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Inequality in Education: Evidence for Latin America

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Facultad de Ciencias Económicas



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Inequality in Education: Evidence for Latin America

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Inequality in Education

Evidence for Latin America *

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Abstract: This paper provides original empirical evidence on the evolution of education inequality for all Latin American countries over the decades of 1990 and 2000. The analysis covers a wide range of issues on differences in educational outcomes and opportunities across the population, including inequality in years of education, gaps in school enrollment, wage skill differentials and public social expenditure. The evidence indicates a significant difference between the 1990s and the 2000s in terms of both the assessment of the equity of the education expansion and its impact on the income distribution. In particular, the changes in the 2000s seem to have had a full equalizing impact on earnings given the more pro-poor pattern of the education upgrading and a more stable or even increasing relative demand for low skill labor.

Keywords: education, inequality, enrollment, wage premium, Latin America.

JEL Codes: I24, I25, I28, O15.

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1. Introduction

Formal education is certainly one of the main determinants of an individual's income and arguably the main key to the access to a wide set of economic and social opportunities. Therefore, understanding the distribution of welfare in a population requires an assessment of the distribution of educational outcomes and their changes over time. This assessment is particularly relevant for Latin America, a region with high levels of income inequality, and wide gaps of educational achievements and opportunities across socioeconomic groups. The issue is particularly relevant for the region since the distributions of incomes and education levels have changed substantially over the last decades. After two decades of distributional setbacks - the 1980s with macroeconomic crises, and the 1990s with market-oriented reforms -, income inequality started to fall consistently in the 2000s in almost all Latin American countries (Gasparini, Cruces and Tornarolli, 2011). At the same time, these decades witnessed a substantial expansion in education. Although the expansion was widespread across countries, attainment levels and socioeconomic groups, changes were not uniform, raising the issue of measuring the pattern in education inequality and its differential impact on the income distribution.

In this paper we document the main features and patterns of education inequality in Latin America, highlighting the links with the income distribution. In fact, "education inequality" is a shortcut for a wide range of issues regarding differences in educational outcomes and opportunities across the population. The concept encompasses the analysis of inequality in years of education, gaps in school enrollment, wage skill differential and labor demand factors, public social expenditure, school segregation and other related topics. This paper tackles most of these important issues, providing original empirical evidence for all Latin American countries.

The rest of the paper is organized as follows. In section 2 we provide empirical evidence on inequality in years of education among the working-age population. As one of the main productive assets for households, the level and distribution of human capital provides important insights on the patterns of income inequality. In section 3 we explore this relationship by means of multivariate regressions and microsimulation analysis that allows us to estimate the potential impact of the observed changes in the distribution of education on the earnings distribution, assuming no changes in the returns to education. Section 3 also discusses the potential impact of the education expansion in Latin American on the labor market, and in particular on wage gaps between workers classified by skill levels. Section 4 shifts the focus from the working-age population to children and youths, providing evidence on differences of schooling rates by income strata for all educational levels. Gaps in school enrollment and completion rates provide valuable information on the future of the income distribution, and are closely related to the concept of equality of opportunity. Section 5 explores the role played in the increase of schooling opportunities by three factors: economic growth, social spending and demography. We find that the positive educational scenario of the 2000s was due to a combination of stronger economic growth, increased salience

of social issues in the public arena, and a favorable phase of the region's demographic transition. We conclude in section 6 with a summary of the results and a discussion of their implications.¹

2. Inequality in education

In this section we briefly discuss the issue of measuring education inequality, we present a large set of indicators for all Latin American countries, we document changes in these indicators over the last two decades, and we provide a long term view since the 1940s for the region as a whole.

Our main source of information is the Socioeconomic Database for Latin America and the Caribbean (SEDLAC), jointly developed by CEDLAS at the Universidad Nacional de La Plata (Argentina) and the World Bank's LAC poverty group (LCSPP). This database contains information on more than 200 official household surveys in 25 LAC countries. All variables in SEDLAC are constructed using consistent criteria across countries and years, subject to the constraint of the survey questionnaires, and identical programming routines (see *sedlac.econo.unlp.edu.ar*).

2.1. Measuring inequality in education

Measuring inequality in education outcomes is not a trivial task. At least two methodological issues must be dealt with before the estimation exercise: the choice of the education variable to consider in the analysis, and the indicators used to measure inequality. Regarding the first issue, we follow most of the literature and focus on years of education of the working-age population. The choice is less clear for the second issue, as reflected in the multitude of inequality indicators used in the literature. A first conceptual issue is whether to make the inequality measurement conditional on a welfare indicator, like household income, or not. Are we, for instance, concerned with the educational gap between the income rich and the poor, or between the most and least educated? By conditioning on income we assume a concern for the association between education and income rather than for disparities in educational levels *per se*.

The second issue has to do with the nature - relative or absolute - of the comparisons. The usual assumption of scale invariance in the measurement of income inequality is not obviously translated into the estimations of inequality in non-monetary variables, like education.² Suppose in a certain period of time there is an increase of 3 years of education for all the relevant population. Is this change inequality increasing, neutral or inequality increasing? Relative inequality measures - the ones used when analyzing income distribution - assess this change as inequality-reducing, since the increase in

¹ The extended working paper version of this paper (Cruces *et al.* 2011) also includes a section on educational mobility and segregation of schools attended by different socioeconomic strata.

² See Cowell (2000) and Lambert (2001) for discussions on axioms behind the measurement of inequality.

years of education is proportionally more relevant for the least educated. Absolute inequality measures, on the other hand, evaluate the change that results from identical additions of years of education to all individuals as neutral for the level of inequality in the distribution of education.

Table 2.1 presents six alternative measures of education inequality for one specific case: Uruguay, 1992-2009. The first three indicators are unconditional, while the rest are conditional on income. In the first group we include two measures of absolute inequality - the education quintile gap and the adjusted Gini coefficient - and one measure of relative inequality: the traditional Gini coefficient. In the group of conditional measures we include the educational gap between income quintiles, the dissimilarity index and the concentration index.³

It is interesting to notice how the assessment of the changes in education inequality varies as we use different indicators. The unconditional measures indicate a fall in inequality, small in the absolute measures (gap and adjusted Gini) and more significant in the relative measure (traditional Gini). Instead, the conditional measures unveil an increase in education inequality. In particular, the gap in years of education between the bottom and top income quintiles widened substantially over the period under analysis.

Table 2.1
Alternative education inequality indicators
Years of education, adults 25-65
Uruguay

	Unconditional			Conditional		
	Gap	Adjusted Gini	Gini	Gap	Dissimilarity	Concentration
1992	11.4	2.3	0.274	4.5	0.080	10.9
1998	11.0	2.3	0.248	5.3	0.090	12.1
2004	11.1	2.3	0.236	6.2	0.099	13.2
2009	10.9	2.2	0.232	6.4	0.103	14.0
Change 92-09	-4%	-2%	-15%	42%	29%	28%

Source: own calculations based on microdata from household surveys.

These different conclusions illustrate the relevance of methodological choices regarding inequality indicators for assessing the evolution in education inequality. Keeping these issues in mind, the rest of this section focuses the analysis on two indicators: the Gini coefficient for the distribution of years of education and the gap in years between quintiles 1 and 5 of the income distribution. These two measures illustrate well the variety of possible results, are widely used in the literature, and are relatively easy to communicate when compared to other alternative indicators.

³ The set of potential indicators includes the standard deviation, the Kolm index and others. See Gasparini, Cicowiez and Sosa Escudero (2011) for illustrations for Latin America.

2.2. Inequality in years of education: the 1990s and 2000s

We start by documenting average years of education in all Latin American countries with information obtained from the last national household survey available in each nation. Table 2.2 presents this information for all adults aged 25-65 (*i.e.* those deemed to have completed their education). The region presents some heterogeneity in the distribution of this indicator: only a minority of countries has an average of more than 9 years of education for adults in the 25-65 age range, including those in the Southern Cone (Argentina, Chile, Uruguay) and Panama, while some countries in Central America (Guatemala, Honduras and Nicaragua) have an average below 6.

