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World Institute for Development
Economics Research

Working Paper No. 2011/x

Inequality in Education

Evidence for Latin America

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December 2011

Abstract

This paper provides original empirical evidence on the evolution of education inequality for the Latin American countries over the decades of 1990 and 2000. The analysis covers a wide range of issues on the differences in educational outcomes and opportunities across the population, including inequality in years of education, gaps in school enrolment, 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, 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 labour.

Keywords: education, inequality, enrolment, wage premium, Latin America

JEL classification: I24, I25, I28, O15

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This study has been prepared within the UNU-WIDER project ‘The New Policy Model, Inequality and Poverty in Latin America: Evidence from the Last Decade and Prospects for the Future’, directed by Giovanni Andrea Cornia.

UNU-WIDER acknowledges the financial contributions to the research programme by the governments of Denmark (Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1798-7237 ISBN 978-92-9230-__-__

Acknowledgements

This paper is part of the UNU-WIDER research project on ‘The New Policy Model, Inequality and Poverty in Latin America’. We are very grateful to Giovanni Andrea Cornia and the participants at the UNU-WIDER meeting in New York City (2010) and Buenos Aires (2011) for their valuable comments and suggestions. We are also grateful to Javier Alejo, Germán Bet, Diego Battistón, David Jaume, Monserrat Serio and Emmanuel Vázquez for comments and helpful inputs. The usual disclaimer applies.

Acronyms

CEDLAS ?? at the Universidad Nacional de La Plata (Argentina)

LAC Latin American countries poverty group

LCSP ??

SEDLAC Socioeconomic Database for Latin America and the Caribbean

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Typescript prepared by Liisa Roponen at UNU-WIDER

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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 in educational achievements and opportunities across socioeconomic groups. The issue is particularly relevant for the region since the distribution of incomes and education levels has 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 income distribution.

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

The rest of the paper is organized as follows. In section 2 we provide empirical evidence on inequality in the 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 allow 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 labour 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 the differences in schooling rates by income strata for all educational levels. Gaps in school enrolment and completion rates provide valuable information on future income distribution, and are closely related to the concept of equality of opportunity. Section 5 explores the role played by three factors (economic growth, social spending and demography) in the increase of schooling opportunities. 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 favourable 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 the Latin American countries, documenting 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 be considered 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. The first conceptual issue is whether or not to make the inequality measurement conditional on a welfare indicator, like household income. Are we concerned, for instance, with the educational gap between the income of the 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 that in a certain period of time there is an increase of three years of education for all the relevant population: is this change inequality increasing, neutral or inequality increasing? Relative inequality measures—the ones used when analysing income distribution—assess this change as inequality-reducing, since the increase in 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.

¹ The extended working paper version of this paper (Cruces, Gasparini and García Domench 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.

Table 1 presents six alternative measures of education inequality for one specific country: 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, a small drop in the absolute measures (gap and adjusted Gini) and a more significant one 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.

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.

Table 1
Alternative education inequality indicators
Years of education, adults 25-65 years

	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.

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

We start by documenting the average years of education in the Latin American countries with information obtained from the last national household survey available for each nation. Table 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 the countries have an average of more than nine 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 six.

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.

Table 2
Years of education by gender and income quintile and inequality in education
Adults aged 25 to 65

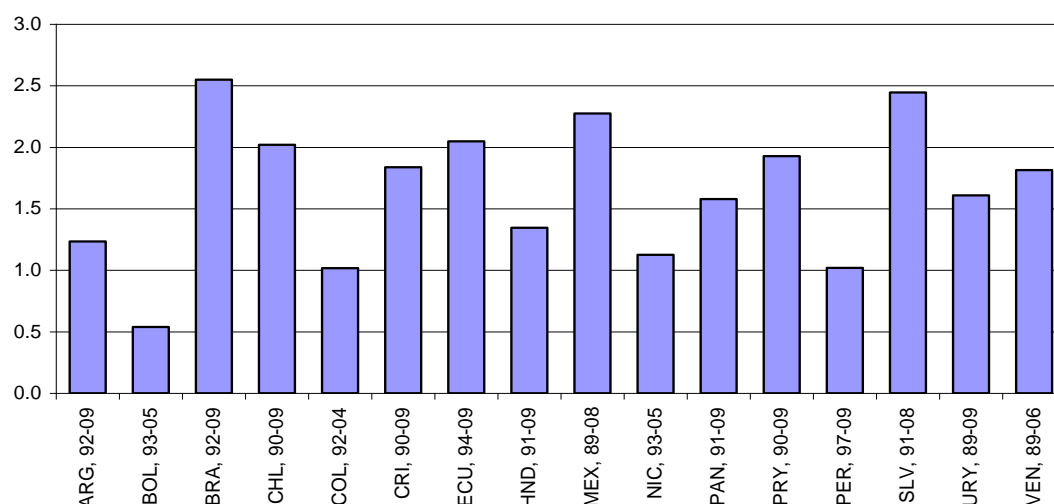
Country	Year	All	By gender		By income quintile					Inequality	
			Females	Males	Q1	Q2	Q3	Q4	Q5	Gap	Gini
Argentina	2009	11.0	11.2	10.8	8.4	9.4	10.3	11.5	13.6	5.2	0.205
Bolivia	2005	7.7	6.8	8.8	3.6	5.7	7.1	8.5	11.7	8.1	0.399
Brazil	2009	7.7	8.0	7.6	4.9	5.9	6.8	8.2	11.2	6.3	0.349
Chile	2009	11.0	10.9	11.1	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 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 1 illustrates the significant increase in the average years of education in the Latin American countries during the last two decades, continuing a process initiated decades ago.⁴

