Educational Inequality at Regional Level and Its Determinants: The Evidence of Latin America in the Second Half of the 20th Century

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Abstract

Background: In the second half of the 20th century, Latin America experienced great economic and political changes from the inward-looking import substitution industrialisation (ISI) to the outward-looking Neoliberalism. However, due to unavailability in data, socioeconomic inequality of Latin America during this period is less studied, especially inequality at regional level.

Objective: This study traces the evolution of educational attainment and its inequality in four types of region (capital, non-capital, rural, and urban) of nine Latin American countries (Bolivia, Brazil, Colombia, Dominican Republic, Guatemala, Haiti, Honduras, Nicaragua, and Peru) from 1950 to 1994, and then examines the determinants of inequality in educational attainment with a particular interest in the role of liberalisation and educational expansion.

Methodology: Inequality in educational attainment is measured by the difference in schooling years between the taller half that represents the richer half and the shorter half that represents the poorer half in a population. The data on body height and schooling year are from the Demographic and Health Survey (DHS). All data refer to female case and are arranged based on five-year birth cohort.

Results: Capital regions have the highest educational attainment, while rural regions are at the bottom. Educational attainment of both the rich and the poor in all the four types of region of the nine countries increases during the considered period. Fixed-effects regressions show that liberalisation that is measured by trade openness only has significant impact in capital regions, and educational expansion that is measured by enrollment rate in primary education serves as an equalising force in capital regions but a disequalising force in non-capital regions and rural regions. Finally, few variables are statistically significant in regressions for non-capital regions and rural regions.

Conclusions: In Latin America regional heterogeneity is great and governmental policies have larger influence on educational inequality in capitals and large cities than in other regions. Importantly, such a huge regional heterogeneity may lead country-level studies on Latin American inequality to generate misleading results, especially in terms of the impact of policies.

Keywords: Educational inequality, Liberalisation, Educational expansion

JEL Classification: I14, I24, O15

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1. Introduction

Latin America is the most unequal region in the world (Gasparini and Lustig, 2011). This inequality features a strong resilience towards different policy regimes and periods (Walton, 2004). Educational inequality, amongst others, is of particular importance, because it is a determinant of economic inequality (Castelló and Doménech, 2002) and can result in lifelong consequence (Behrman and Knowles, 1997). However, because previous studies tend to examine Latin American inequality from the 1980s, our knowledge of inequality in this continent prior to the 1980s is still insufficient, especially for inequality in some socioeconomic dimensions other than income. Extending the research period ahead of the 1980s does not only imply a longer time span and more observations, but also an inclusion of a totally different historical era of import substitution industrialisation (ISI) from the 1950s to the 1970s.

This paper aims to analyse the evolution and determinants of educational inequality at regional level (capital[2], non-capital, rural, and urban)[3] in nine Latin American countries (Bolivia, Brazil, Colombia, Dominican Republic, Guatemala, Haiti, Honduras, Nicaragua, and Peru) across nine five-year birth cohorts from 1950 to 1994. A particular interest is given to the impact of liberalisation and educational expansion that are two major socioeconomic changes in Latin America in the second half of the 20th century. The results can shed light on the major contributors to educational inequality and whether

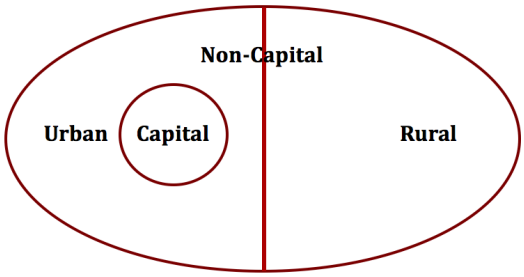
[2] In the DHS database, capital region includes both the capital and large cities with population more than one million. This definition is adopted in this paper.

[3] Non-capital region refers to all regions other than capital region, urban region includes capital, large cities, small cities and towns, and rural region refers to the region other than urban region. Thus, the four types of region overlap with each other to some degree. Figure 1 shows the relationship between the four types of region.

different types of region response to the same policy in different ways. Thanks to the unique database of the Demographic and Health Survey (DHS), educational inequality between the upper class and the lower class, alternatively between the rich and the poor, can be measured by the difference in average schooling years between the taller half and the shorter half of a female population at regional level. Such a region-level study on educational inequality in Latin America where regional disparity is great is unique and novel. The selection of these nine countries is due to data availability. The DHS database contains fifteen Latin American and Caribbean countries, but five of them (Ecuador, El Salvador, Mexico, Paraguay, and Trinidad and Tobago) do not have data on body height. These five countries are only present in the survey rounds of 1985, 1987 or 1990, but the DHS programme did not start to collect body height data until the early 1990s. Guyana, despite available body height data, was not an officially independent country until 1970. Therefore, the geographical scope of this paper is constrained to the nine countries listed above.