Table 2.2
Years of education by gender and income quintile
and inequality in education
Adults aged 25 to 65

Country	Year	By gender			By income quintile					Inequality	
		All	Females	Males	Q1	Q2	Q3	Q4	Q5	Gap	Gini
Argentina	2009	11.0	11.2	10.8	8.4	9.4	10.3	11.5	13.6	5.2	0.205
Bolivia	2005	7.7	6.8	8.8	3.6	5.7	7.1	8.5	11.7	8.1	0.399
Brazil	2009	7.7	8.0	7.6	4.9	5.9	6.8	8.2	11.2	6.3	0.349
Chile	2009	11.0	10.9	11.1	8.9	9.6	10.2	11.3	13.7	4.8	0.195
Colombia	2006	7.9	7.9	7.9	5.3	5.5	6.6	8.1	12.0	6.7	0.357
Costa Rica	2009	8.7	8.8	8.6	5.8	6.7	7.3	9.0	12.7	7.0	0.283
Dominican Rep.	2007	8.2	8.4	8.1	5.9	6.5	7.5	8.6	11.3	5.5	0.348
Ecuador	2009	8.7	8.7	9.0	6.3	6.8	7.7	9.0	12.2	5.9	0.323
El Salvador	2008	7.1	6.7	7.6	3.5	5.0	6.1	7.5	11.3	7.8	0.418
Guatemala	2006	4.8	4.3	5.4	1.4	2.3	3.4	5.1	9.0	7.7	0.560
Honduras	2009	5.9	5.9	5.7	3.4	3.6	4.7	6.3	9.6	6.2	0.425
Mexico	2008	8.4	8.1	8.7	5.3	6.7	7.5	8.9	12.0	6.8	0.324
Nicaragua	2005	5.8	5.8	5.8	2.7	3.8	5.0	6.2	9.4	6.8	0.473
Panama	2009	9.9	10.1	9.7	5.8	7.8	9.3	10.6	13.7	7.9	0.270
Paraguay	2009	8.3	8.1	8.4	5.3	6.1	7.7	9.1	11.4	6.1	0.317
Peru	2009	8.9	8.2	9.5	4.9	6.8	8.5	10.0	12.2	7.3	0.330
Uruguay	2009	9.4	9.7	9.1	6.7	7.5	8.6	10.1	13.0	6.3	0.237
Venezuela	2006	8.9	9.3	8.6	6.8	7.3	8.1	9.3	11.6	4.9	0.284

Source: own calculations based on SEDLAC (CEDLAS and World Bank).

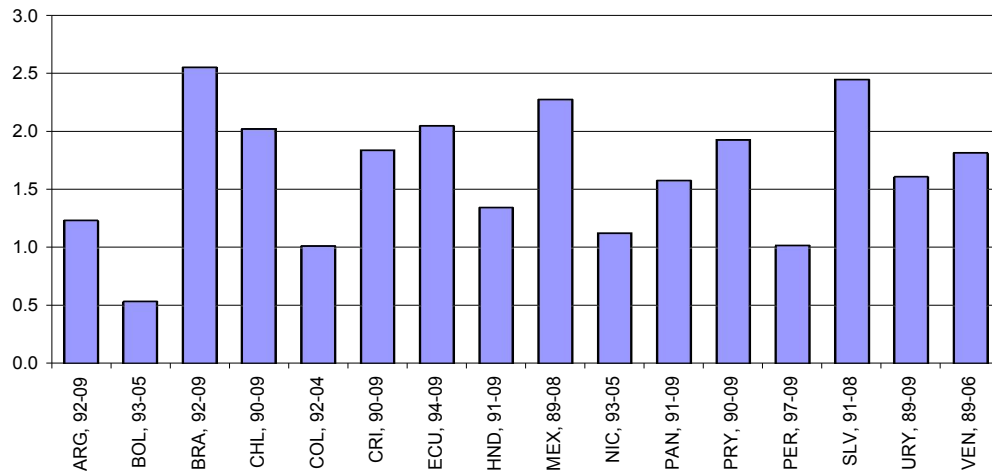
The third panel in table 2.2 indicates that the average difference in years of education for adults in the top quintile compared to those in the bottom quintile is very large, at around 6.5 years. The Gini for years of education varies over a wide range. It is about 0.40 or higher for Bolivia, El Salvador, Guatemala, Honduras and Nicaragua, and below 0.25 for Southern Cone countries.

Now let us turn to changes over time. Figure 2.1 illustrates the significant increase in the average years of education in all Latin American countries during the last two decades,⁴ continuing a process initiated decades ago.⁵

⁴ Notice that bars are not strictly comparable since they represent different time spans.

⁵ The average number of years of education for the adult population is a “sticky” indicator since the formal education accumulation process typically stops when people are in their twenties.

Figure 2.1
Change in years of education
Adult aged 25-65



Source: own calculations based on SEDLAC (CEDLAS and World Bank).

In all countries, education levels increased along the income distribution. Individuals from poor and rich socioeconomic strata are now more educated than individuals in the same groups some decades ago. In this paper, however, we are more concerned about *differences* in educational achievements than on trends for the mean. Figure 2.2 shows for each country changes in the two selected educational inequality indicators discussed above: the gap between the bottom and top income quintile and the Gini coefficient for the distribution of years of education.

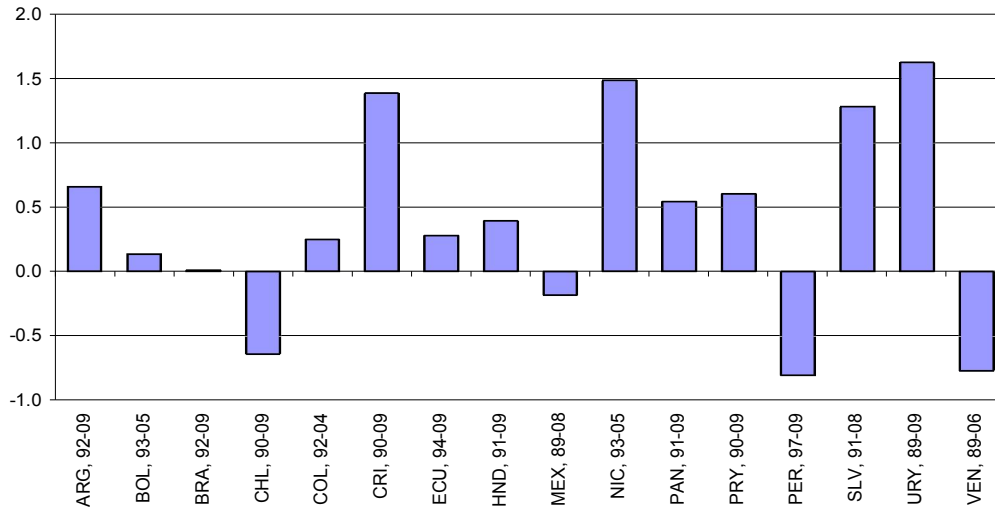
The assessment of the pattern in education inequality is not robust to the choice of indicator. While the Gini for years of education has fallen for all the countries considered, the gap between quintiles has increased or remained virtually unchanged for most countries in the sample. Only in Chile, Peru and Venezuela the gap has shrunk in more than 0.5 years. Changes in the quintile gaps and the Gini are loosely correlated: the Pearson linear correlation coefficient is just 0.09.

In our companion paper we carry out an analysis of the changes in education inequality at the country level. Again, as education expands the Gini tends to go down. Changes in the gap are more erratic. However, a closer inspection unveils an interesting fact. In most countries the gap increases in the 1990s, and falls in the 2000s. Table 2.3 summarizes this finding. Education expanded and the Gini fell at almost the same rate in the two decades. However, the quintile gap widened in all countries in the 1990s (except for Venezuela) and shortened in most countries in the 2000s.

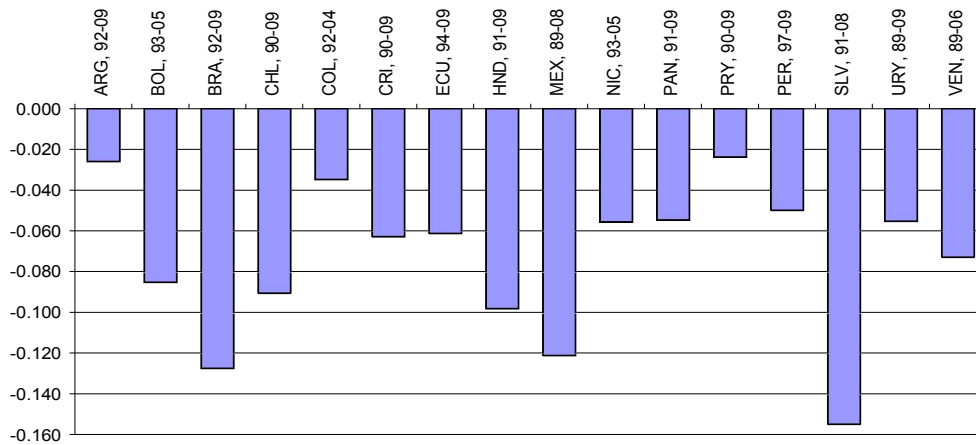
The reasons behind the differences in the changes in the education distribution between decades may lie partly in the intensification of efforts to extend the education to the poor by governments in the 2000s, but naturally also in efforts in previous decades that materialized in the 2000s. We return to this topic in sections 4 and 5.

