through generations which stresses the need of policies aiming to eliminate ethnic disparities in education, especially at the middle and high levels of schooling.

Affirmative action policies should aim to eliminate inequalities that arise from unequal initial endowments (Blumkin *et al.*, 2009). On the one hand, existing large scale poverty programs may include an ethnic component, possibly, through conditional cash transfers. This kind of program typically involves monetary transfers and the fulfillment of some conditionalities regarding children enrolment and health check-ups. The program *Familias en Accion* in Colombia has already included an ethnic component, since all indigenous children are eligible for the monetary transfers. This type of policy might contribute to reduce the ethnic gap in the initial levels of education.<sup>44</sup>

As already mentioned, the findings of this paper suggest that there are greater ethnic gaps in higher education, which stresses the need for inclusion policies at this level. Inclusion policies could be implemented (or extended if they already exist) for this purpose, targeted at minority groups who do not usually have access to college. For instance, ethnic ‘quotas’ have already been implemented in some universities in Brazil, and have been proved to reduce the gap between Afro-Brazilians and White-Brazilians (Andrade, 2004; Ferman and Assunção, 2005). However, some studies have challenged these findings, pointing that even though they

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<sup>43</sup> Again, these results might be affected by the small sample size of indigenous cohorts.

<sup>44</sup> Mexico’s *Progresa* also includes specific components targeted at minority groups; in this case, women receive higher transfers than men in order to reduce the gender gap in educational outcomes.



have guaranteed the access of some Afro-Brazilians to college, their proportion in the total alumnae is still remarkably small (Francis and Tannuri-Piant, 2010). Extending their coverage could increase the efficiency of quotas and generate a greater impact in reducing the ethnic gap, while ensuring that future generations of the ethnic minority are able to ‘catch-up’ to the more advantaged group, which would directly address the persistent nature of educational inequalities (Fizbein and Schady, 2009).

However, there are some important notions to consider when designing policies from the presented results. First, both countries begin from different initial situations, which suggest that educational policies should focus on the particularities of each country’s educational system. Second, it is also relevant to consider the relative size of the ethnic groups in each country. Afro-Brazilians represent 40 percent of the total population, which implies that policies would have to be comparatively larger than any interventions in Chile (where the indigenous represent only 6 percent). Therefore, these differential concerns are also relevant when determining the extent and scale of the proposed interventions. These policies should lead to a more equitable society and increase efficiency in the development process (Bourguignon *et al.*, 2007a).

Finally, further research is also required to consider inequality traps between other groups and outcomes, as well as additional methodological refinements to create a more comprehensive measurement framework to study long-term inequality of opportunity and the mechanisms which perpetuate situations of unequal power among groups to create a fairer society, at least in terms of opportunities.

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## 8 Tables

**Table 1**  
**Cohort definitions, sample sizes and composition**

### Brazil

Cohort label	Age in 2006	Years of birth	No. of Observations	Ethnicity		Parental Education			Children's Education		
				Ethnic Majority	Ethnic Minority	Low	Medium	High	Low	Medium	High
1	65 or +	1931 or -	12636	63.8	36.2	92.5	5.3	2.2	91.4	4.6	4.0
2	55 - 64	1932 - 41	15357	61.0	39.0	92.2	6.1	1.7	88.0	6.6	5.3
3	45 - 54	1942 - 51	24011	60.2	39.8	90.0	8.0	2.0	79.3	11.2	9.5
4	35 - 44	1952 - 61	34128	60.2	39.8	86.3	11.0	2.7	71.6	16.8	11.7
5	25 - 34	1962 - 71	32782	58.8	41.2	82.7	13.8	3.5	69.0	21.1	9.9

Source: Authors' calculations from PNAD data.

Note: Data is from survey year 1996 of the *Pesquisa Nacional por Amostra de Domicílios* (PNAD). Ethnic Majority corresponds to descendants of European immigrants while Ethnic Minority includes afro-descendent individuals following Guerreiro (2008).

The low education category includes individuals with complete primary level or less. The medium education category includes individuals with incomplete or complete high-school and the high category includes individuals with incomplete or complete college or technical education and some post-high school degree.

**Table 2**  
**Cohort definitions, sample sizes and composition**

### Chile

Cohort label	Age in 2006	Years of birth	No. of Observations	Ethnicity		Parental Education			Children's Education		
				Ethnic Majority	Ethnic Minority	Low	Medium	High	Low	Medium	High
1	65 or +	1941 or -	31223	94.8	5.2	76.8	15.6	7.6	61.8	28.8	9.4
2	55 - 64	1942 - 51	29950	94.4	5.6	71.6	20.3	8.0	47.8	35.5	16.7
3	45 - 54	1952 - 61	42583	94.3	5.7	66.9	23.9	9.2	33.7	44.8	21.5
4	35 - 44	1962 - 71	49057	93.7	6.3	60.9	29.0	10.1	25.9	50.9	23.2
5	25 - 34	1972 - 81	37311	92.7	7.3	49.1	35.9	15.0	16.9	52.6	30.6

Source: Authors' calculations from CASEN data.

Note: Data are from survey years 2006 and 2009 of the *Encuesta de Caracterización Socioeconómica Nacional* (CASEN). Ethnic Majority corresponds to indigenous individuals while Ethnic Minority includes non-indigenous individuals following the classification in Agostini *et al.* (2010).

The low education category includes individuals with complete primary level or less. The medium education category includes individuals with incomplete or complete high-school and the high category includes individuals with incomplete or complete college or technical education and some post-high school degree.



**Table 3**  
**Inequality of educational opportunities between ethnic groups**  
**Heterogeneity index  $H^{IO}$**

Groups	Cohort label									
	1		2		3		4		5	
<b>Brazil</b>										
Ethnicity	<b>0.185</b>		<b>0.178</b>		<b>0.201</b>		<b>0.233</b>		<b>0.217</b>	
	(0.170	0.198)	(0.162	0.189)	(0.190	0.214)	(0.223	0.244)	(0.206	0.229)
Ethnicity, Gender and parental education	<b>0.452</b>		<b>0.414</b>		<b>0.467</b>		<b>0.460</b>		<b>0.460</b>	
	(0.410	0.478)	(0.385	0.429)	(0.439	0.488)	(0.439	0.474)	(0.441	0.472)
<b>Chile</b>										
Ethnicity	<b>0.273</b>		<b>0.267</b>		<b>0.236</b>		<b>0.238</b>		<b>0.227</b>	
	(0.232	0.315)	(0.219	0.302)	(0.197	0.271)	(0.210	0.267)	(0.195	0.261)
Ethnicity, Gender and parental education	<b>0.501</b>		<b>0.441</b>		<b>0.387</b>		<b>0.445</b>		<b>0.419</b>	
	(0.464	0.529)	(0.406	0.467)	(0.362	0.400)	(0.414	0.475)	(0.388	0.443)

Source: Authors' calculations from PNAD and CASEN data.