This paper is organised as follows. Section 2 reviews literature on liberalisation and inequality in Latin America. Section 3 reviews educational expansion in Latin America. Section 4 introduces the anthropometric measurement of educational inequality. Section 5 shows data. Section 6 presents the evolution of schooling year and its inequality at regional level in the nine countries from 1950 to 1994. Section 7 shows regression analysis. Section 8 concludes this paper.

Figure 1. Regional Classification



Source: Author's elaboration

2. Liberalisation and Inequality in Latin America

De-liberalisation and liberalisation are two important events in Latin America during the second half of the 20th century. In the 1950s import substitution industrialisation (ISI) spread in Latin America. An essential policy tool of the ISI strategy is trade restriction (Taylor, 1998). Many Latin American countries reversed their previous open trade policy and adopted trade restriction. Thus, the 1950s and the early 1960s can be seen as a de-liberalisation period. During this period, educational expansion is an important part of social policies in Latin America (Frankema, 2009). In the 1980s, Latin America began to abandon the ISI strategy, and experienced a wave of liberalisation, say neoliberalism. Table 1 shows the periods of trade closure and openness in the nine countries from 1950 to 1994. However, the neoliberal reform that features a replacement of the state by the market in socioeconomic life and a superiority of economic efficiency over social fairness tends to be detrimental in terms of welfare (Walton, 2004; Biglaiser and Jr. DeRouen, 2004; Fraile, 2009). Regarding the effect of trade openness on inequality, two conflicting arguments coexist. The traditional Heckscher-Ohlin-Samuelson (HOS) theorem argues that trade openness can increase the demand for unskilled labour in developing countries and raise their wages and eventually reduce inequality. By contrast, trade openness may

generate skill wage premium by introducing skill-biased technology, and benefit skilled labour more than unskilled labour, which raises inequality (Green, Dickerson and Arbache, 2001). The Latin American experience seems to reject the HOS theorem and confirm the existence of skill wage premium (Castilho, Menéndez ans Sztulman, 2012), and there is a consensus on the disequalising effect of trade liberalisation in Latin America (Londoño and Székely, 1997). However, Székely, Birdsall and Behrman (2000) suggest that the extent of this disequalising effect of trade openness is limited or even trivial, perhaps because the welfare-enhancing effect and the disequalising effect of trade openness coexist and cancel out each other (Gasparini and Lustig, 2011).

Table 1. Periods of Trade Openness and Closure from 1950 to 1994

Country	***Trade Closure***	***Trade Openness***
Bolivia	1950-1955, 1979-1985	1956-1978,1986-1994
Brazil	1950-1991	1992-1994
Colombia	1950-1985	1986-1994
Dominican Republic	1950-1994	None
Guatemala	1962-1988	1950-1961, 1989-1994
Haiti	1950-1994	None
Honduras	1962-1991	1950-1961, 1992-1994
Nicaragua	1961-1991	1950-1960, 1992-1994
Peru	1968-1991	1950-1967, 1992-1994

Source: Author's elaboration based on Sachs and Warner (1995)

Concerning educational inequality, Baten and Mumme (2010) examine the impact of trade openness on schooling year gap in a large number of developing countries from 1950 to 1984, and show that openness reduces educational inequality. This is opposite to the impact of openness on economic inequality that is specifically found for Latin America in Baten and Fraunholz (2004). Besides different country samples in the two studies, a possible explanation is that educational inequality and income inequality may response to policy change in different ways. This indirectly supports the argument that educational inequality and income inequality have opposite dynamics (Cox, 2010). A

more recent evidence is from Sahn and Younger (2006) who find that educational inequality (downward) evolved in an opposite direction relative to income inequality (upward) in the late 1980s and the 1990s in Latin America. Moreover, Cruces, Domench and Gasparini (2011) show that in the 1990s, although education was expanded and the poor became more educated, the gap in schooling years between the poor and the rich was widened.