Figure 2.2
Change in education inequality
Gini of years of education and years gap between Q5 and Q1
Adults aged 25-65

Change in educational gap



Change in educational Gini



Source: own calculations based on SEDLAC (CEDLAS and World Bank).

Table 2.3
Changes in average years of education and in education inequality measures
Adults aged 25-65

	Average years of education			Gap in years Q5-Q1			Gini		
	1990s	2000s	All	1990s	2000s	All	1990s	2000s	All
Argentina	0.4	0.8	1.2	1.2	-0.6	0.7	-0.003	-0.023	-0.026
Bolivia	0.4	0.1	0.5	0.4	-0.3	0.1	-0.067	-0.018	-0.085
Brazil	0.9	1.7	2.5	0.8	-0.8	0.0	-0.049	-0.078	-0.127
Chile	1.1	0.9	2.0	0.4	-1.0	-0.6	-0.044	-0.047	-0.090
Colombia	0.7	0.4	1.0	0.3	0.0	0.3	-0.022	-0.013	-0.035
Costa Rica	0.5	1.3	1.8	0.2	1.1	1.4	-0.031	-0.032	-0.063
Ecuador	0.8	1.2	2.0	0.8	-0.6	0.3	-0.030	-0.032	-0.061
El Salvador	1.5	1.0	2.4	1.2	0.1	1.3	-0.097	-0.058	-0.154
Honduras	0.6	0.7	1.3	0.1	0.2	0.4	-0.045	-0.053	-0.098
Mexico	1.6	0.7	2.3	1.5	-1.6	-0.2	-0.074	-0.047	-0.121
Nicaragua	0.5	0.6	1.1	0.1	1.4	1.5	-0.035	-0.021	-0.056
Panama	0.8	0.8	1.6	0.2	0.3	0.5	-0.032	-0.023	-0.055
Paraguay	0.5	1.5	1.9	0.6	0.0	0.6	0.008	-0.031	-0.024
Peru	0.1	1.0	1.0	0.0	-0.8	-0.8	0.000	-0.050	-0.050
Uruguay	1.1	0.5	1.6	0.6	1.1	1.6	-0.044	-0.012	-0.055
Venezuela	1.1	0.7	1.8	-0.4	-0.3	-0.8	-0.048	-0.025	-0.073
Average	0.8	0.9	1.6	0.5	-0.1	0.4	-0.038	-0.035	-0.073

Source: own calculations based on SEDLAC (CEDLAS and World Bank).

2.3. Inequality in years of education: a long term perspective

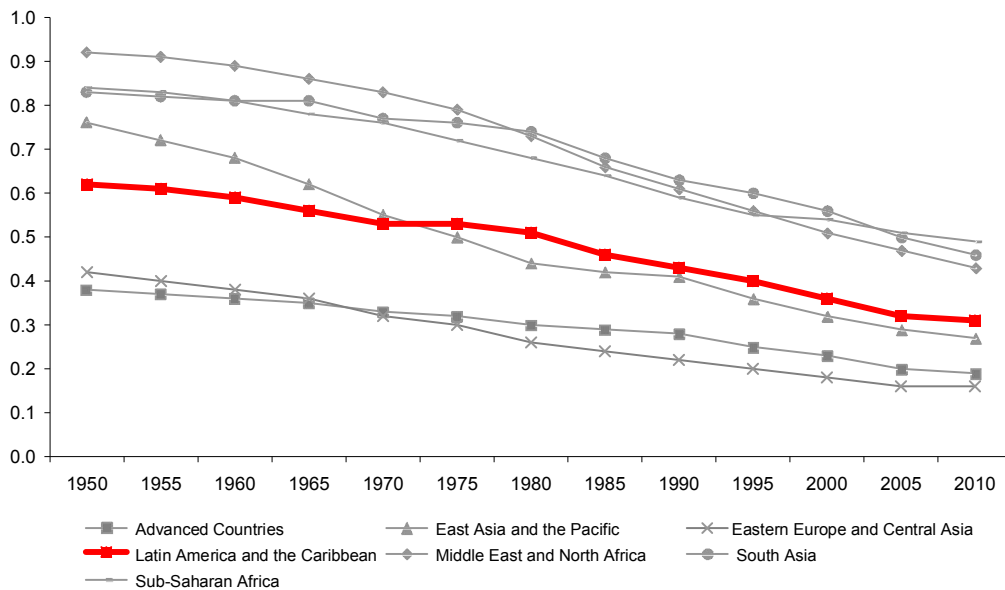
By computing years of education by age group in a given survey we can get an assessment of changes in the extension of education from a longer term perspective. In our companion paper we analyze years of education by age group and income quintile. Educational attainment has been increasing cohort after cohort in all Latin American countries, indicating a secular growth in the stock of human capital, even among the poorest.

In some countries, the gap between the rich and the poor in years of education has remained rather constant across age groups (Argentina, Uruguay, Venezuela), as a consequence of a parallel increase in years of education across socioeconomic strata over the century. However, for the majority of the Latin American countries the gap displays an inverse-U shape, implying shrinking differences in years of school between the top and bottom income quintiles for the younger cohorts. This pattern is the result of differences in the timing of the increase in education across quintiles: years of education for the top quintile increased over time first strongly but then more moderately, as most individuals in that strata completed secondary school. Instead, for the poor population years of education increased very slowly in the 1940s and 1950s and started to peak in the 1970s. In some countries the gap starts to shrink for people in their forties (those who attended high school in the 1980s), while in some poorest Central American countries the gap shrinks for people in their thirties (who attended high school in the 1990s). In almost all countries the gap is smaller for people aged 25-30 than for people in their thirties or forties.

2.4. Latin America in international perspective

In recent years researchers have produced new evidence that allow international comparisons of inequality in education (e.g. Barro and Lee, 2001, 2010). According to this evidence Latin America is a region with levels close to the world average, higher than in the developed countries, Eastern Europe and Central Asia, but lower than in the rest of the developing world. Figure 2.3 reveals a notorious decline in the level of education inequality as measured by the Gini of years of formal education in all the regions of the world. The fall has been particularly sharp in East Asia and the Pacific. In fact, based on the estimations of Wail *et al.* (2011) with Barro and Lee (2010) data, while the educational Gini in that region was 14 points higher than in Latin America in 1950, it is now 4 points lower. According to these estimations the fall in Latin America was dramatic (from 0.62 to 0.31 in just half a century) but not different from the fall in the world mean.

Figure 2.3
Gini of years of education
Population aged 15 and over, 1950-2010



Source: Wail *et al.* (2011) based on Barro-Lee Data (2010).

3. Education and income inequality

There is vast evidence of the strong positive link between education and earnings at the individual level. At a more aggregate level the relationship between the distribution of these two variables has proved harder to analyze. In this section we provide evidence for Latin America following three alternative approaches.

3.1. The correlation between income and education inequality: A cross country regression analysis

The literature that explores the relationship between income and education inequality in a regression framework has been growing in the last decade. Checchi (2004), for instance, assembles an unbalanced panel of 454 observations in 94 countries and runs fixed effects models. The author finds that the relationship between the Gini for education achievement and the income Gini is rather unstable, being U-shaped and non-U-shaped depending on the specification. Cornia (2010) runs a model of the Gini coefficient for the distribution of income per capita including the Gini index for the distribution of years of education for the adult population as one of several explanatory variables. The regression is estimated over a panel of 18 Latin American countries over the period 1990-2007 by fixed-effects methods to control for specific country effects due to geography, institutions and unobservables.⁶ The author finds that after controlling for other factors the correlation between the income and educational Ginis vanishes. In fact, the coefficient of the educational Gini is negative but statistically non-significant.