Note: 95% confidence intervals obtained by bootstrap methods with 300 replications. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 4**  
**Differences in the  $H^{IO}$  index between cohorts**

<b>Brazil</b>									
Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5				
1		<b>0.001</b>	<b>0.025</b>	<b>0.057</b>	<b>0.044</b>				
		(-0.014	0.019)	(0.008	0.040)	(0.042	0.072)	(0.028	0.060)
2			<b>0.024</b>	<b>0.056</b>	<b>0.043</b>				
			(0.008	0.042)	(0.041	0.073)	(0.027	0.059)	
3				<b>0.032</b>	<b>0.019</b>				
				(0.016	0.045)	(0.004	0.034)		
4					<b>-0.013</b>				
					(-0.029	-0.001)			
5									
<b>Chile</b>									
Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5				
1		<b>0.007</b>	<b>-0.002</b>	<b>0.006</b>	<b>0.013</b>				
		(-0.015	0.030)	(-0.024	0.017)	(-0.014	0.026)	(-0.007	0.036)
2			<b>-0.009</b>	<b>-0.002</b>	<b>0.006</b>				
			(-0.033	0.013)	(-0.023	0.022)	(-0.016	0.031)	
3				<b>0.007</b>	<b>0.015</b>				
				(-0.015	0.029)	(-0.007	0.040)		
4					<b>0.007</b>				
					(-0.013	0.031)			
5									

Source: Authors' calculations from PNAD and CASEN data.

Note: Each cell presents the estimate difference between the estimation of  $H^{IO}$  for cohort t+1 and cohort t (see Table 3). 95% confidence intervals obtained by bootstrap methods with 300 replications. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 5**  
**Intergenerational educational mobility by ethnicity**  
**Heterogeneity index  $H(g)^M$  between the transition matrices of each ethnicity and the perfect independence matrix**

*Brazil*

Cohort label	Ethnic Majority			Ethnic Minority		
	Index	Statistic*	P-value	Index	Statistic*	P-value
1	0.140	4429.3	0.000	0.220	5465.1	0.000
2	0.121	4433.8	0.000	0.187	5841.5	0.000
3	0.124	4694.6	0.000	0.146	6781.8	0.000
4	0.123	4831.1	0.000	0.124	7653.6	0.000
5	0.114	4414.5	0.000	0.123	6922.4	0.000

*Chile*

Cohort label	Ethnic Majority			Ethnic Minority		
	Index	Statistic	P-value	Index	Statistic	P-value
1	0.103	5430.1	0.000	0.139	8294.0	0.000
2	0.100	3229.5	0.000	0.082	4536.9	0.000
3	0.103	3656.0	0.000	0.075	3814.1	0.000
4	0.128	5148.9	0.000	0.093	4807.5	0.000
5	0.155	5232.1	0.000	0.113	4171.0	0.000

Source: Authors' calculations from PNAD and CASEN data.

Note: \*Homogeneity test results.  $H_0: P_{ij}^{Ethnic\ group\ g} = P_{ij}^{Perfect\ independence}, \forall i, j = 1, \dots, O$  at 95% of confidence. For both countries and all the cohorts the  $H_0$  is rejected at 95%.

In Brazil, Ethnic Majority corresponds to descendants of European immigrants, while Ethnic Minority includes afro-descendent individuals. In Chile, Ethnic Majority corresponds to indigenous individuals, while Ethnic Minority includes non-indigenous individuals. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 6**  
**Differences in the  $H(g)^M$  index between cohorts - Brazil**

*Ethnic Majority*

Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5
1		<b>-0.019</b> (-0.029 -0.008)	<b>-0.016</b> (-0.030 -0.001)	<b>-0.017</b> (-0.030 -0.007)	<b>-0.026</b> (-0.037 -0.017)
2			<b>0.003</b> (-0.013 0.016)	<b>0.002</b> (-0.012 0.013)	<b>-0.007</b> (-0.018 0.003)
3				<b>-0.001</b> (-0.015 0.012)	<b>-0.010</b> (-0.025 0.003)
4					<b>-0.009</b> (-0.022 0.002)
5					

**Table 6 (cont.)**

*Ethnic Minority*

Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5
1		<b>-0.033</b> (-0.072 0.009)	<b>-0.074</b> (-0.118 -0.048)	<b>-0.096</b> (-0.146 -0.069)	<b>-0.097</b> (-0.141 -0.074)
2			<b>-0.041</b> (-0.079 -0.012)	<b>-0.062</b> (-0.105 -0.042)	<b>-0.064</b> (-0.099 -0.043)
3				<b>-0.022</b> (-0.046 0.004)	<b>-0.023</b> (-0.051 -0.004)
4					<b>-0.002</b> (-0.019 0.013)
5					

Source: Authors' calculations from PNAD data.

Note: Each cell presents the estimate difference between the estimation of  $H(g)^M$  for cohort t+1 and cohort t (see Table 5). 95% confidence intervals obtained by bootstrap methods with 300 replications. Ethnic Majority corresponds to descendants of European immigrants, while Ethnic Minority includes afro-descendent individuals. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 7**  
**Differences in the  $H(g)^M$  index between cohorts - Chile**

*Ethnic Majority*

Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5
1		<b>-0.003</b> (-0.015 0.009)	<b>0.000</b> (-0.012 0.010)	<b>0.025</b> (0.014 0.034)	<b>0.052</b> (0.043 0.062)
2			<b>0.003</b> (-0.009 0.013)	<b>0.028</b> (0.014 0.038)	<b>0.055</b> (0.043 0.065)
3				<b>0.025</b> (0.017 0.033)	<b>0.052</b> (0.043 0.061)
4					<b>0.027</b> (0.019 0.036)
5					

*Ethnic Minority*

Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5
1		<b>-0.058</b> (-0.151 0.016)	<b>-0.064</b> (-0.173 -0.016)	<b>-0.047</b> (-0.153 -0.010)	<b>-0.027</b> (-0.130 0.001)
2			<b>-0.007</b> (-0.069 0.020)	<b>0.011</b> (-0.055 0.039)	<b>0.031</b> (-0.033 0.050)
3				<b>0.018</b> (-0.024 0.056)	<b>0.037</b> (-0.013 0.072)
4					<b>0.020</b> (-0.021 0.072)
5					

Source: Authors' calculations from CASEN data.

Note: Each cell presents the estimate difference between the estimation of  $H(g)^M$  for cohort t+1 and cohort t (see Table 5). 95% confidence intervals obtained by bootstrap methods with 300 replications. Ethnic Majority corresponds to indigenous individuals while Ethnic Minority includes non-indigenous individuals. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 8**  
**Intergenerational educational mobility**  
**Heterogeneity index  $H^M$  between transition matrices**

Cohort label	Brazil			Chile		
	$H^M$	Statistic*	P-value	$H^M$	Statistic*	P-value
1	0.051	261.9	0.000	0.089	1263.5	0.000
2	0.059	384.2	0.000	0.081	1405.2	0.000
3	0.034	639.7	0.000	0.042	1387.7	0.000
4	0.053	1424.3	0.000	0.036	1273.6	0.000
5	0.049	1158.3	0.000	0.026	773.2	0.000

Source: Authors' calculations from PNAD and CASEN data.