Another important signal of liberalisation is regressive tax reform. In Latin America, tax reform is represented by the replacement of a progressive taxation focusing on income by a value-added taxation focusing on consumption. Thus, redistribution becomes a secondary goal of tax design and the new neoliberal taxation system worsened income inequality (Gasparini and Lustig, 2011; Mahon, 2011). Unlike trade openness, the disequalising effect of tax reform on human capital formation is clearer. Under progressive taxation system the poor pays much lower tax than the rich does, while shifting to regressive taxation leads the poor to pay more and the rich to pay less relative to their own income. Thus, under progressive taxation, poor parents have higher motivation to invest in children's human capital (Erosa and Koreshkova, 2007), while proportional taxation has a negative impact on the poor's human capital formation (Trostel, 1993). Table 2 shows the starting year of value-added tax in the nine countries.

Table 2. Starting Year of Value-Added Tax

Country	*Starting Year of VAT*
Bolivia	1973
Brazil	1967
Colombia	1975
Dominican Republic	1983
Guatemala	1983
Haiti	1982
Honduras	1976
Nicaragua	1975
Peru	1976

Source: Mahon (2011)

3. Educational Expansion and Inequality in Latin America

The effect of educational expansion on educational inequality is another important point. As a result of the great educational expansion, by the end of the 20th century Latin America had reached universal primary education (Frankema, 2009), and this expansion reduced educational inequality (Cox, 2010)[4]. A reasonable assumption is that expansion at lower level of education is always larger than that at higher level. Once the upper class has reached universal access to lower-level education (elite saturation), increasing access to education will spread to the lower class. As a result, educational inequality decreases in educational expansion. Using data on 94 countries, Ram (1990) finds that educational inequality increases in educational expansion (measured by average schooling years) until around seven years of schooling, and then decreases. Torche (2010) shows that for birth cohorts from 1940 to 1975 the proportion of people with (complete and incomplete) secondary education increases significantly in Brazil, Colombia, Chile and Mexico from earlier birth cohort to later birth cohort, while the corresponding proportion for primary education decreases and the proportion for

[4] But for the 1990s, Cruces, Domench and Gasparini (2011) find increasing educational inequality in the presence of educational expansion.

tertiary education grows very slowly. Put it differently, the probability of completing primary education and/or entering into secondary education increases across the four cohorts in decreasing margin. By contrast, the probability of completing secondary education is almost stagnant, and the probability of entering into tertiary education decreases across cohorts. This demonstrates that education at lower level tends to reach universality, while access to higher education actually decreases for the later cohorts (probably due to debt crisis and structural reform since the 1980s when the later cohorts reached their age for the second half of secondary education and the beginning of tertiary education). The author thus suggests an educational equalisation at lower educational level resulting from educational expansion, but an educational disequalisation at higher educational level resulting from worse situation of the poor.

4. An Anthropometric Measure of Educational Inequality

Following Baten and Mumme (2010), in this paper educational inequality is measured by the difference in average schooling years between the taller half and the shorter half of a given female population. In the economic literature, body height is regarded as a major indicator of living standard, and it is a consensus that people of better socioeconomic position tend to be taller. For developing countries where data on income and socioeconomic class tend to be lacking in the long run, height is a good proxy. In modern societies, nutrition is the most important factor that generates height gap between the rich and the poor (Baten and Blum, 2012)[5], especially in impoverished environment

[5] Baten and Mumme (2010) response to the potential confounding effect of individual genetic height variation by arguing that at population level this individual variation can be basically averaged out.

(Moock and Leslie, 1986)[6]. This further justifies the use of height in developing countries. Height as an indicator of socioeconomic status has an important advantage over income measures, because it is an output indicator. For instance, height can reflect the provision of public goods and the result of intra-household allocation, and can cover a wider range of social groups other than wage earners (Baten and Fraunholz, 2004; Moradi and Baten, 2005; Baltzer and Baten, 2008). The last point particularly applies to Latin America where there is a high degree of informality. Among the total 355 observations of the taller-shorter schooling year difference (71 observations for each of the four types of region plus another 71 observations at national level), only three observations show negative values and all the three exceptional values are trivial (-0.35, -0.09, and -0.04). This confirms that the taller half tends to have higher educational attainment.