Figure 1
Change in years of education
Adult aged 25-65



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

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

Education levels in all countries increased along the income distribution. Individuals from the 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 the *differences* in educational achievements than the trends for the mean. Figure 2 shows changes for each country 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 has the gap shrunk 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.

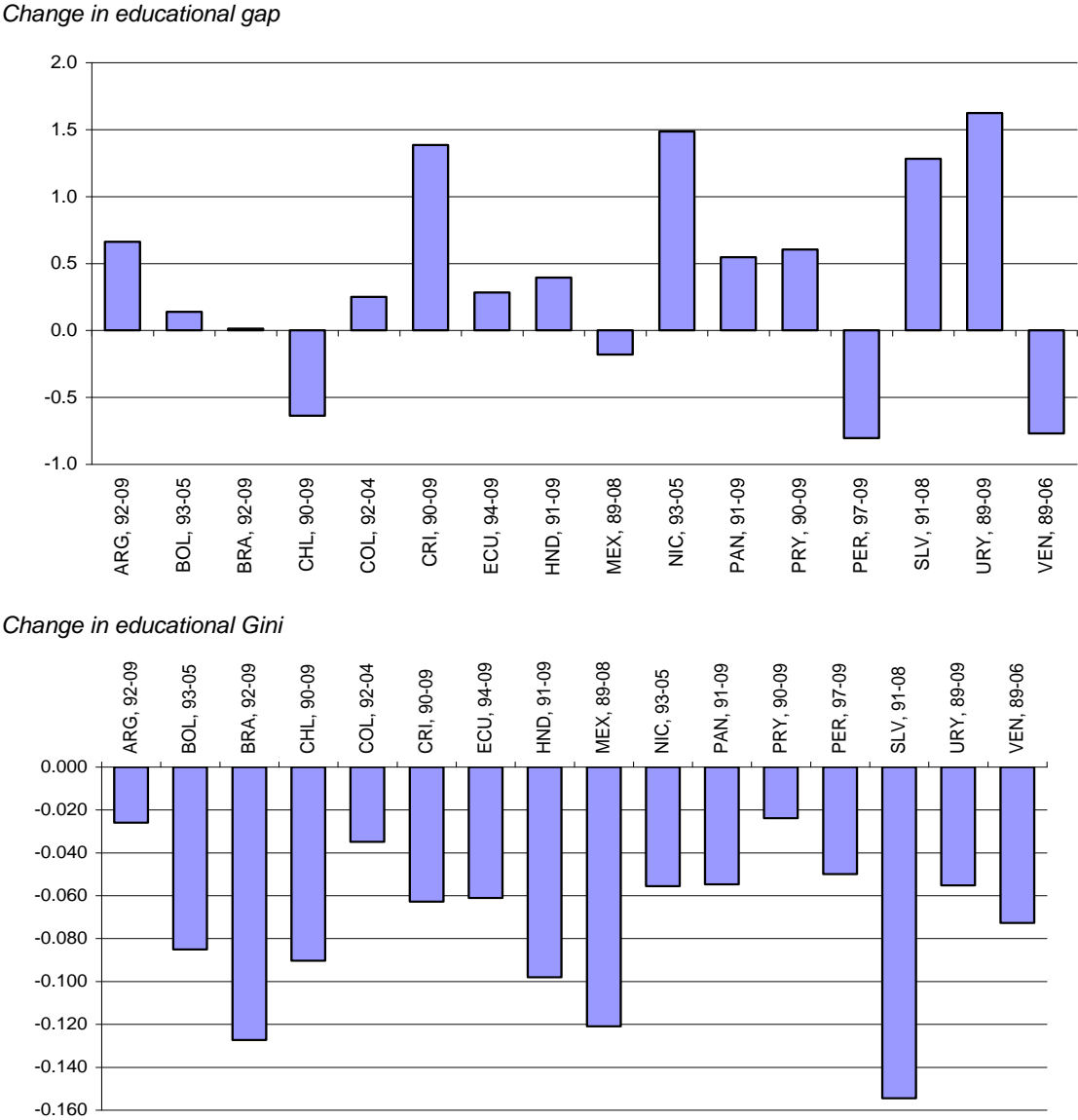
In our companion paper we carry out an analysis of the changes in education inequality at the country level. Again, as education expands the Gini tends to go down. Changes in the gap are more erratic. However, a closer inspection unveils an interesting fact. In

⁴ 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.

most countries the gap increases in the 1990s, and falls in the 2000s. Table 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 intensified efforts by governments in the 2000s to extend education to the poor, but naturally may also reflect the efforts of previous decades that materialized in the 2000s. We return to this topic in sections 4 and 5.