In what follows we use SEDLAC data to explore this issue. We start by exploring simple correlations. On average, countries with higher inequality in the distribution of education are those with higher income inequality. However, the association is rather loose. When using the last available household survey for each Latin American country (2009 for most countries), the linear correlation coefficient between the Gini coefficient for the earnings distribution and the educational gap is 0.455, while it drops to 0.340 when taking the educational Gini. Both coefficients increase to 0.634 and 0.503 respectively when dropping Chile, the main outlier for this relationship in the sample, a country with high measured income inequality and relatively low education inequality.⁷ When taking the correlations between changes there is still a positive relationship between changes in education inequality and income inequality, although weaker than in levels. The linear correlation coefficients are 0.344 for the gap and 0.304 for the Gini. On average countries that experienced a greater reduction in the dispersion of years of education also benefited from a larger reduction in income inequality. However, the

⁶ Cornia (2010) also presents random effects estimates, but the results are quite similar to those estimated by fixed effect.

⁷ Cornia (2010) finds a linear correlation of 0.5 between the income and education Ginis over the period 1990-2007.

association is weak, suggesting the presence of many other factors affecting both variables in different directions.

To further analyze this relationship we run a fixed-effects model of income inequality on alternative measures of inequality in education with Latin American microdata. In particular, we take advantage of the panel assembled in Alejo (2011) for all the Latin American countries in the period 1992-2009 with observations at the sub national level. We work with two panels: the short one includes 6 biannual observations for regions in 10 countries (Argentina, Brazil, Costa Rica, El Salvador, Honduras, Mexico, Paraguay, Peru, Uruguay and Venezuela) in the period 1995-2006. The long panel includes 17 annual observations in regions of 5 countries (Argentina, Brazil, Costa Rica, Honduras and Uruguay). This panel is larger in observations although encompasses fewer countries and is unbalanced.

Table 3.1 shows the results for the fixed-effects models. The dependent variable is the Gini for the distribution of earnings for workers aged 25 to 65. As right-hand side variables we alternatively include two indicators of education inequality - the Gini for the distribution of years of education and the gap in years between education quintiles - and mean years of education (either that variable or its inverse to capture non linearities). Mean earnings and its square are included as controls.⁸

Table 3.1
Coefficients of model for earnings inequality
Dependent variable: Gini coefficient for the distribution of earnings

	Long panel				Short panel			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Educational Gini	-2.07 (2.01)*	-1.18 (1.18)			-1.94 (2.52)*	-1.22 (1.60)		
Educational Gini ²	0.049 (2.63)**	0.035 (2.01)*			0.047 (3.43)**	0.036 (2.88)**		
Educational Gap			-2.53 (2.24)*	-2.38 (2.10)*			0.39 (0.26)	0.32 (0.21)
Educational Gap ²			0.407 (3.52)**	0.395 (3.40)**			0.100 (0.83)	0.101 (0.81)
Years of education		1.037 (2.04)*		-0.238 (0.69)		1.064 (2.46)*		-0.657 (2.55)*
1/years of education	-39.7 (1.97)*		1.8 (0.13)		-31.7 (2.03)*		28.9 (2.80)**	
Observations	478	478	478	478	366	366	366	366
Number of sub-countries regions	27	27	27	27	61	61	61	61
R ² (within)	0.06	0.03	0.13	0.13	0.13	0.13	0.10	0.10

Note: Estimation carried out with a fixed effect procedure; t-statistics in parentheses. * significant at 5%; ** significant at 1%. All regressions include as controls the level of earnings (and its square).
 Source: own estimates based on data from household surveys.

The evidence points to the existence of a conditional non-linear positive relationship between education and earnings inequality. Regions with higher education inequality are regions with larger disparities in earnings, even after controlling for some factors and taking into account fixed-effects. The relationship between mean years of education and earnings inequality looks somewhat more opaque. When controlling for the educational Gini, more years of education seem to be associated to higher earnings inequality. A proportional increase in education that will not alter the Gini implies a

⁸ Results are robust to alternative specifications.

greater raise in absolute value for the more educated, a fact that compounded with increasing returns to scale could generate a surge in earnings inequality. The next section has more on this. Notice that when controlling for the educational gap, the relationship vanishes (or flip sign in the short panel).

3.2. Exploring the direct impact of education on earnings inequality

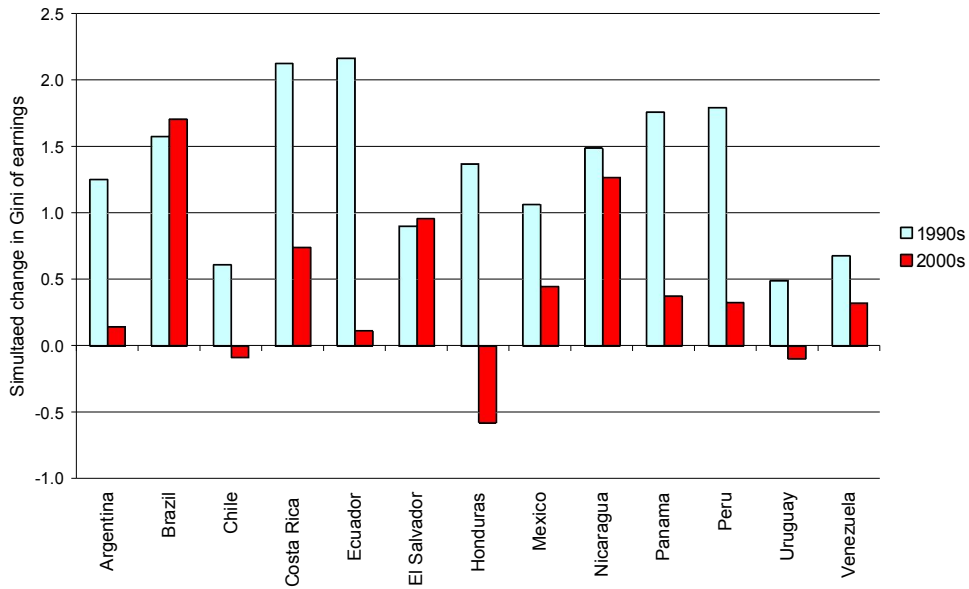
Given convexity in the returns to education, even an equalizing increase in schooling may generate an unequalizing change in the distribution of labor incomes. In this section we report the results of Battistón, García Domench and Gasparini (2011) who explore whether this “paradox of progress” (Bourguignon *et al.*, 2005) is just a theoretical possibility with little relevance in practice, or it is in fact a widespread phenomenon across Latin America.⁹ To that aim they carry out microeconomic decompositions that isolate the direct effect of changes in the distribution of education on earnings inequality.¹⁰ The methodology is applied to household survey microdata for most Latin American countries in the period 1990-2009 exploiting a dataset that contains homogeneous definitions for the education and labor variables involved in the analysis (SEDLAC).

Figure 3.1 reports the counterfactual change in the Gini coefficient of the earnings distribution after altering the education structure of the population. The results indicate that in the 1990s if only individual education had changed over time we would have observed increases in earnings inequality across all Latin American economies. This result is not surprising since educational changes were unequalizing in this period. Instead, in the 2000s educational changes were more balanced or even biased toward poorer groups. However, in most countries these equalizing changes in education were not enough to compensate the unequalizing effect of the highly convex structure of returns, and hence the effect on earnings inequality remained positive. However, in almost all countries the increase in the Gini for the distribution on earnings driven by educational changes was substantially lower in the 2000s than in the 1990s.

⁹ Klasen, Villalobos and Otter (2011) find evidence for the paradox in Honduras.