Note: \*Homogeneity test results.  $H_0: P_{ij}^{EthnicMajority} = P_{ij}^{EthnicMinority}, \forall i, j = 1, \dots, O$  at 95% of confidence. For both countries and all the cohorts the  $H_0$  is rejected at 95%. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 9**  
**Differences in the  $H^M$  index between cohorts**

*Brazil*

Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5
1		<b>0.009</b> (-0.055 0.061)	<b>-0.016</b> (-0.079 0.013)	<b>0.002</b> (-0.059 0.028)	<b>-0.002</b> (-0.60 0.025)
2			<b>-0.025</b> (-0.071 0.009)	<b>-0.006</b> (-0.059 0.027)	<b>-0.010</b> (-0.062 0.021)
3				<b>0.019</b> (-0.008 0.039)	<b>0.015</b> (-0.008 0.034)
4					<b>-0.004</b> (-0.027 0.015)
5					

*Chile*

Cohort label	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5
1		<b>-0.008</b> (-0.135 0.092)	<b>-0.047</b> (-0.175 0.020)	<b>-0.053</b> (-0.174 0.020)	<b>-0.063</b> (-0.174 -0.006)
2			<b>-0.039</b> (-0.122 0.026)	<b>-0.045</b> (-0.125 0.007)	<b>-0.055</b> (-0.142 -0.005)
3				<b>-0.006</b> (-0.049 0.033)	<b>-0.016</b> (-0.054 0.021)
4					<b>-0.010</b> (-0.048 0.023)
5					

Source: Authors' calculations from PNAD and CASEN data.

Note: Each cell presents the estimate difference between the estimation of  $H^M$  for cohort t+1 and cohort t (see Table 8). 95% confidence intervals obtained by bootstrap methods with 300 replications. See Tables 1 and 2 for definitions of birth-cohorts.

**Table 10**  
**% of Individuals high lower, same and higher educational level than their parents**

Cohort label	Brazil				Chile			
	Average years of education	% Lower education than parents	% Same education than parents	% Higher education than parents	Average years of education	% Lower education than parents	% Same education than parents	% Higher education than parents
<i>Total</i>								
1	2.7	4.0	90.2	5.8	6.7	7.7	69.2	23.2
2	3.6	3.7	87.2	9.1	8.4	6.2	59.1	34.7
3	4.9	3.4	80.0	16.6	10.0	5.9	49.0	45.1
4	6.2	4.0	73.5	22.5	10.9	5.6	46.5	47.9
5	6.8	5.9	72.1	22.0	12.0	5.5	47.0	47.6
<i>Ethnic Majority</i>								
1	3.4	5.0	87.0	8.0	6.8	7.9	68.3	23.8
2	4.4	4.3	83.6	12.1	8.5	6.3	58.3	35.4
3	5.9	3.7	75.5	20.8	10.2	5.9	48.5	45.6
4	7.2	4.3	67.6	28.1	11.0	5.7	46.0	48.2
5	7.7	6.2	66.8	27.0	12.1	5.5	46.9	47.6
<i>Ethnic Minority</i>								
1	1.4	2.0	96.1	2.0	4.3	3.4	84.7	11.9
2	2.3	2.5	93.0	4.4	6.2	4.8	72.0	23.2
3	3.4	2.4	87.8	9.8	8.1	5.3	57.4	37.4
4	4.7	3.6	82.6	13.8	9.2	4.2	53.2	42.7
5	5.6	5.4	79.3	15.4	10.4	5.1	47.5	47.4

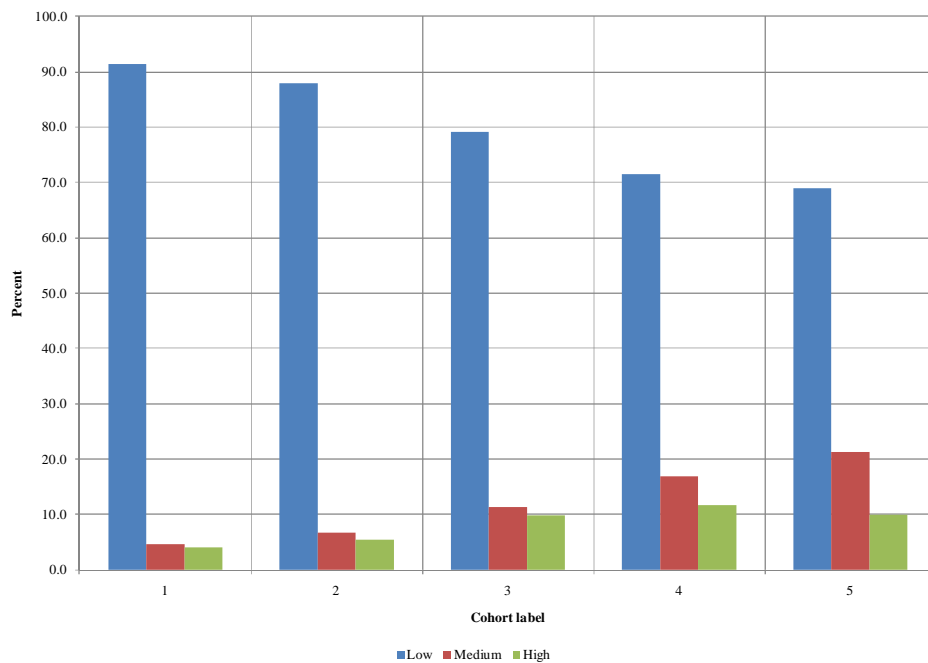
Source: Authors' calculations from PNAD and CASEN data.

Note: In Brazil, Ethnic Majority corresponds to descendants of European immigrants while Ethnic Minority includes afro-descendent individuals. In Chile, Ethnic Majority corresponds to indigenous individuals while Ethnic Minority includes non-indigenous individuals. See Tables 1 and 2 for definitions of birth-cohorts.