Figure 2
Change in education inequality
Gini of years of education and years gap between Q5 and Q1
Adults aged 25-65



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

Table 2
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

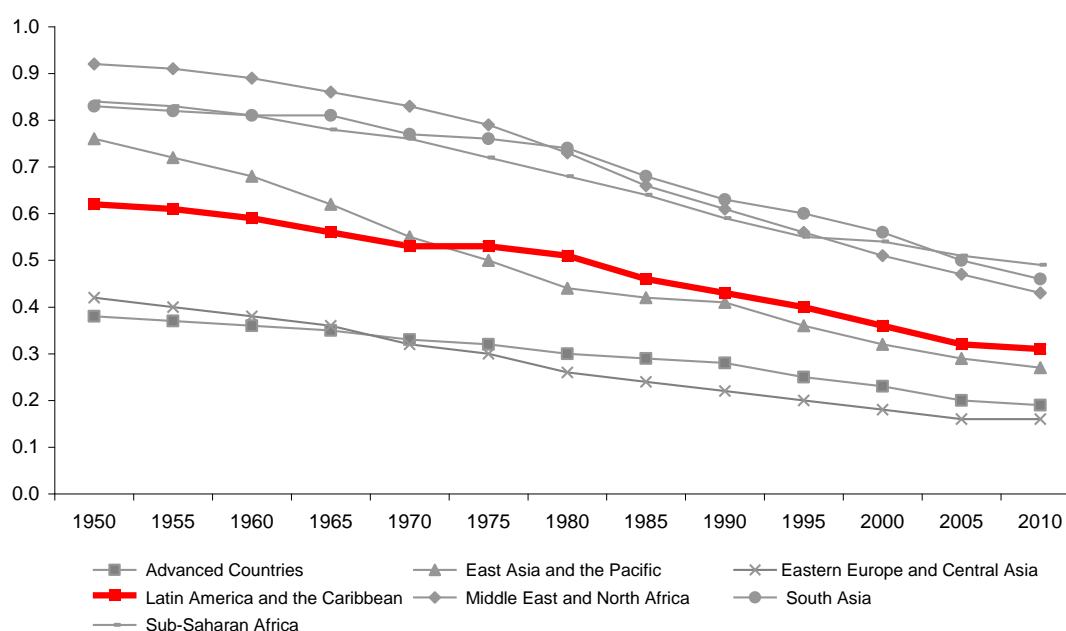
By computing the years of education by age group in a given survey we can get an assessment of changes in the extension of education from a longer-term perspective. In our companion paper we analyse years of education by age group and income quintile. Educational attainment has been increasing in cohort 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 the 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 schooling 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. Conversely, the years of education for the poor population 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 allows international comparisons of inequality in education (e.g., Barro and Lee 2001, 2010). According to

Figure 3
Gini of years of education
Population aged 15 and over, 1950-2010



Source: Wail, Said and Abdelhak (2011) based on Barro-Lee data (2010).

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 3 reveals a notorious decline in the level of education inequality as measured by the Gini of years of formal education in all regions of the world. The fall has been particularly sharp in East Asia and the Pacific. In fact, based on the estimations of Wail, Said and Abdelhak (2011) with the 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 four 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 no different from the fall in the world mean.

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 analyse. 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.⁵ 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

⁵ Cornia (2010) also presents random effects estimates, but the results are quite similar to those estimated by fixed effect.

country with high measured income inequality and relatively low education inequality.⁶ When taking the correlations between changes into account, 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 association is weak, suggesting the presence of many other factors affecting both variables in different directions.

To analyse this relationship further 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 Latin American countries in the period 1992-2009 with observations at the subnational level. We work with two panels: the short one includes six 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 five countries (Argentina, Brazil, Costa Rica, Honduras and Uruguay). This panel is larger in observations although encompasses fewer countries and is unbalanced.

Table 4
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
No. 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

Notes: Estimation was carried out with a fixed effect procedure; t-statistics in parentheses. * significant at 5%; ** significant at 1%

Source: Own estimates based on data from household surveys.

⁶ Cornia (2010) finds a linear correlation of 0.5 between the income and education Ginis over the period 1990-2007.