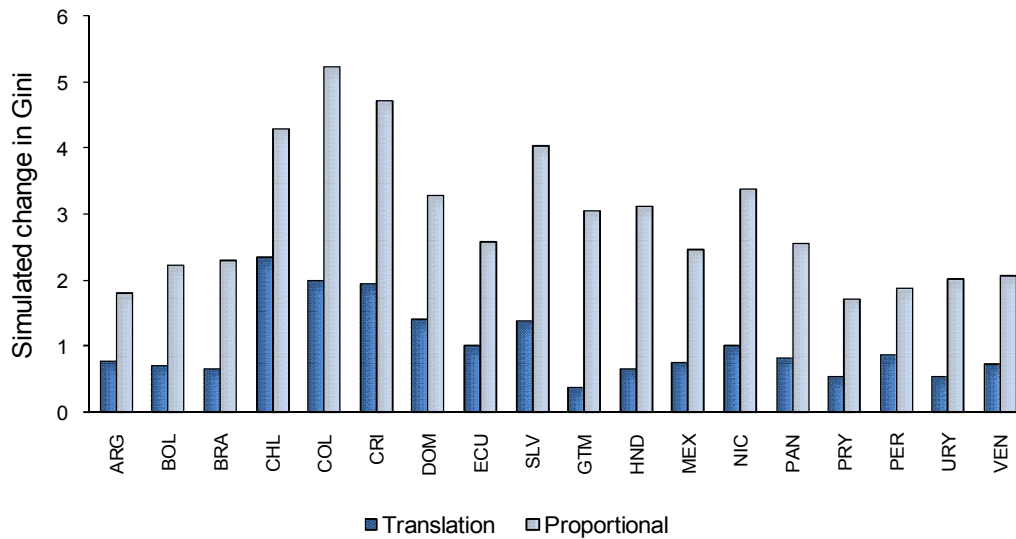
¹⁰ The methodology follows closely Gasparini, Marchionni and Sosa Escudero (2005) that in turn follow Bourguignon, Ferreira and Lustig (2005).

Figure 3.1
Effect of change in distribution of education on earnings inequality (Gini index)
Results from microeconomic decomposition



Source: Battistón et al. (2011).

Figure 3.2
Effect of an extra year of education on earnings inequality
Results from microeconomic decomposition



Source: Battistón et al. (2011).

To further illustrate the direct impact of increasing education on earnings inequality figure 3.2 shows the change in the Gini coefficient for the distribution of labor incomes after an increase in one year of education in each country. The figure shows two alternatives; in the first one (translation) years of education are increased in one for all the working population, while in the second (proportional) years of education are increased proportionally, so the educational Gini does not vary. If we assume that returns to education remain constant, the effect of one year more of education for every worker is undoubtedly unequalizing in all countries. On average the Gini in earnings increase in 1 point. Since the change in education is assumed to be balanced, this example illustrates the standing role of the convexity of the returns to education.

3.3. Exploring wage skill gaps, supply and demand factors ¹¹

The counterfactual analysis of the previous section illustrates the first-order impact of education on the income distribution. The impact of education on earnings, however, also depends crucially on returns to human capital, which were held constant in the previous analysis. The purpose of this section is to present empirical evidence on the evolution of remuneration differentials by skill level over the decades of 1990 and 2000. The analysis is based on Tinbergen's (1975) seminal contribution on the relationship between human capital accumulation, technical change and income inequality, which provides a framework to interpret the role of labor supply and demand factors in the evolution of the earnings distribution. Tinbergen's (1975) discussion is often referred to as "the race between education and technology", because he postulated that secular technological change would favor the relative demand for skilled labor, thus increasing the skill premium (and thus inequality), whereas educational upgrading would provide a counterbalancing force reducing this premium.

Following Goldin and Katz's (2008) study of the United States in the XXth century, it is possible to simplify the analysis by assuming only two levels of skills among workers (high and low), which facilitates the interpretation of the underlying patterns in terms of the evolution of the relative supply of high skill to low skill workers, and the corresponding relative wage - the skill wage premium.

Lustig and López Calva (2009) present some evidence on increasing levels of education for Argentina (Gasparini and Cruces, 2009), Brazil (Paes de Barros *et al.*, 2009), Mexico (Esquivel, Lustig and Scott, 2009) and Peru (Jaramillo and Saavedra, 2009). Although the authors do not develop a full analysis of the relationship between education upgrading and the wage skill premium, they interpret their partial evidence as consistent with a Tinbergerian setting with prevalence of supply factors which reduces aggregate inequality. Manacorda *et al.* (2010), on the other hand, develop a full analysis of the relationship between changes in the wage skill premium and in the relative supply of skilled workers for Argentina, Brazil, Chile, Colombia, and Mexico in the 1980s and

¹¹ The material and text in this section is based on Gasparini, Galiani, Cruces, and Acosta (2011).

the 1990s, and find an increase in the supply of skilled workers and a simultaneous rise in the relative wages of skilled workers, which they attribute to a “generalized shift in the demand for workers with tertiary education”.

The evidence presented in this section originates in Gasparini, Galiani, Cruces and Acosta (2011), which carry out a Goldin and Katz (2008) type of analysis for 16 countries in the region from the early 1980s to 2010 (although most of their observations correspond to the period 1990-2009). The analysis requires the construction of country and time consistent aggregate measures of labor supply and wages by skill level. The document contains a detailed analysis of each country’s specific evolution over time, as well as decompositions of the skill intensity of employment by sector and a further disaggregation accounting for three skill levels.¹²

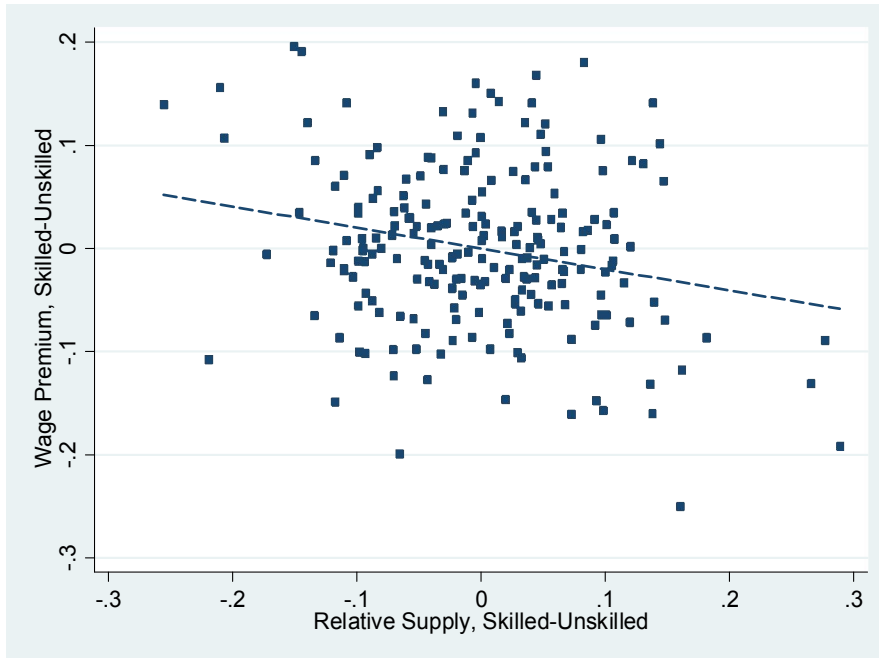
Figure 3.3 sums up the main findings from the analysis at the regional level. The figure depicts the skilled-unskilled wage premium plotted against the relative supply of skilled to unskilled labor for the sixteen countries in the sample during the period 1989-2009. Both series, which are constructed as specific indices for each country, are presented net of country and year fixed effects. Consistent with the Tinbergen hypothesis, there is a clear negative relationship between the relative supply of skilled labor and its relative remuneration over the 1989-2009 period in Latin America.

The evidence summarized in figure 3.3 does not distinguish the evolution of the underlying variables over time. This is presented in figure 3.4, which depicts the skilled-unskilled wage premium and the relative supply of skilled to unskilled labor for the same sixteen Latin American countries over the period 1989-2009. Both series are plotted net of country effects (averages), but allowing for time variation.

The results from figure 3.4 complement those of figure 3.3. The first remarkable fact is the constant and strong increase in the relative supply of skilled labor over the whole period under analysis. This is a relative measure of supply, and this evidence combined with the increase in years of education for all countries in the region (documented in section 2) indicates an educational upgrading of the labor force. The wage skill premium, on the other hand, exhibits a modest quadratic trend, consistent with the previously documented increase in earnings inequality in the 1990s and its subsequent fall in the 2000s. Moreover, Gasparini, Galiani, Cruces and Acosta (2011) also report a strong positive correlation between this skill wage premium and the Gini coefficient of the distribution of household per capita income – in fact, the two variables follow the same pattern for the decades of 1990 (increasing) and 2000 (decreasing) in terms of regional averages. Taken together, the figures indicate that a secular increase in the relative supply of skilled labor, *ceteris paribus*, was a factor behind the reduction in the wage skill premiums in Latin America over the 1990s and the 2000s.