Nutritional conditions and environment during childhood largely determine adult height (Baten, 2000) and human capital accumulation (Duncan, Yeung, Brooks-Gunn and Smith, 1998; Alderman, Hoogeveen and Rossi, 2009). Malnutrition during early childhood reduces both height and schooling years (Alderman, Behrman, Lavy and Menon, 2001; Alderman, Hoddinott and Kinsey, 2006). Following this argument, in this paper each mean height is calculated specifically for each five-year birth cohort in each region of a country, instead of across all birth cohorts and all regions, in order to reflect nutritional and economic conditions in each given region during each five-year period when interviewed women were born. The sorting of sampled women's regional classification is determined by their childhood place of residence, instead of their current place of residence[7]. This is particularly

[6] In rich countries, height difference largely reflects difference in individual genetic endowment.

[7] For some DHS databases that do not record childhood place of residence, this information is inferred by combining information from several other variables.

important for Latin America that experienced huge domestic migration in the 1970s and the 1980s. Thus, each group of interviewed women born in each birth cohort in each type of region of each country has its own mean height upon which the taller half and the shorter half are divided. By doing this, each mean height and each taller-shorter difference reflect economic condition and distribution during each corresponding birth cohort in each region of each country.

5. Data on Adult Height and Schooling Years

This study uses various rounds of the Demographic and Health Survey (DHS) database on the nine Latin American and Caribbean countries. The DHS database records schooling years and body height of women aged between 15 and 49 years old. Hence, all height and schooling data refer to female case. Table 3 shows the available period coverage. Totally, each of the four types of region (capital, non-capital, rural and urban) has 71 observations for birth cohorts from 1950 to 1994 in the nine countries. Because height may have not reached the final level until 20 years old, women younger than 20 years old are excluded. Another possible bias is that people under 22 years old may have not eventually finished their education, thus the real schooling years of people aged 20 and 21 years old may be underestimated. But such a downward bias is not found in the sample (perhaps because the share of people with tertiary education is very low). Thus, people aged 20 and 21 are still contained. Table 4 shows the number of sampled women who are actually used in calculating the means of body height and schooling years. Sampling weight and de-normalisation across various survey rounds are considered. The samples are demographically representative for these countries in each survey round. But the sample size is not necessarily proportional to the geographical and population size of a country. Brazil, the largest country in Latin America, has the smallest sample size, because it was surveyed in

only two rounds after 1988 (1990 and 1996)[8].

Table 3. Period Coverage

Country	***Available Period****	***No. Birth Cohort***
Bolivia	1950-1988	8
Brazil	1950-1976	6
Colombia	1950-1990	9
Dominican Republic	1950-1993	9
Guatemala	1950-1979	6
Haiti	1950-1992	9
Honduras	1955-1992	8
Nicaragua	1950-1981	7
Peru	1950-1992	9

Source: Author's calculation based on the DHS database

Table 4. Number of Actually-used Sampled Women

Region / Country	Capital	Non-Capital	Rural	Urban	National (Total)
Bolivia	10042	22973	11533	21482	66030
Brazil	555	2557	1017	2095	6224
Colombia	6603	57636	14990	29504	108733
Dominican Republic	1885	15073	7661	9266	33885
Guatemala	274	7399	5422	2251	15346
Haiti	2564	18006	11994	8732	41296
Honduras	3843	28135	17550	15404	64932
Nicaragua	1666	17562	8422	10806	38456
Peru	36172	97642	47110	86689	267613

Source: Author's calculation based on the DHS database

[8] Only from the second phase (1988-1993), did the DHS begin to collect body height information on mothers and/or women. But databases from 1988 to 1990 still tend to lack height information.