Table 4 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.⁷

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 fixed-effects into account. 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 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 labour incomes. In this section we report the results of Battistón, García Domench and Gasparini (2011) who explore whether this ‘paradox of progress’ (Bourguignon, Ferreira and Lustig 2005) is just a theoretical possibility with little relevance in practice, or it is in fact a widespread phenomenon across Latin America.⁸ To that aim they carry out microeconomic decompositions that isolate the direct effect of changes in the distribution of education on earnings inequality.⁹ 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 labour variables involved in the analysis (SEDLAC).

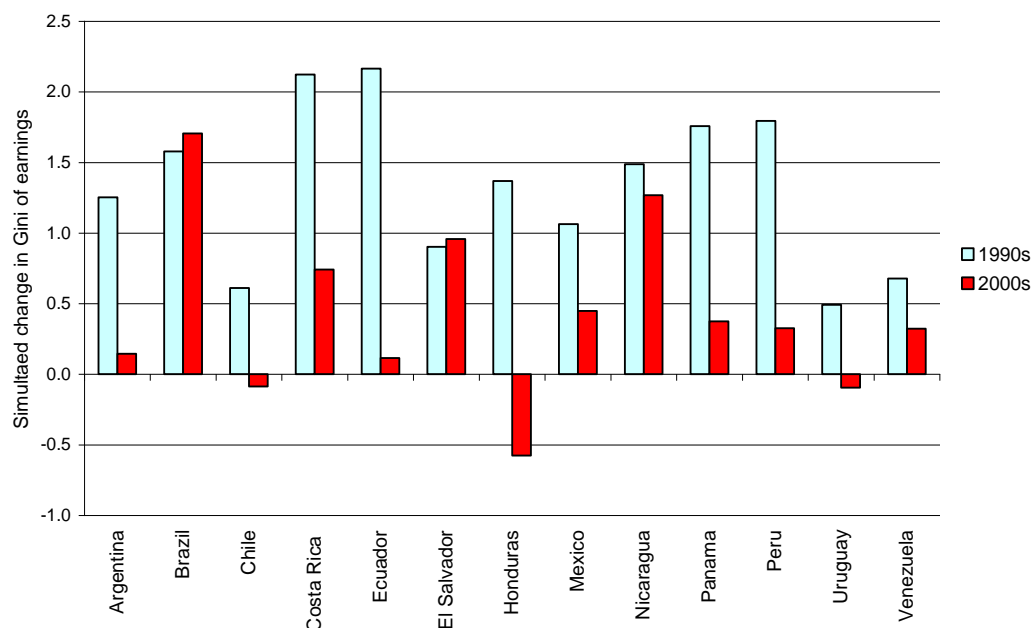
Figure 4 reports the counterfactual change in the Gini coefficient of the earnings distribution after altering the education structure of the population. The results indicate that if only individual education in the 1990s had changed over time, we would have observed increases in earnings inequality 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 towards 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.

⁷ Results are robust to alternative specifications.

⁸ Klasen, Villalobos and Otter (2011) find evidence for the paradox in Honduras.

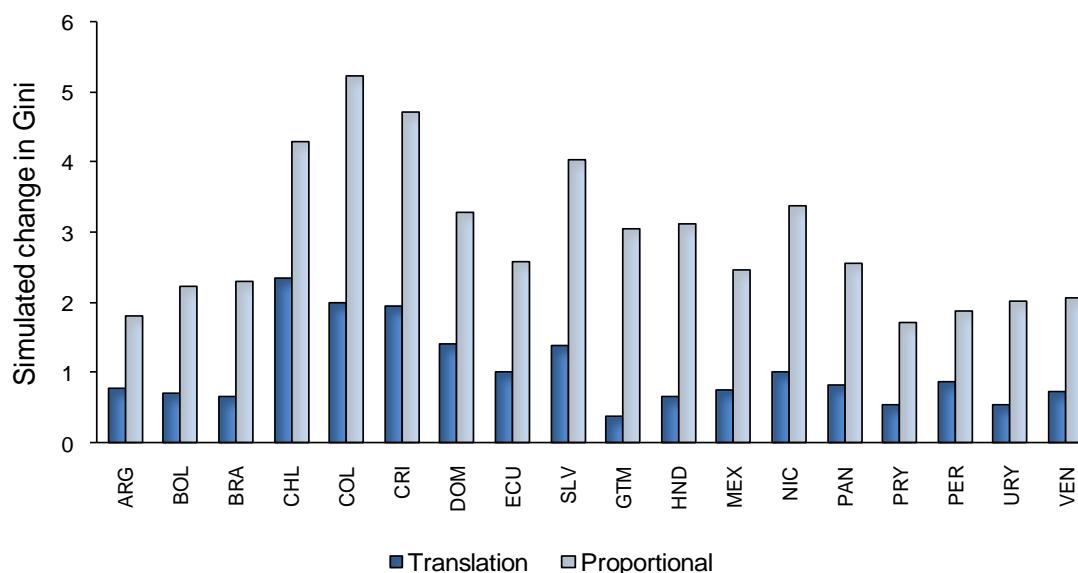
⁹ The methodology follows closely Gasparini, Marchionni and Sosa Escudero (2005) that in turn follow Bourguignon, Ferreira and Lustig (2005).