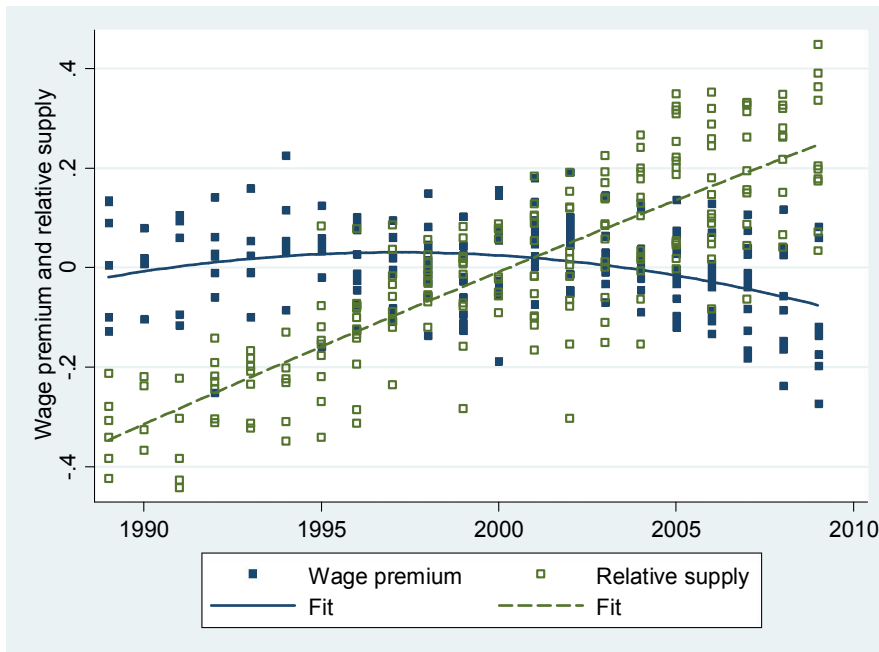
¹² The empirical evidence presented here is based only on the skilled-unskilled differential, where skilled workers are those with some tertiary education and all the rest are considered unskilled. Gasparini, Galiani, Cruces and Acosta (2011) also analyze evidence based on the distinction between three levels of skills – with semi-skilled workers defined as those with a secondary degree.

Figure 3.3
Skilled-unskilled wage premium and relative supply, net of country and year fixed effects.
Sixteen LA countries, 1989-2009



Source: Gasparini, Galiani, Cruces and Acosta (2011), calculations based on SEDLAC (CEDLAS and World Bank).

Figure 3.4
Skilled-unskilled wage premium and relative supply over time, net of country effects.
Sixteen LA countries, 1989-2009



Source: Gasparini, Galiani, Cruces and Acosta (2011), calculations based on SEDLAC (CEDLAS and World Bank).

As stated previously, there is a constant increase in the relative supply of skilled labor over this period, while the wage skill premium has first an increasing trend and then a decreasing tendency, resulting in a relatively flat tendency over the 1990s decade. This relatively constant wage skill premium, combined with a strong increase in the relative supply of skilled labor, can be interpreted in a Tinbergen framework as denoting the presence of a strong demand shift towards skilled labor, which neutralizes the equalizing effect expected from the increase in relative supply. This interpretation is consistent with some country-specific studies which highlight the importance of privatizations, trade openness and other structural reforms during the 1990s in facilitating skill biased technical change and, more generally, spurring the demand for skilled labor (see, for instance, the account of the Argentine case in Gasparini and Cruces, 2009). For the years 2000-2009 there is a marked downward tendency in the wage skill premium. In terms of the Tinbergen model, such reductions in the wage premium accompanied with an increase in the relative supply of skilled labor indicate the presence of weaker shifts in the relative demand for skilled labor with respect to those implied by trends in the previous decade. Further analysis carried out by Gasparini, Galiani, Cruces and Acosta (2011) indicates that some of this shift in the relative demand for unskilled labor is related to the increase in commodity prices and in terms of trade of the decade of 2000.

These results highlighted the importance of the skills in the market for the evolution of key socioeconomic indicators such as income inequality. The following section studies school enrollment among children and youths, which determine the future skill composition of the labor force.

4. School enrollment

While the previous pages concentrate on the educational attainment of the adult population, in this section we report the level and distribution of enrollment rates.^{13 14} Enrollment rates at all levels for all countries have increased (figure 4.1). For primary education, the quintile gap has remained almost constant or fallen for all countries. There is a clear relationship between higher enrollment and lower gaps, since the top quintile has historically being close to the 100 percent ceiling - any improvement would narrow the gap. Notably, a set of countries have achieved increases of more than 10 percentage points in net primary enrollment rates in relatively short periods of time. The increase was low for the countries that were already close to universal coverage at the time of the first available survey.

While net enrollment rates also increased substantially for secondary schooling (by 20 percentage points or more in several countries), the quintile gap has increased in some

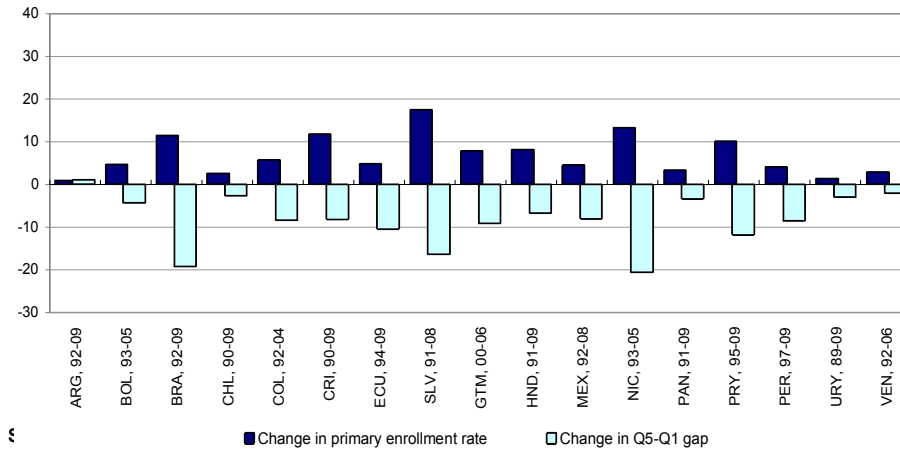
¹³ The net enrollment rate is defined as the share of individuals in a given age group that attend the educational level corresponding to their age.

¹⁴ The longer version of this paper includes a section on education quality with evidence taken from other studies showing a strong positive relationship between educational quality and achievements, and socioeconomic status.

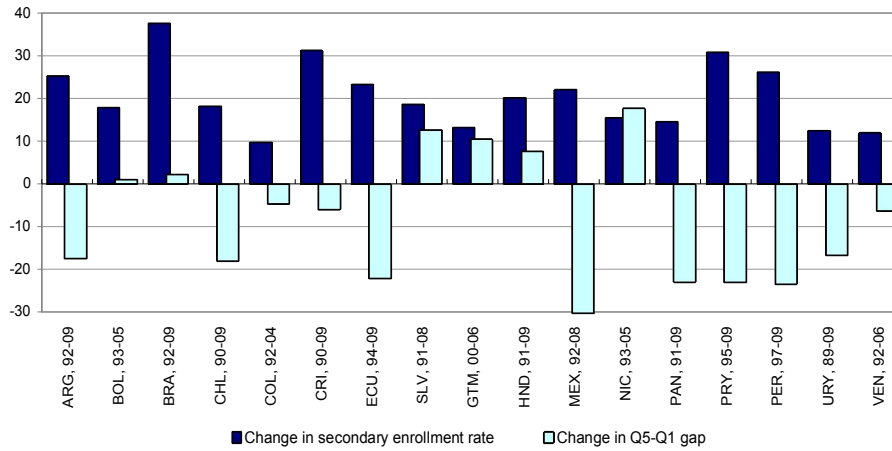
cases, including Nicaragua, Guatemala, El Salvador and Honduras. Finally, the increases in tertiary enrollment have been accompanied by rising quintile gaps in all countries, which implies that the increase has happened mostly at the upper level of the income distribution.