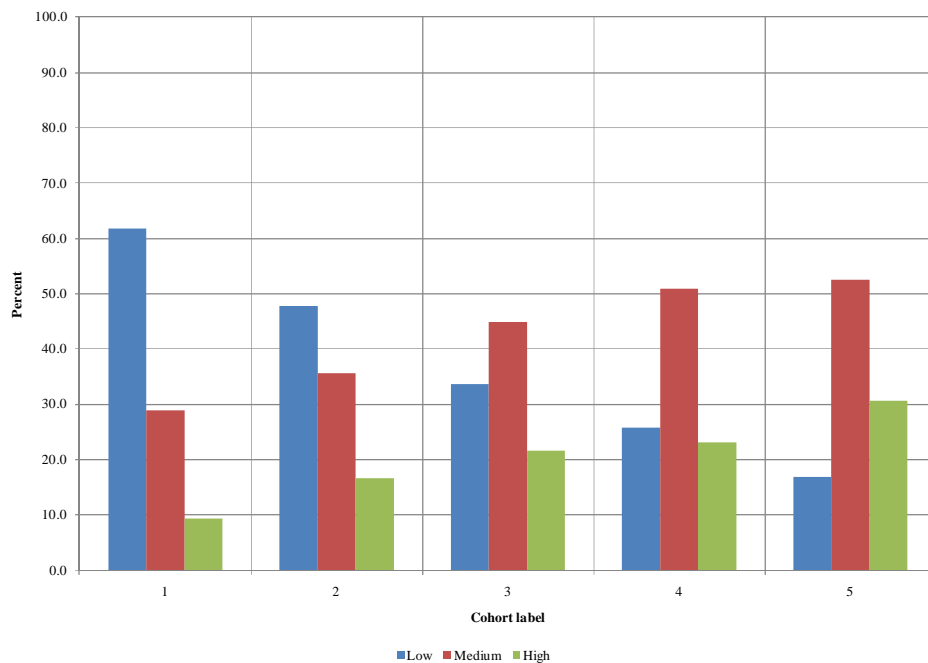
## 9 Figures

**Figure 1**  
Individual educational distributions by cohort

*Panel A – Brazil*



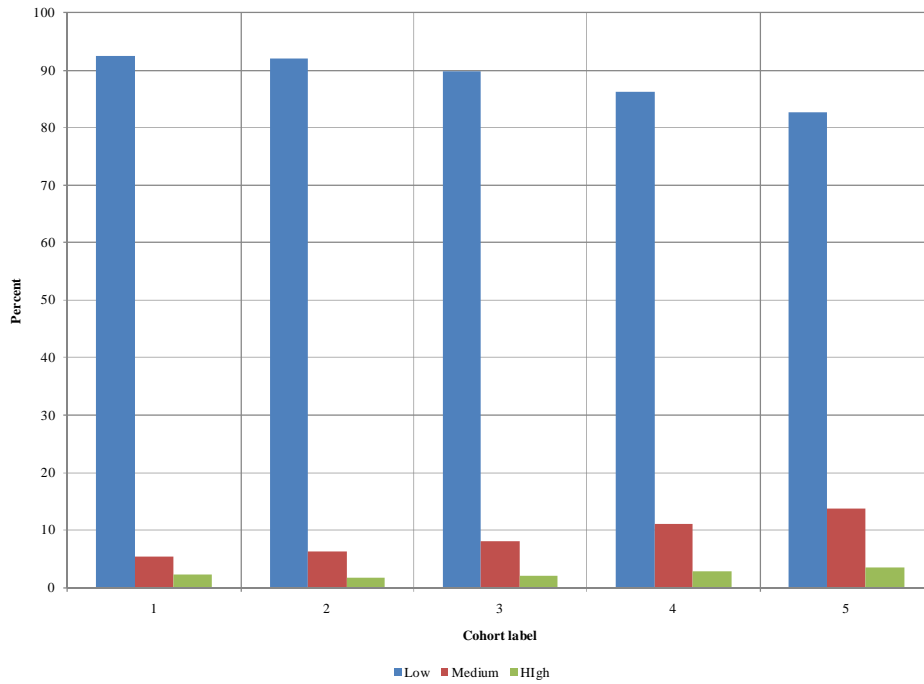
*Panel B – Chile*



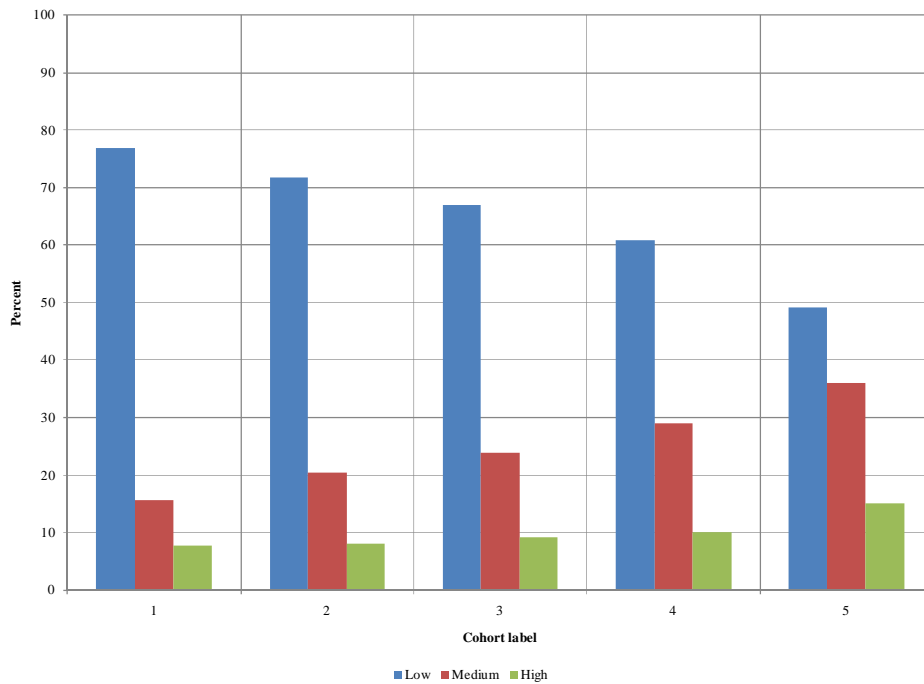
Source: Authors' calculations from PNAD and CASEN data.

Note: The low education category includes individuals with complete primary level or less. The medium education category includes individuals with incomplete or complete high-school and the high category includes individuals with incomplete or complete college or technical education and some post-high school degree. See Tables 1 and 2 for definitions of birth-cohorts.