Figure 4
Effect of change in distribution of education on earnings inequality (Gini index)
Results from microeconomic decomposition



Source: Battistón, García Domench and Gasparini (2011).

Figure 5
Effect of an extra year of education on earnings inequality
results from microeconomic decomposition



Source: Battistón, García Domench and Gasparini (2011).

To further illustrate the direct impact of increasing education on earnings inequality Figure 5 shows the change in the Gini coefficient for the distribution of labour incomes after an increase in one year of education in each country. The figure shows two alternatives: in the first one (translation) the years of education are increased by one for

the entire working population, while in the second (proportional) the 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 additional year of education for every worker is undoubtedly unequalizing in all countries. On average the Gini in earnings increases by 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 ¹⁰

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 for interpreting the role of labour 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 postulates that secular technological change would favour the relative demand for skilled labour, 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 twentieth 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.

Evidence on increasing levels of education for Argentina, Brazil, Mexico and Peru is presented in Lustig and López Calva (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 reduce aggregate inequality. Manacorda, Sánchez-Páramo and Schady (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 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 et al. (2011), who 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 labour 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

¹⁰ The material and text in this section are based on Gasparini et al. (2011).

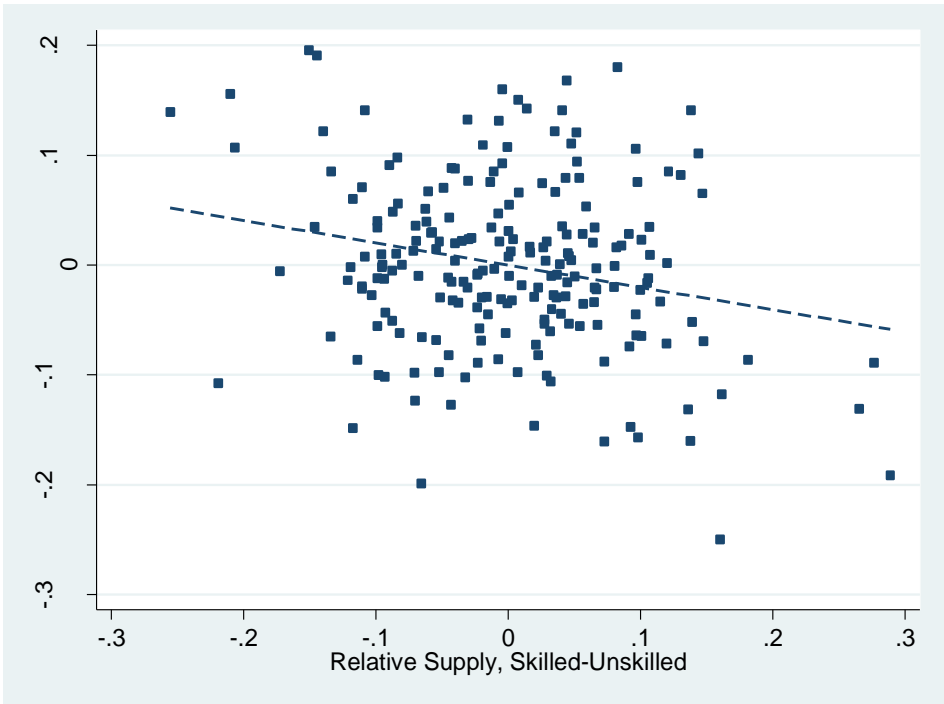
skill intensity of employment by sector and a further disaggregation accounting for three skill levels.¹¹

Figure 6 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 labour 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 labour and its relative remuneration over the 1989-2009 period in Latin America.

The evidence summarized in Figure 6 does not distinguish the evolution of the underlying variables over time. This is presented in Figure 7, which depicts the skilled-unskilled wage premium and the relative supply of skilled to unskilled labour 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 7 complement those of Figure 6. The first remarkable fact is the constant and strong increase in the relative supply of skilled labour over the whole period under analysis. This is a relative measure of supply, and this evidence combined