6. Evolution of Female Schooling Year and Its Inequality

Figure 2 shows the evolution of adjusted average schooling years of the taller half and the shorter half in the four types of region and at national level for the nine countries. Figure 3 shows the taller-shorter schooling year difference in each type of region. The horizontal axis is five-year birth cohort, and the vertical axis is schooling year. Several patterns are found. First, in the nine countries women born in capital regions generally have the highest schooling years, followed by urban regions, non-capital regions, and finally rural regions. The national average level lies between urban level and non-capital level. The capital-urban difference in schooling years is small, while the capital/urban-rural difference is very large. Second, schooling years of both the taller half and the shorter half show smooth increase, except for Brazil where schooling years decrease after the 60-64 birth cohort. The evolution of schooling years of both the taller half and the shorter half in the four types of region within each country is basically consistent. Among countries with available data in the whole 1980s and/or the 1990s, Colombia, Dominican Republic, Haiti, and Peru show stagnation across birth cohorts of this period, and in only few cases schooling years slightly decrease. This suggests the possible depressing effect of the debt crisis and the neoliberal reform. Third, among the nine countries, Dominican Republic, Haiti, Honduras, and Peru show clear convergence in regional disparity in schooling years during the considered period. Bolivia, Colombia, Guatemala, and Nicaragua have basically unchanged regional disparity, while regional disparity of Brazil increases first and then decreases. That is to say, there is not country that shows obvious regional divergence in schooling years.

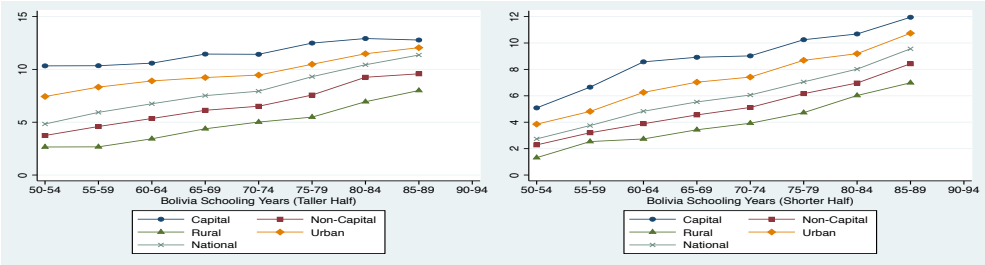
Concerning educational inequality measured by the taller-shorter difference in schooling years, Brazil,

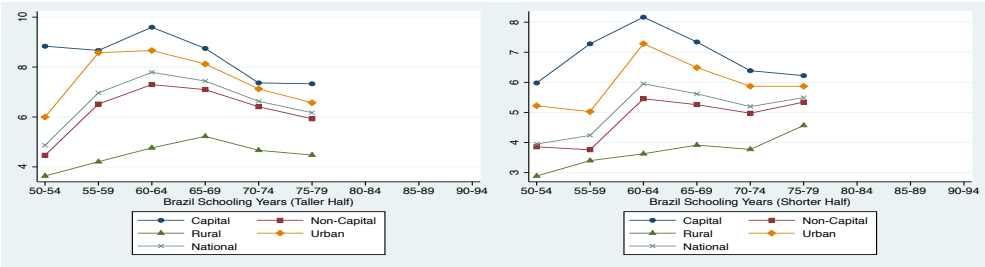
Colombia, Dominican Republic, and Peru feature a continuous downward trend, while Bolivia, Haiti and Honduras have a clear downward trend only from birth cohorts of the 1980s. Guatemala shows a slight upward trend with strong fluctuation, and Nicaragua also shows relatively strong fluctuation but without a clear trend. It is important to note that for all countries with available data in the whole 1980s and/or the 1990s, educational inequality in the four types of region tends to decrease across birth cohorts during this period. In addition, educational inequalities in different regions within a country basically show a similar dynamic. Except for Colombia and Nicaragua, rural regions tend to have the lowest educational inequality within a country. Given their lowest schooling year level, rural regions show a situation of low educational attainment but also low educational inequality. In other words, rural regions are poor but equal.