**Figure 2**  
**Parental educational distributions by cohort**  
*Panel A – Brazil*



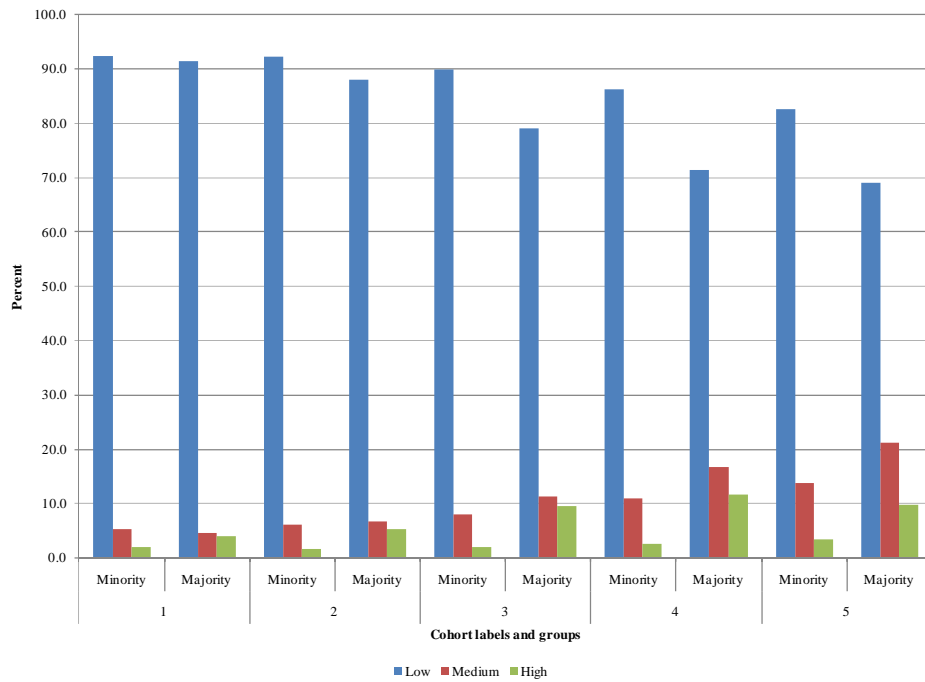
*Panel B – Chile*



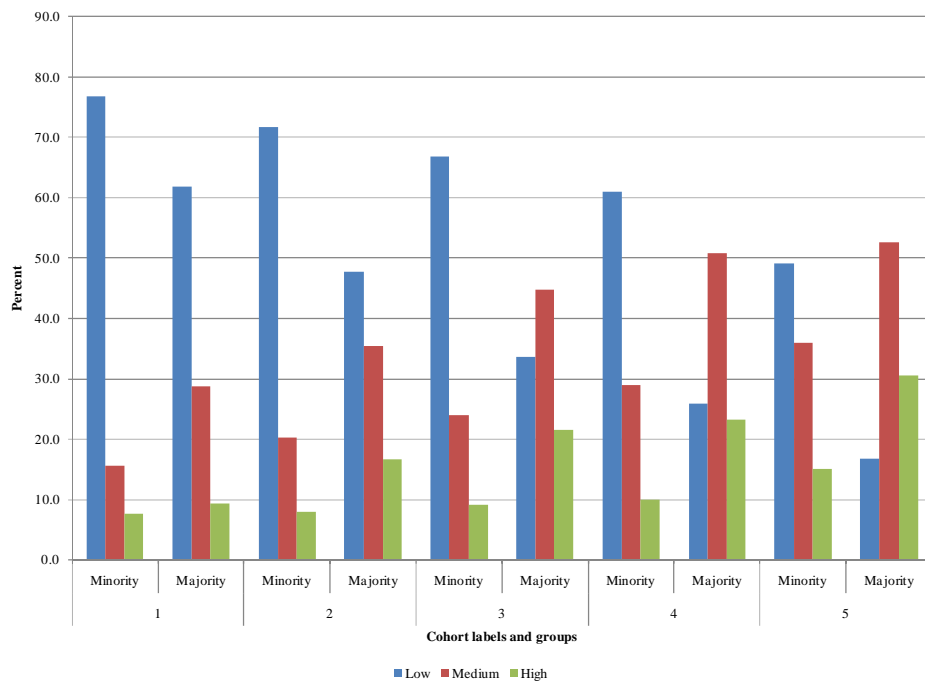
Source: Authors' calculations from PNAD and CASEN data.

Note: The low education category includes individuals with complete primary level or less. The medium education category includes individuals with incomplete or complete high-school and the high category includes individuals with incomplete or complete college or technical education and some post-high school degree. See Tables 1 and 2 for definitions of birth-cohorts.

**Figure 3**  
**Educational distributions by ethnic groups across cohorts.**  
*Panel A - Brazil*



*Panel B - Chile*

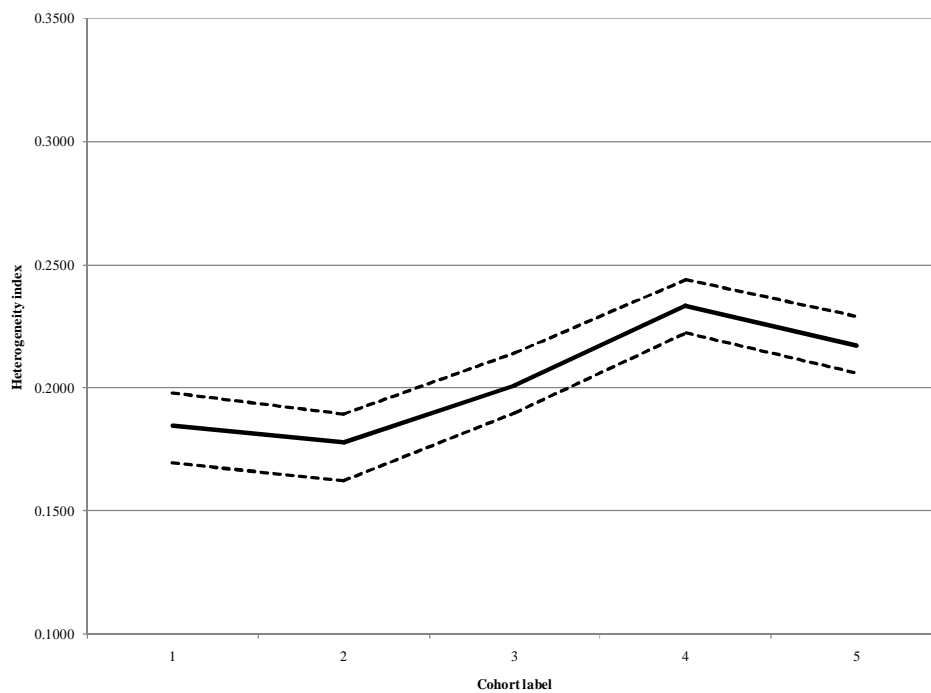


Source: Authors' calculations from PNAD and CASEN data.

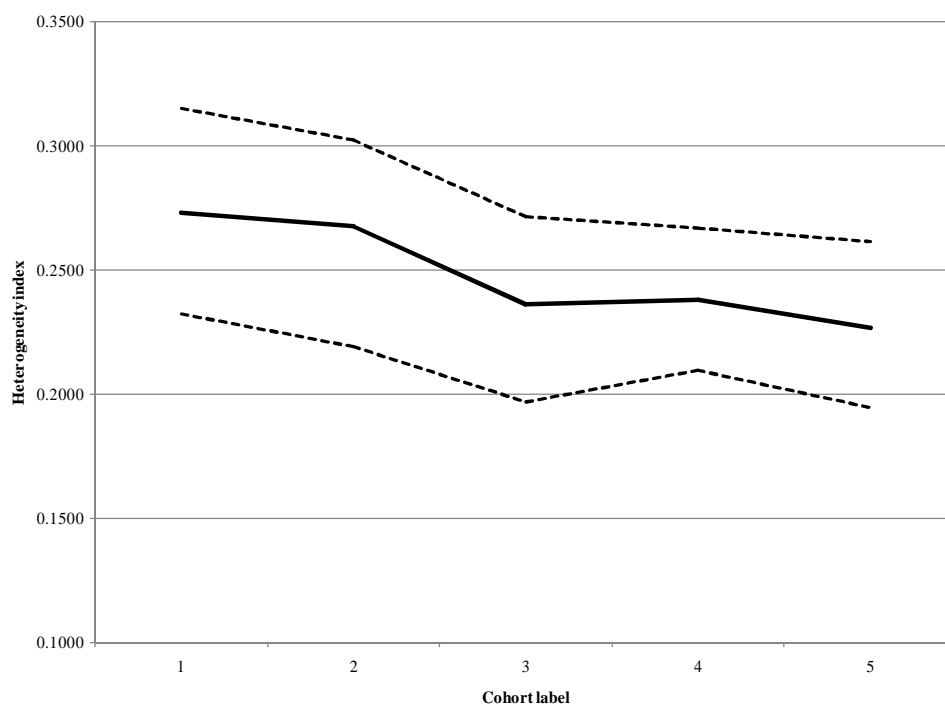
Note: In Brazil, Ethnic Majority corresponds to descendants of European immigrants while Ethnic Minority includes afro-descendent individuals. In Chile, Ethnic Majority corresponds to indigenous individuals while Ethnic Minority includes non-indigenous individuals. The low education category includes individuals with complete primary level or less. The medium education category includes individuals with incomplete or complete high-school and the high category includes individuals with incomplete or complete college or technical education and some post-high school degree. See Tables 1 and 2 for definitions of birth-cohorts.