When examining changes by decade, an interesting fact emerges (table 4.1). Although the average speed of the educational upgrading did not increase in the 2000s, the pattern of that process was substantially different both in secondary and tertiary school. Compared to the previous decade, growth in school enrollment rates for the poor was considerably higher in those educational levels. In contrast, changes in primary school were not very different between decades. As most countries in the region approached universal enrollment the expansion in the access to primary education slowed down in the 2000s, and the educational gap between income quintiles slowly narrowed down at almost the same rate as in the 1990s. The story has been dramatically different for the secondary level of education. On average, the increase in enrollment was similar in both decades but while in the 1990s the educational gap widened in most countries and on average, the 2000s witnessed a widespread pattern of shrinking gaps. On average, for the sample of countries with consistent observations in the early 1990s, early 2000s and late 2000s, the gap between quintiles 5 and 1 in secondary school enrollment widened 2.6 points in the 1990s and shrunk 8 points in the 2000s. The gap was reduced in all countries but El Salvador, Nicaragua and Uruguay. Active educational policies and the inception of massive cash transfer programs conditional on school attendance in many countries surely contributed to this substantial increase in enrollment for the poor. For tertiary education the difference between decades is also striking. While the LA average gap increased almost 14 points in the 1990s, it rose only 3.3 points in the 2000s. In some countries that gap even shrunk during the last years.

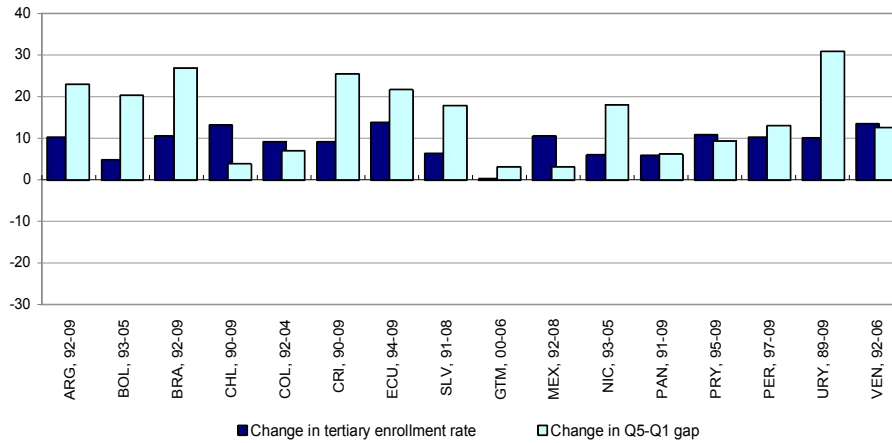
Figure 4.1
Change in net enrollment rates and in Q5-Q1 gap in enrollment rates
Primary



Secondary



Tertiary



Source: own calculations based on SEDLAC (CEDLAS and World Bank).

Table 4.1**Change in net enrollment rates and gap Q5-Q1 by decades**

	Change in enrollment			Change in gap Q5-Q1		
	1990s	2000s	All	1990s	2000s	All
Argentina	16.9	8.3	25.2	-4.6	-12.7	-17.4
Bolivia	9.0	8.8	17.9	18.5	-17.4	1.1
Brazil	16.3	21.2	37.5	16.5	-14.3	2.2
Chile	10.9	7.4	18.2	-3.8	-14.0	-17.9
Costa Rica	7.6	23.6	31.2	2.0	-8.0	-6.0
El Salvador	9.0	9.7	18.6	9.4	3.3	12.7
Honduras	12.4	7.7	20.1	13.3	-5.6	7.7
Mexico	15.3	6.8	22.1	-13.2	-17.0	-30.1
Nicaragua	12.4	3.2	15.5	3.1	14.6	17.7
Panama	4.8	9.9	14.6	-2.4	-20.5	-22.9
Uruguay	6.5	1.1	7.6	-7.3	2.0	-5.3
Venezuela	1.5	10.4	12.0	0.3	-6.6	-6.3
Average	10.2	9.8	20.1	2.6	-8.0	-5.4

Tertiary

	Change in enrollment			Change in gap Q5-Q1		
	1990s	2000s	All	1990s	2000s	All
Argentina	4.7	5.7	10.4	21.5	1.5	23.0
Bolivia	2.1	2.7	4.9	9.3	11.0	20.3
Brazil	3.5	7.2	10.7	15.5	11.3	26.9
Chile	9.9	3.3	13.2	14.8	-10.8	3.9
Costa Rica	2.2	7.0	9.2	6.1	19.4	25.4
El Salvador	5.7	0.8	6.5	15.1	2.7	17.8
Honduras	2.8	1.2	4.0	14.8	3.3	18.1
Mexico	6.4	4.2	10.6	10.7	-7.4	3.3
Nicaragua	6.4	-0.3	6.1	18.1	-0.1	18.1
Panama	4.1	2.0	6.1	7.9	-1.6	6.2
Uruguay	7.3	2.0	9.4	23.4	6.5	30.0
Venezuela	4.5	9.0	13.5	9.3	3.3	12.6
Average	5.0	3.7	8.7	13.9	3.3	17.1

Source: own calculations based on SEDLAC (CEDLAS and World Bank).

5. Spending, growth and demographics

Latin American countries have committed increasing resources to support education, with the aim of expanding access and fostering quality. This higher fiscal and private effort has been the consequence of deliberate actions to give priority to education, but also was possible due to a favorable economic and demographic scenario. In this section we take a preliminary view of this issue.

In what follows we concentrate on public spending since the government is by large the main actor in the education sector, but also because consistent information on private spending in education is not readily available. In any case the evidence suggests a sizeable increase in the relevance of the private sector, both in absolute and relative terms, which adds to the increase in public spending that we document in this section.

In table 5.1 we compute a measure of the potential of public investment in education to increase access and quality. Specifically the table shows for each country/year public spending in education in USD PPP by children under 14.¹⁵ In all countries there is a sustained increase in the public funds available for education per child. The average for Latin America steadily increased from USD 320 in 1990, 511 in 1995, 756 in 2000 and 1451 in 2010: this figure has multiplied by more than 4 in just 20 years. The increase in the 2000s was roughly the same as in the 1990s in proportional terms, but much larger in absolute terms.

Table 5.1
Public spending in education per child aged 0-14 (in USD PPP)

	1990	1995	2000	2010
Argentina	657	1128	1678	3052
Bolivia		377	456	807
Brazil	514	1016	1216	2394
Chile	370	685	1334	2749
Colombia	264	445	536	877
Costa Rica	475	706	1146	2520
Dominican R.	68	172	399	648
Ecuador	276	325	289	666
El Salvador	137	220	478	741
Guatemala	115	147	246	354
Honduras	218	226	434	873
Mexico	489	880	1257	2068
Nicaragua	90	113	192	425
Panama	397	544	874	1649
Paraguay	93	311	376	575
Peru	135	332	416	801
Uruguay	508	693	995	2604
Venezuela	645	886	1291	2312
Average *	320	511	756	1451

Source: own calculation based on information from CEPAL (share of public spending in education, and population) and World Bank (GDP).

Note: the table assumes constant share of spending in education from 2006 to 2010.

* To compute the LA average we estimate missing observations using information from close years.

¹⁵ Spending includes all educational levels. We restrict the youth population at 14 due to data availability.

A simple decomposition can be useful to characterize this increase. We write public spending in education per child $g_N=G/N$ as the product of three terms: the share of spending in education in GDP (G/Y), per capita GDP (Y/P) and the inverse of the share of children in the population (P/N)

$$(5.1) \quad g_N = \frac{G}{Y} \cdot \frac{Y}{P} \cdot \frac{P}{N}$$

Of course, this decomposition is exact by definition, but illustrates the forces that can allow a change in public spending per child g_N : changes in social policy that modify the share of public spending in education in GDP, economic growth that affects per capita GDP, and demographic changes that alter the share of children in the population.

Table 5.2 shows public spending in education as a share of GDP in all Latin American countries. The dispersion across countries is remarkable: while the share was 2.3 in Dominican Republic it was 7.6 in Honduras.¹⁶ However, it should be taken into account that public spending figures are not easy to harmonized, and that recorded gaps between countries might be largely driven by differences in accounting procedures.

Despite the fluctuations, there is a clear pattern in all countries toward an increase in the fiscal effort to support public education. On average, the pace of this increase seems to have been constant over time. The mean share of public spending in education in total GDP is 2.8 in 1990, 3.3 in 1995, 4.0 in 2000 and 4.4 in 2010. From this data there is not a discernible change in public spending in education during the 2000s, a decade characterized by the election of many progressive regimes, some of them with new approaches to educational policy.

¹⁶ The share reported for Cuba is 14.6. Due to data limitations we do not include that country into the analysis.