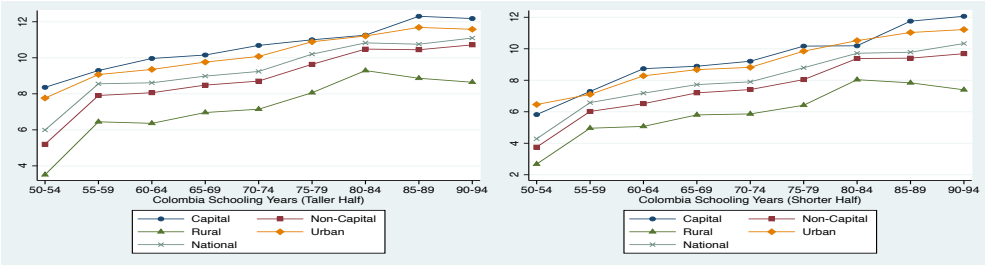
In capital regions, Colombia, Peru, Bolivia (to a lesser degree), and Brazil (to a lesser degree) have a continuous reduction in educational inequality. Other countries have some fluctuations. For all the nine countries, educational inequality in capital regions is lower for the ending cohort than for the starting cohort. Bolivia, Colombia and Haiti experience large reduction in educational inequality in capital regions across the birth cohorts of the 1950s and the early 1960s. For Honduras and Nicaragua, such a large reduction continues to the birth cohort of the late 1960s, and for Peru the early 1970s. For Brazil and Guatemala, such a large reduction only occurs for the birth cohorts of the 1950s. Only Dominican Republic shows an increase in educational inequality in capital regions across the birth cohorts of the 1950s and the 1960s. Such a widespread large reduction in educational inequality across the birth cohorts of the 1950s and the 1960s basically does not occur in regions other than capitals and large cities. This may suggest an unbalanced equalising effect of the ISI strategy in

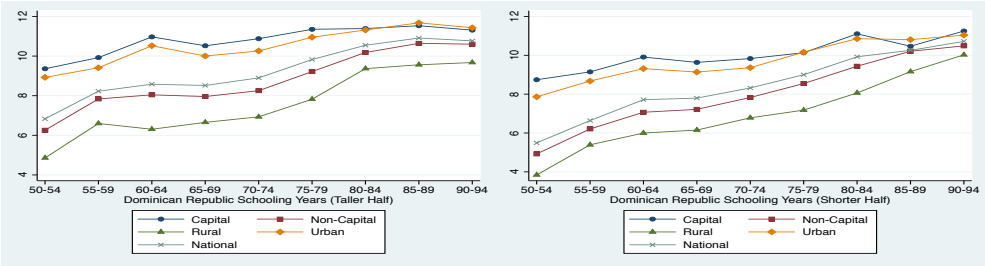
political and economic centres of a country in the 1950s and the 1960s.

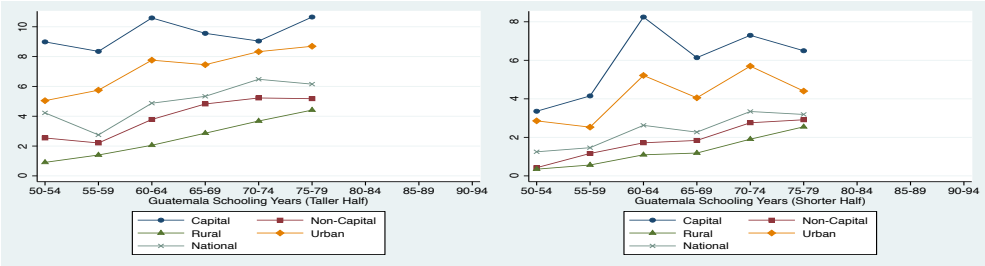
Figure 2. Average Schooling Years of the Taller Half and the Shorter Half