**Figure 4**  
**Inequality in educational opportunities between ethnic groups and cohorts.**  
**Heterogeneity index  $H^{IO}$**   
*Panel A – Brazil*



*Panel B – Chile*



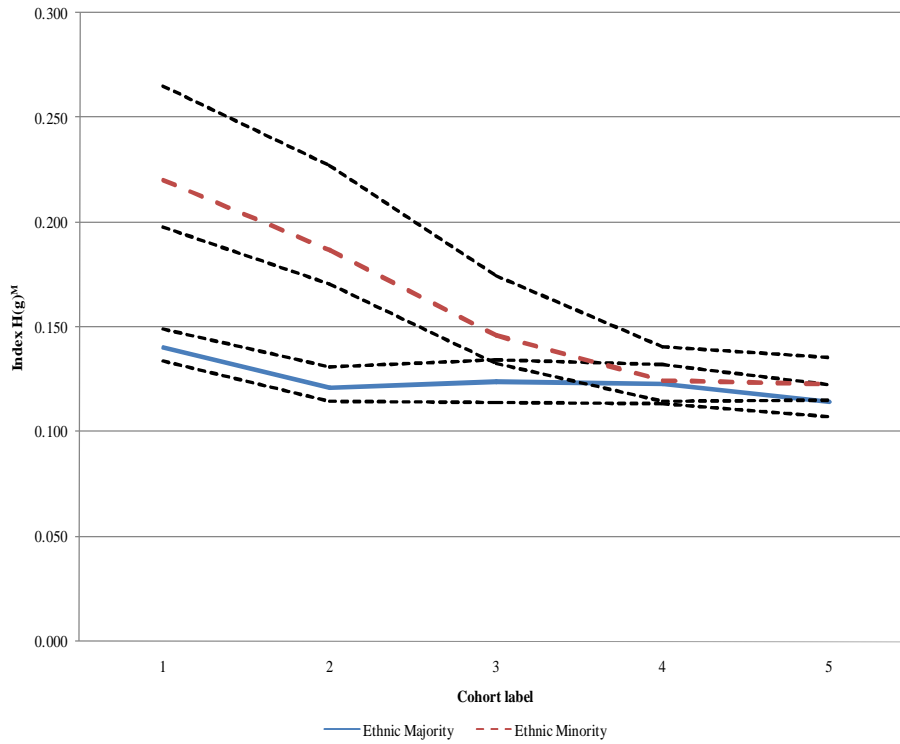
Source: Authors' calculations from PNAD and CASEN data.

Note: 95% confidence intervals depicted by dotted lines (obtained by bootstrap methods with 300 replications). See Tables 1 and 2 for definitions of birth-cohorts.

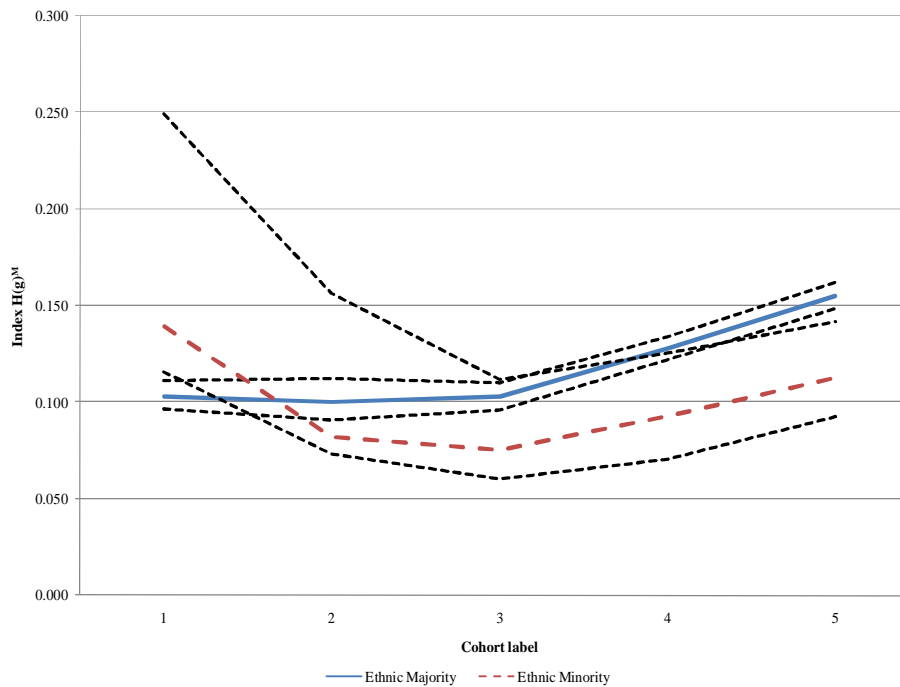
**Figure 5**

**Differences in intergenerational educational mobility between ethnic groups and cohorts**  
**Heterogeneity index  $H(g)^M$  between transition matrices**

*Panel A – Brazil*



*Panel B – Chile*



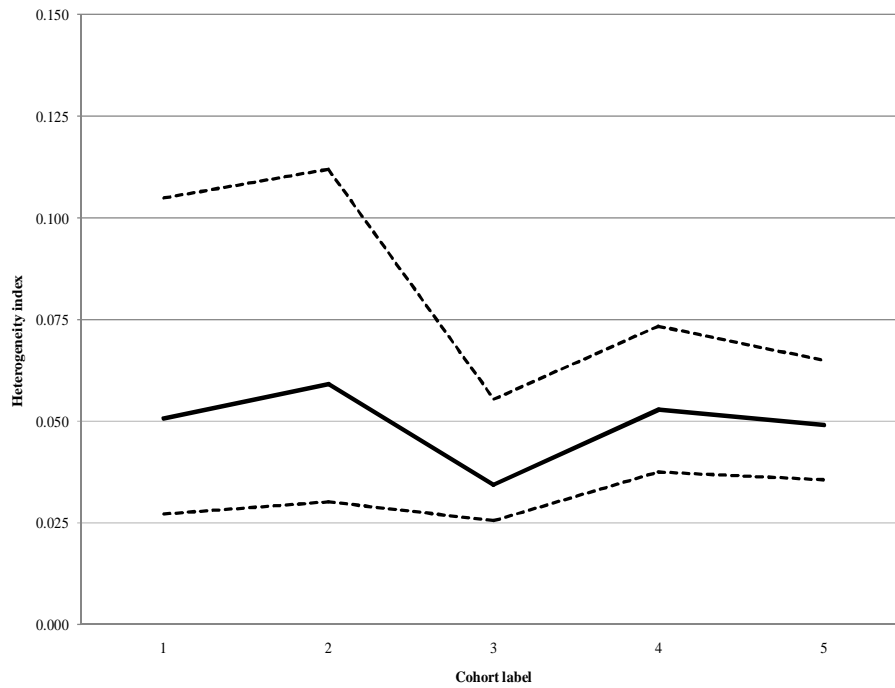
Source: Authors' calculations from PNAD and CASEN data.