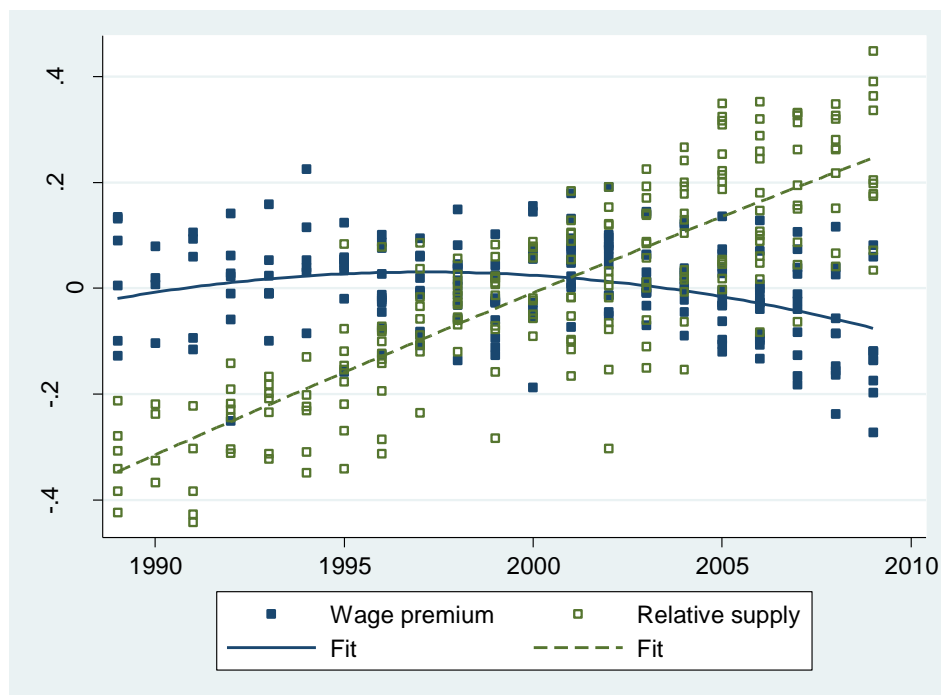
Figure 6
Skilled-unskilled wage premium and relative supply, net of country and year fixed effects.
Sixteen LA countries, 1989-2009



Source: Gasparini et al. (2011), calculations based on SEDLAC (CEDLAS and World Bank).

¹¹ 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 et al. (2011) also analyse evidence based on the distinction between three levels of skills, with semi-skilled workers defined as those with a secondary degree.

Figure 7
 Skilled-unskilled wage premium and relative supply over time, net of country effects. Sixteen LA countries, 1989-2009



Source: Gasparini et al. (2011), calculations based on SEDLAC (CEDLAS and World Bank).

with the increase in years of education for all countries in the region (documented in section 2) indicates an educational upgrading of the labour 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 et al. (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 labour, *ceteris paribus*, was a factor behind the reduction in the wage skill premiums in Latin America over the 1990s and the 2000s.

As stated previously, there is a constant increase in the relative supply of skilled labour over this period, while the wage skill premium first has 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 labour, can be interpreted in a Tinbergen framework as denoting the presence of a strong demand shift towards skilled labour, 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 privatization, trade openness and other structural reforms during the 1990s in facilitating skill biased technical change and, more generally, spurring the demand for skilled labour (see, for instance, the account of the Argentine case in Gasparini and Cruces 2009). For the years 2000-09 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 labour indicate the presence of weaker shifts in the relative demand for skilled labour with respect to those implied by trends in the previous decade. Further analysis carried out by Gasparini et al. (2011) indicates that some of this shift in the relative demand for unskilled labour is related to the increase in commodity prices and in the terms of trade of the first decade of 2000.

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

4 School enrolment

While the previous pages concentrate on the educational attainment of the adult population, in this section we report the level and distribution of enrolment rates.^{12, 13} Enrolment rates at all levels for all countries have increased (Figure 8). For primary education, the quintile gap has remained almost constant or fallen for all countries. There is a clear relationship between higher enrolment and smaller gaps, since the top quintile has historically been close to the 100 per cent ceiling—any improvement would narrow the gap. Notably, a set of countries have achieved increases of more than 10 percentage points in net primary enrolment rates in relatively short periods of time. The increase was low for those countries that were already close to universal coverage at the time of the first available survey.

While net enrolment rates also increased substantially for secondary schooling (by 20 percentage points or more in several countries), the quintile gap has increased in some cases, including Nicaragua, Guatemala, El Salvador and Honduras. Finally, the increases in tertiary enrolment 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.