Table 5.2
Share of public spending in education in GDP

	1990	1995	2000	2010
Argentina	3.6	4.2	5.1	5.3
Bolivia		5.5	5.8	6.3
Brazil	3.4	5.1	5.0	5.6
Chile	2.3	2.6	3.9	4.1
Colombia	2.4	3.0	3.3	3.0
Costa Rica	3.9	4.2	5.1	5.9
Dominican R.	0.9	1.6	2.5	2.3
Ecuador	2.8	2.6	2.1	2.6
El Salvador	1.9	2.0	3.4	3.1
Guatemala	1.8	1.9	2.9	3.0
Honduras	4.3	3.7	6.2	7.6
Mexico	2.6	3.9	3.9	4.1
Nicaragua	2.6	2.8	3.7	5.5
Panama	3.6	3.5	4.2	4.0
Paraguay	1.3	3.6	4.3	4.1
Peru	1.6	2.7	2.8	2.6
Uruguay	2.5	2.5	3.0	4.3
Venezuela	3.5	3.8	5.1	5.5
Average *	2.8	3.3	4.0	4.4

Source: CEPAL, Anuario Estadístico de América Latina y el Caribe, various issues.

* To compute the LA average we estimate missing observations using information from close years.

All Latin American economies have grown during the period under analysis. Mean (unweighted) per capita GDP grew at annual 5% between 1990s and 1995, 3% between 1995 and 2000, 4% between 2000 and 2005 and 5% between 2005 and 2009.

It is a well-known fact that there have been dramatic changes in the demographic pattern of the Latin American populations in the last fifty years. Fertility rates increased until the 1960s implying a peak in the share of the young population in the national censuses of 1970. From that point on, the region experienced a significant reduction in fertility rates. The fall in the participation of children in the population has been speeding up over time: it was 7% in the 1970s, 8% in the 1980s, 12% in the 1990s, 13% in the 2000s and it is forecasted to be 15% in the 2010s (table 5.3). The figures are even larger for the weighted average, since the fall in fertility rates are larger in Brazil and Mexico. While the share of children dropped 35% in Latin America from 1970 to 2010, the fall was 40% both in Brazil and Mexico. With constant real resources and education costs, this demographic pattern has implied and would imply a great opportunity to increase school enrollment rates.¹⁷

¹⁷ The situation is different for the youths, where in the LA aggregate the share in the total population has not changed much in the last decades. The share of the young population in age of attending high school, college and graduate programs is expected to fall 5% between 2010 and 2020, so the “demographic bonus” at that level would be small or negligible. In fact, in some poor countries like Bolivia, El Salvador or Guatemala the share of the youth is expected to increase in the following years, posing an additional challenge over the perspectives of expanding superior education.

Table 5.3
Share of people aged 0-14 in total population

	1950	1960	1970	1980	1990	2000	2010	2020*
Argentina	30.5	30.8	29.4	30.5	30.7	28.0	25.0	23.1
Bolivia	41.4	42.7	43.0	42.6	40.9	39.6	35.8	31.1
Brazil	41.6	43.3	42.4	38.1	35.3	29.6	25.5	20.1
Chile	36.7	39.5	39.7	33.0	29.9	27.8	22.3	20.2
Colombia	42.7	46.4	45.9	40.9	36.6	32.9	28.8	25.4
Costa Rica	38.5	44.8	44.8	37.8	35.9	31.8	25.3	21.9
Ecuador	39.5	43.4	44.4	42.8	39.0	34.5	30.6	26.1
El Salvador	42.7	45.1	46.3	44.7	40.9	37.3	31.5	27.2
Guatemala	44.6	45.8	44.6	45.4	45.4	44.1	41.5	37.0
Honduras	42.3	46.1	47.7	47.0	45.5	42.4	36.8	31.8
Mexico	42.5	45.9	46.6	44.7	38.6	33.1	27.9	23.3
Nicaragua	42.9	47.5	48.1	47.1	46.0	40.9	34.5	30.2
Panama	40.2	43.0	43.9	40.5	35.2	31.9	29.0	25.5
Paraguay	47.0	47.9	46.1	42.5	41.4	38.2	33.5	29.5
Peru	41.6	43.3	44.0	41.9	38.3	34.1	29.9	25.9
Dominican R.	45.3	48.2	47.8	42.7	38.7	35.1	31.4	28.1
Uruguay	27.9	27.9	27.9	26.9	26.1	24.6	22.5	20.5
Venezuela	43.4	45.7	45.6	40.7	38.0	33.7	29.5	26.3
Latin America	40.2	42.5	42.5	39.6	36.4	31.9	27.7	23.6

Source: CEPAL based on census data.

Note: Estimations for 2020.

Table 5.4
Decomposition in the change of public spending in education per child aged 0-14

	Social policy	Growth	Demographics	Total
Argentina	26.1	60.0	13.9	100.0
Brazil	32.7	45.7	21.6	100.0
Chile	29.9	54.5	15.6	100.0
Colombia	19.0	60.4	20.5	100.0
Costa Rica	25.5	53.0	21.5	100.0
El Salvador	29.1	54.9	16.0	100.0
Guatemala	45.3	46.6	8.1	100.0
Honduras	41.0	43.4	15.6	100.0
Mexico	31.8	45.2	23.0	100.0
Nicaragua	47.7	33.3	19.0	100.0
Panama	8.0	77.2	14.8	100.0
Paraguay	60.9	26.8	12.3	100.0
Peru	28.3	57.1	14.6	100.0
Uruguay	34.0	56.6	9.4	100.0
Venezuela	35.5	44.2	20.3	100.0
Average	33.0	50.6	16.4	100.0

Source: own calculation based on information from CEPAL (share of public spending in education, and population) and World Bank (GDP).

Based on equation (5.1) table 5.4 reports the results of a simple decomposition that simulates for each country the change in g_N if all but one factor had remained constant between 1990 and 2010.

The three factors have contributed to the increase in spending per child. On average economic growth contributed with around 1/2 of the increase while changes in social policy roughly contributed with 1/3 and demographics with the remaining 1/6. The figures illustrate the central role that economic growth had in sustaining the efforts to increase education, and at the same time warn us about the sustainability of the education upgrading in a less favorable economic scenario. The table also illustrates the key role played by policy: most countries have made substantial progress in the accumulation of human capital due to consistent efforts to increase fiscal funds assigned to education.

6. Concluding remarks

The evidence presented in this paper suggests that Latin American countries have made substantial inroads in increasing overall levels of human capital. This expansion has been encouraged by social policy, fueled by economic growth and favored by the demographics transition. Although the size of this expansion was roughly similar over the last decades, the evidence suggests a significant difference between the 1990s and the 2000s in terms of both the assessment of the equity of the education expansion and its impact on the income distribution.

While the gap in years of education across income quintiles widened in all Latin American countries in the 1990s, it shrunk in several countries, and as an overall average in the 2000s. The reasons behind the differences in the changes in the education distribution between decades lie partly in the intensification of efforts to extend the education to the poor by governments in the 2000s, but also in efforts in previous decades that materialized in the 2000s. The recent encouraging patterns for the indicators of inequality in years of education are also present in other dimensions of education as enrollment rates and educational mobility. Latin America might have reached a turning point where educational upgradings become unambiguously equalizing.

Increases in education did not have a visible equalizing impact on the earnings and income distributions in the 1990s due to at least two factors: the educational upgrading was unbalanced, and the relative demand for unskilled labor fell in that decade due to several factors including some market-oriented reforms, technological changes, international prices, and weak labor policies. In contrast the increase in education in the 2000s seems to have had a full equalizing impact on earnings given the more pro-poor pattern of the education upgrading and a more stable or even increasing relative demand for low skill labor.

There are some caveats about the effect of the educational trends in future inequality. It might be difficult to sustain high quality schooling systems in the context of large

increases in enrollment rates. While gaps in the quantity might be closing, it is possible that the gap in quality (especially between public and private schools) might be increasing in the region. This fact may reduce the probability of access to tertiary education for poor children, since they will compete with better-prepared children from richer households. Increasing quality at public schools should be a priority in the agenda of governments interested in equalizing opportunities through education. Also, despite a reduction in income disparities in the 2000s, there is no evidence of a reduction in the degree of school segregation between public and private schools across children from different socioeconomic strata (Gasparini *et al.*, 2010), a fact that raises some concerns over the degree of social cohesion in the near future.

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