Note: 95% confidence intervals depicted by dotted lines (obtained by bootstrap methods with 300 replications).

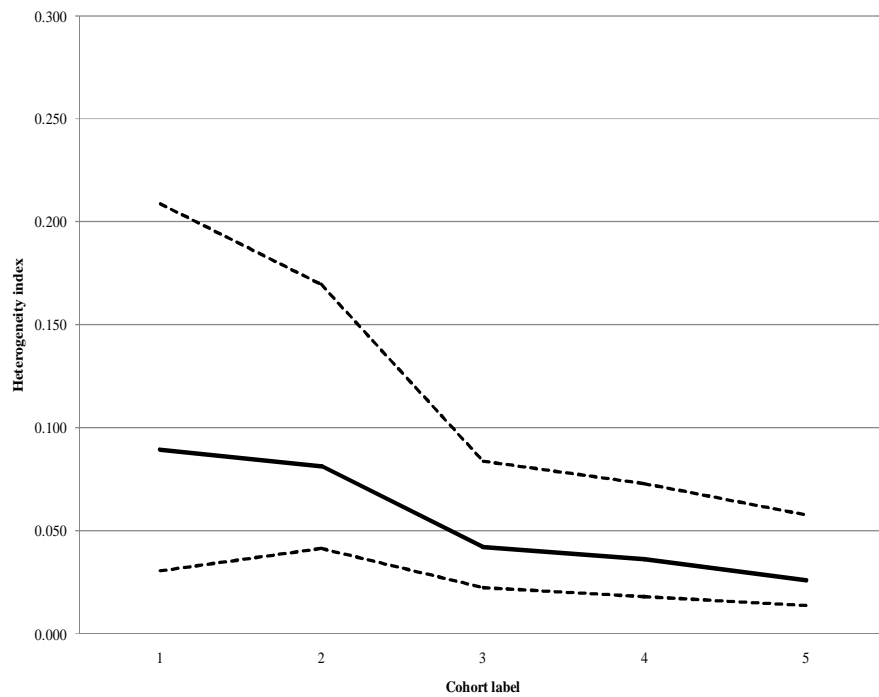
See Tables 1 and 2 for definitions of birth-cohorts.

**Figure 6**  
**Differences in intergenerational educational mobility between ethnic groups and cohorts**  
**Heterogeneity index  $H^M$  between transition matrices**

*Panel A – Brazil*



*Panel B – Chile*



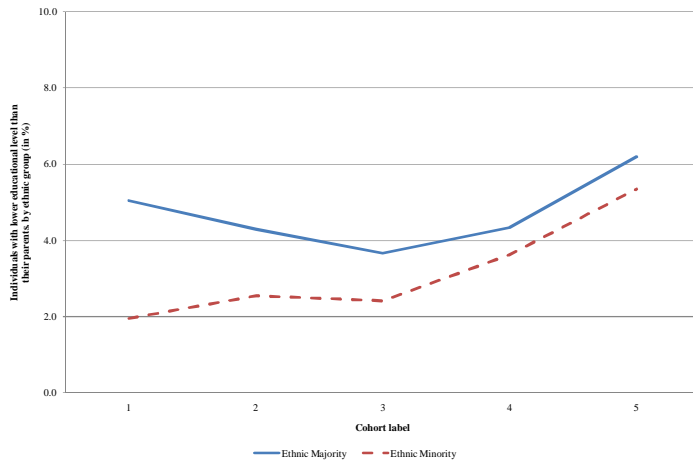
Source: Authors' calculations from PNAD and CASEN data.

Note: 95% confidence intervals depicted by dotted lines (obtained by bootstrap methods with 300 replications).

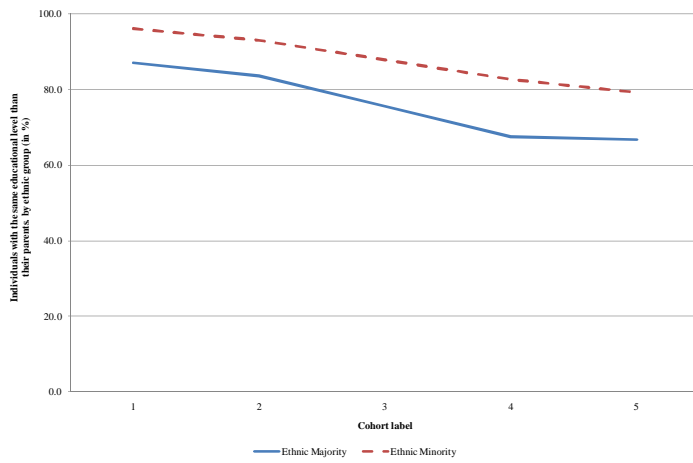
See Tables 1 and 2 for definitions of birth-cohorts.

**Figure 7**  
**Brazil: Percentage of individuals whose education is lower, the same or higher than their parents, by ethnic group and cohorts**

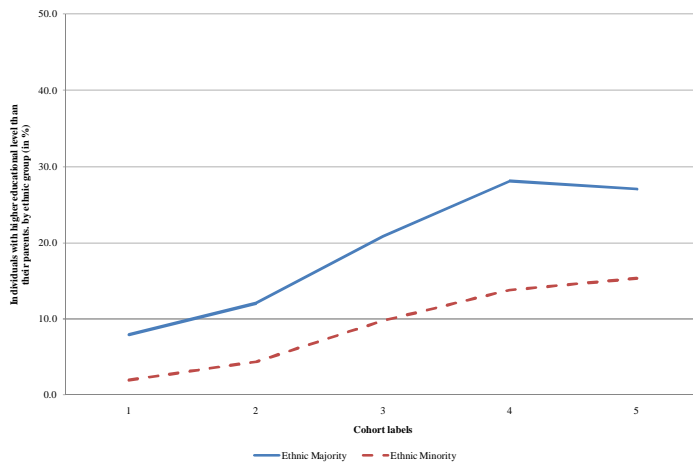
*Panel A*



*Panel B*



*Panel C*



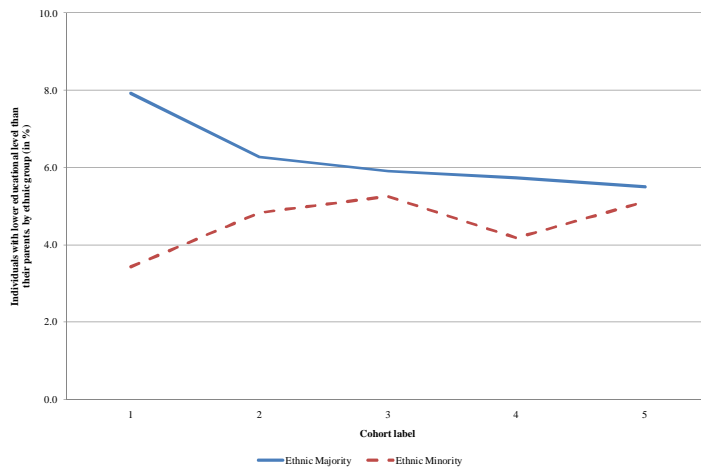
Source: Authors' calculations from PNAD data.