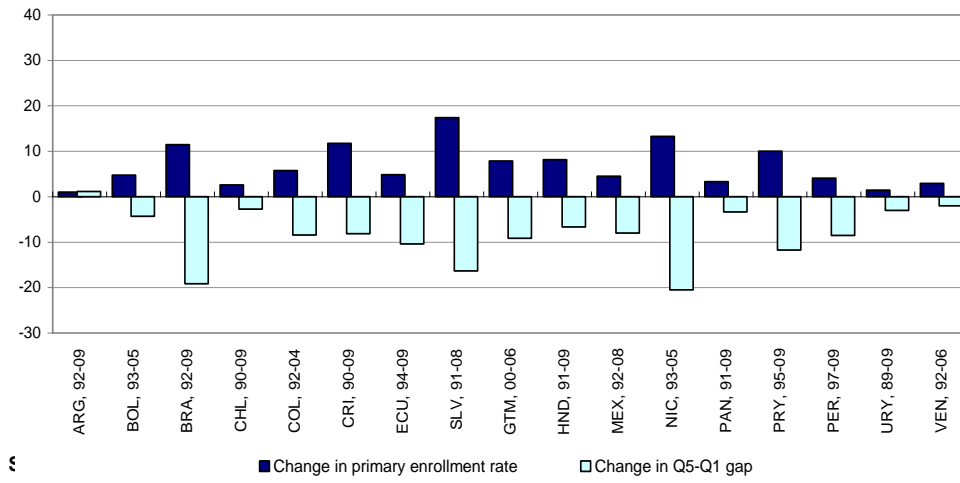
When examining changes by decade, an interesting fact emerges (Table 5). Although the average speed of educational upgrading did not increase in the 2000s, the pattern of that process was substantially different both in secondary and tertiary schooling. Compared to the previous decade, the growth in school enrolment rates for the poor was considerably higher in these educational levels. In contrast, changes in primary schooling were not very different between decades. As most countries in the region approached universal enrolment 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 enrolment

¹² The net enrolment rate is defined as the share of individuals in a given age group that attend the educational level corresponding to their age.

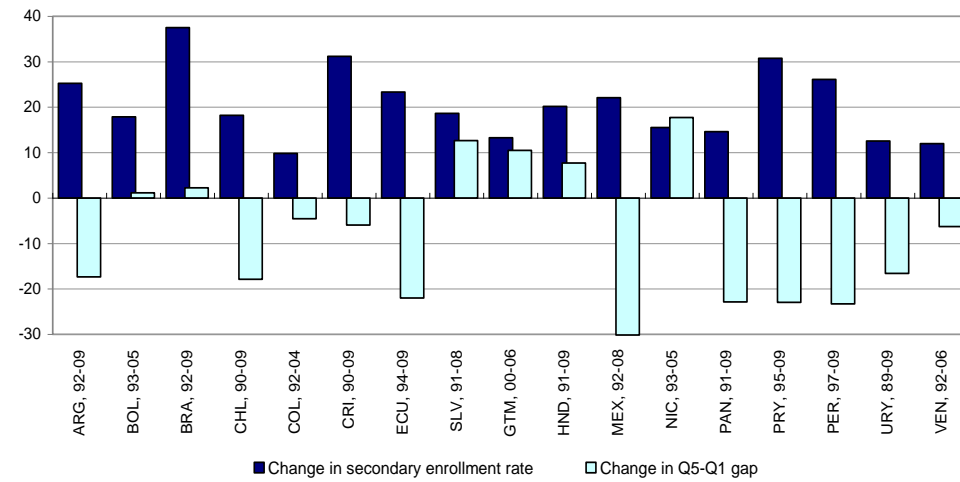
¹³ The longer version of this paper includes a section on education quality with evidence taken from other studies showing a strong positive relationship between educational quality and achievements, and socioeconomic status.

Figure 8
Change in net enrolment rates and in Q5-Q1 gap in enrolment rates

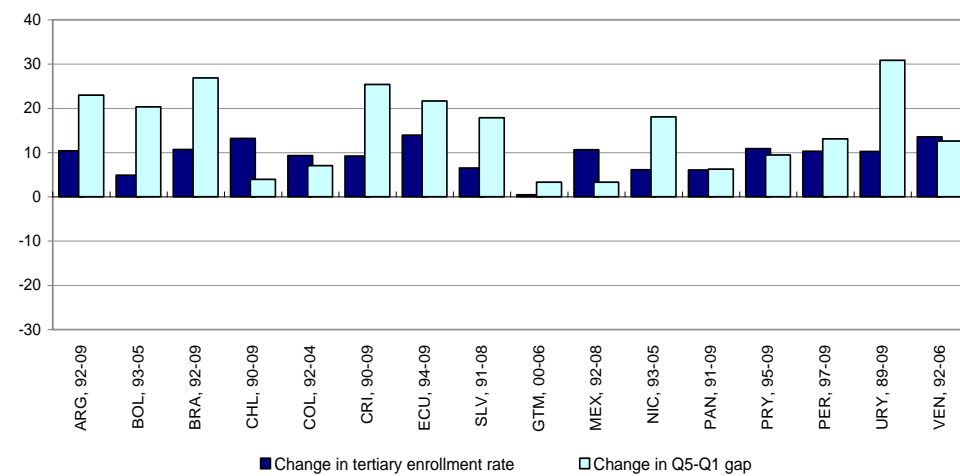
Primary



Secondary



Tertiary



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

was similar in both decades but while the educational gap in the 1990s widened in most countries, the first decade of the 2000s witnessed on average a widespread pattern of shrinking gaps. On average, for the sample of countries with consistent observations in the early 1990s and during the first decade of the millennium, the gap between the fifth and first quintiles in secondary school enrolment widened 2.6 points in the 1990s and shrunk eight points in the 2000s. The gap was reduced in all countries except El Salvador, Nicaragua and Uruguay. Active educational policies and the inception of massive cash transfer programmes conditional on school attendance in many countries surely contributed to this substantial increase in enrolment for the poor. For tertiary education the difference between the 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 has even shrunk during the last years.