Note: In Brazil, Ethnic Majority corresponds to descendants of European immigrants while Ethnic Minority includes afro-descendent individuals. See Table 1 for definitions of birth-cohorts.

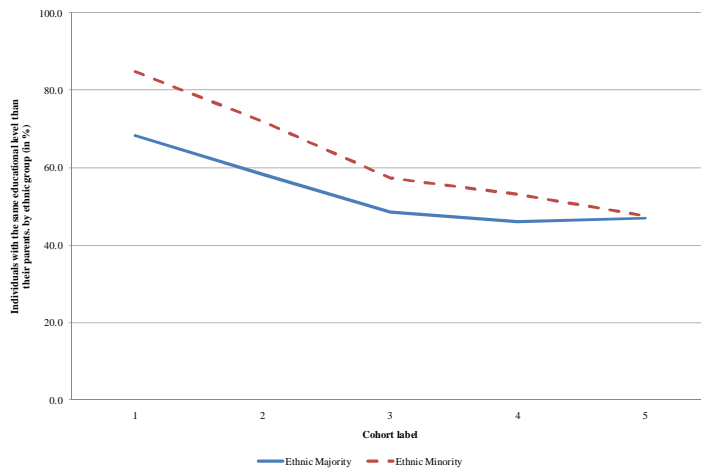
**Figure 8**

**Chile: Percentage of individuals whose education is lower, the same or higher than their parents, by ethnic group and cohorts**

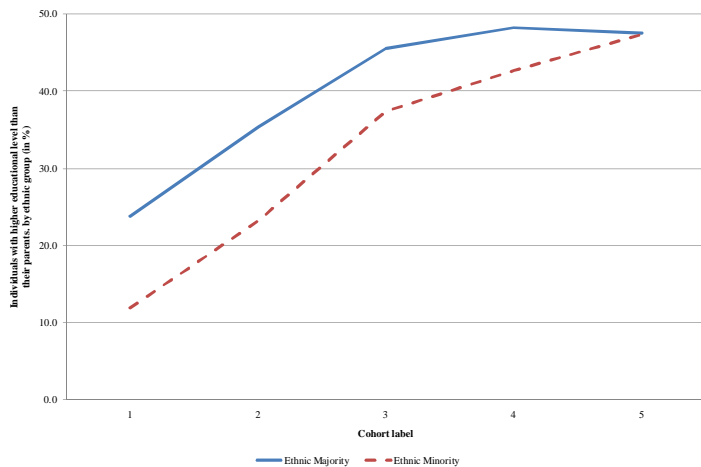
*Panel A*



*Panel B*



*Panel C*



Source: Authors' calculations from CASEN data.

Note: In Brazil, Ethnic Majority corresponds to descendants of European immigrants while Ethnic Minority includes afro-descendent individuals. See Table 2 for definitions of birth-cohorts.

## Appendix

**Table A.1**  
**Transition matrices - Brazil**

Parental Educational Level	Individual's Educational Level								
	Total			Ethnic Majority			Ethnic Minority		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
<i>Cohort 1</i>									
Low	0.88	0.03	0.02	0.84	0.04	0.02	0.96	0.01	0.01
Medium	0.03	0.01	0.01	0.03	0.02	0.02	0.02	0.00	0.00
High	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
<i>Cohort 2</i>									
Low	0.85	0.05	0.03	0.80	0.06	0.04	0.92	0.03	0.01
Medium	0.03	0.02	0.02	0.03	0.02	0.03	0.02	0.01	0.00
High	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00
<i>Cohort 3</i>									
Low	0.76	0.08	0.05	0.70	0.09	0.07	0.86	0.06	0.02
Medium	0.02	0.03	0.03	0.03	0.03	0.04	0.02	0.02	0.01
High	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.00
<i>Cohort 4</i>									
Low	0.68	0.13	0.06	0.60	0.15	0.08	0.80	0.10	0.03
Medium	0.03	0.04	0.04	0.03	0.04	0.06	0.03	0.03	0.02
High	0.00	0.00	0.02	0.00	0.01	0.03	0.00	0.00	0.00
<i>Cohort 5</i>									
Low	0.64	0.15	0.04	0.57	0.17	0.05	0.75	0.12	0.02
Medium	0.05	0.06	0.04	0.05	0.07	0.05	0.05	0.04	0.02
High	0.00	0.01	0.02	0.00	0.01	0.04	0.00	0.00	0.01

Source: Authors' calculations from PNAD data.

Note: In Brazil, Ethnic Majority corresponds to descendants of European immigrants while Ethnic Minority includes afro-descendent individuals. See Table 1 for definitions of birth-cohorts.

**Table A.2**  
**Transition matrices - Chile**

Parental Educational Level	Individual's Educational Level								
	Total			Ethnic Majority			Ethnic Minority		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
<i>Cohort 1</i>									
Low	0.57	0.17	0.02	0.56	0.18	0.02	0.82	0.09	0.02
Medium	0.03	0.09	0.04	0.03	0.09	0.04	0.02	0.03	0.01
High	0.01	0.03	0.03	0.01	0.03	0.04	0.01	0.00	0.00
<i>Cohort 2</i>									
Low	0.44	0.23	0.05	0.43	0.23	0.05	0.68	0.18	0.03
Medium	0.03	0.10	0.07	0.03	0.11	0.07	0.03	0.03	0.02
High	0.01	0.02	0.05	0.01	0.02	0.05	0.01	0.01	0.01
<i>Cohort 3</i>									
Low	0.30	0.30	0.07	0.29	0.30	0.07	0.51	0.30	0.04
Medium	0.03	0.13	0.09	0.03	0.13	0.09	0.03	0.05	0.04
High	0.01	0.03	0.06	0.01	0.03	0.06	0.01	0.02	0.02
<i>Cohort 4</i>									
Low	0.23	0.32	0.06	0.22	0.32	0.06	0.41	0.34	0.04
Medium	0.03	0.16	0.10	0.03	0.17	0.10	0.03	0.10	0.05
High	0.00	0.03	0.07	0.00	0.03	0.08	0.00	0.01	0.01
<i>Cohort 5</i>									
Low	0.14	0.29	0.06	0.13	0.28	0.06	0.29	0.35	0.06
Medium	0.02	0.21	0.13	0.02	0.21	0.14	0.02	0.14	0.06
High	0.00	0.03	0.12	0.00	0.03	0.12	0.00	0.03	0.04

Source: Authors' calculations from CASEN data.

Note: In Chile, Ethnic Majority corresponds to indigenous individuals while Ethnic Minority includes non-indigenous individuals. See Table 2 for definitions of birth-cohorts.