Table 5
Change in net enrolment rates and gap Q5-Q1 by decades

	Change in enrolment			Change in gap Q5-Q1		
	1990s	2000s	All	1990s	2000s	All
Secondary						
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						
	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 action to give priority to education, but also was possible due to a favourable 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.

Table 6
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

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.

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

In Table 6 we compute a measure of the potential of public investment in education to increase access and quality. Specifically, the table shows public spending in education for each country/year in USD PPP for children under 14.¹⁴ There is a sustained increase in all countries in the public funds available for education per child. The average for Latin America steadily increased from USD 320 in 1990, to 511 in 1995, 756 in 2000 and 1451 in 2010: this figure has become fourfold in just 20 years. The increase in the

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

2000s was roughly the same as in the 1990s in proportional terms, but much larger in absolute terms.

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)

$$g_N = \frac{G}{Y} \cdot \frac{Y}{P} \cdot \frac{P}{N} \quad (1)$$

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 for education in GDP, economic growth that affects per capita GDP, and demographic changes that alter the share of children in the population.

Table 7 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.¹⁵ 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.

Table 7
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

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

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

¹⁵ The share reported for Cuba is 14.6. Due to data limitations we do not include this country in the analysis.

Despite the fluctuations, there is a clear pattern in all countries towards 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 these data there is no discernible change in public spending in education during the 2000s, a decade characterized by the election of many progressive regimes, some with new approaches to educational policy.

Table 8
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

Note: Estimations for 2020.

Source: CEPAL based on census data.

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 1970 censuses. From that point on, the region experienced a significant reduction in fertility rates. The fall in the ratio of children in the population has been speeding up over time: it was 7 per cent in the 1970s, 8 per cent in the 1980s, 12 per cent in the 1990s, 13 per cent in the 2000s and is forecasted to be 15 per cent in the 2010s (Table 8). The figures are even larger for the weighted average, since the fall in fertility rates is larger in Brazil and Mexico. While the share of children in Latin America dropped 35 per cent from 1970 to 2010, the fall in both Brazil and Mexico was 40 per cent. With constant real resources and education costs, this demographic pattern has implied, and would imply, a great opportunity to increase school enrolment rates.¹⁶

¹⁶ The situation is different for the youths: in the LA aggregate, the share in the total population has not changed much over the last decades. The population share of the young in the age of attendance at

Table 9
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 (1), Table 9 reports the results of a simple decomposition that simulates the change in g_N for each country if all but one factor had remained constant between 1990 and 2010.

Three factors have contributed to the increase in spending per child. On average economic growth contributed approximately half of the increase while changes in social policy contributed roughly a third and demographics the remaining one-sixth. The figures illustrate the central role of economic growth in sustaining the efforts to increase education, and at the same time alert us to the difficulty of sustaining education upgrading in less favourable economic scenarios. 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 progress in increasing overall levels of human capital. This expansion has been encouraged by social policy, fuelled by economic growth and favoured by the region's demographics transition. Although the size of this expansion was roughly the same over the last decades, the evidence suggests a significant difference between the

high school, college and graduate programmes is expected to fall 5 per cent 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 coming years, posing an additional challenge to the perspective of expanding superior education.

decades of the 1990 and 2000 in terms of both the assessment of the equity of the education expansion and its impact on income distribution.

While the gap in the years of education across the income quintiles widened in the 1990s in all Latin American countries, during the first decade of the 2000s, it shrunk as an overall average and individually in several countries. The reasons behind the differences in the changes in the education distribution between decades lie partly in the intensification of efforts by governments in the 2000s to extend education to the poor, but also in the efforts of the previous decades that materialized in the new millennium. The recent encouraging patterns for the indicators of inequality in years of education are also present in other dimensions as enrolment rates and educational mobility. Latin America might have reached a turning point where educational upgradings are becoming 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: educational upgrading was unbalanced, and the relative demand for unskilled labour fell during the decade due to several factors including some market-oriented reforms, technological changes, international prices, and weak labour 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 education upgrading and a more stable or even increasing relative demand for low-skill labour.

There are some caveats with respect to the educational trends' effect on future inequality. It might be difficult to sustain high quality schooling systems in the context of large increases in enrolment 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 the quality of 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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