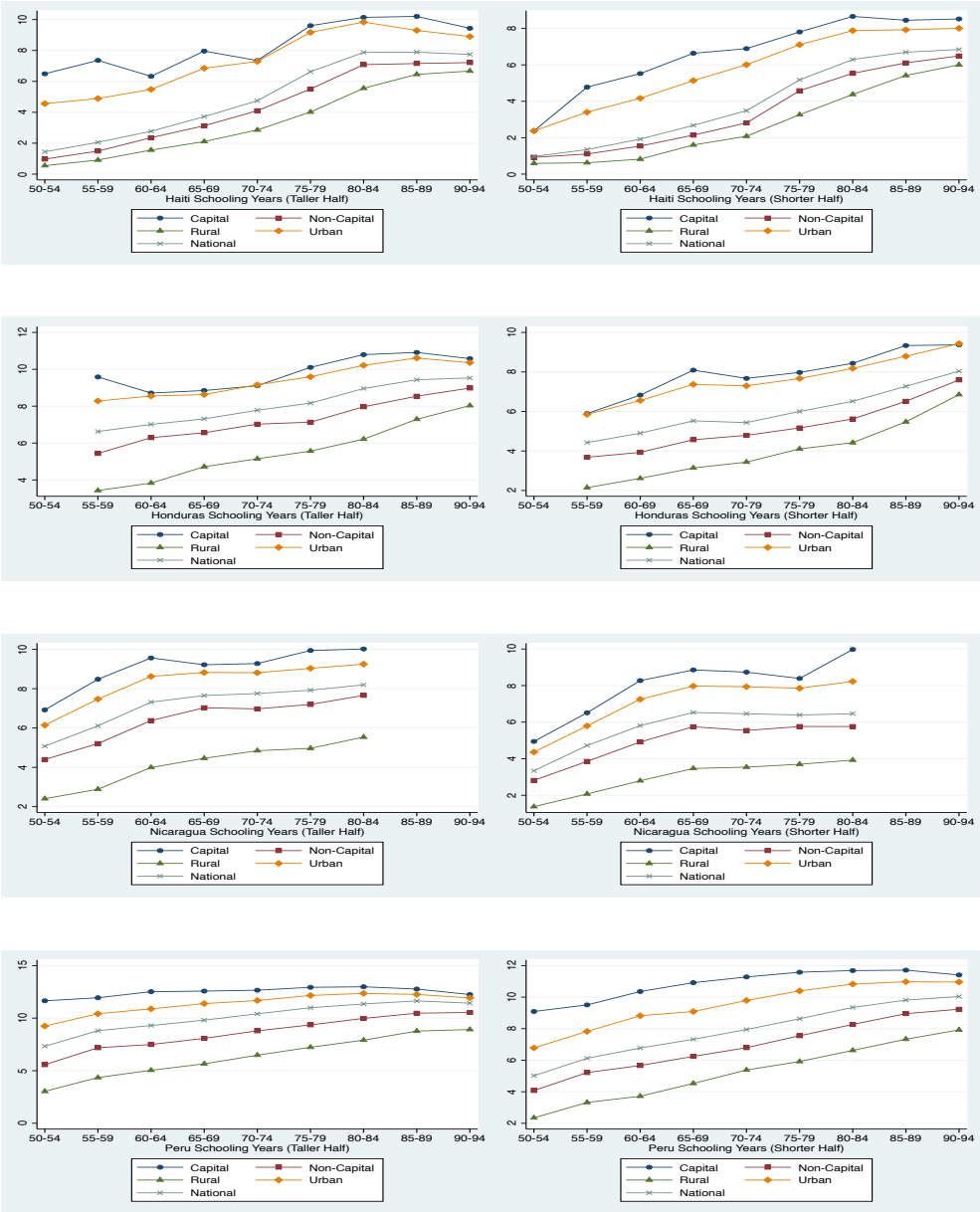






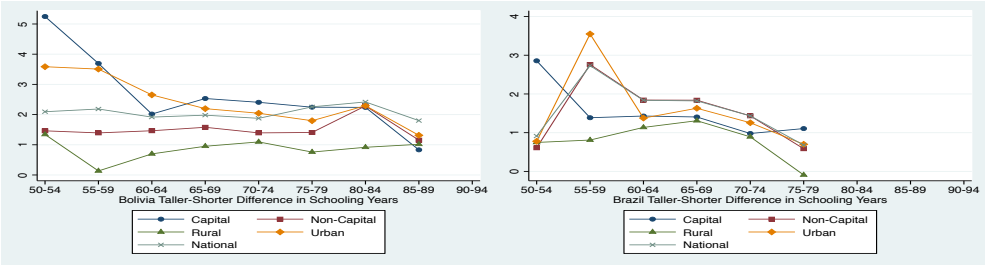


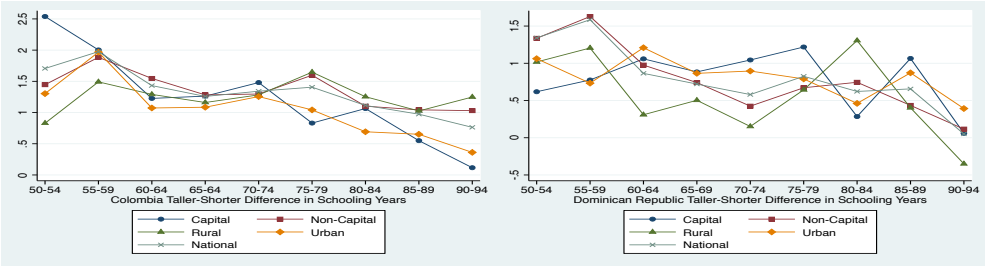


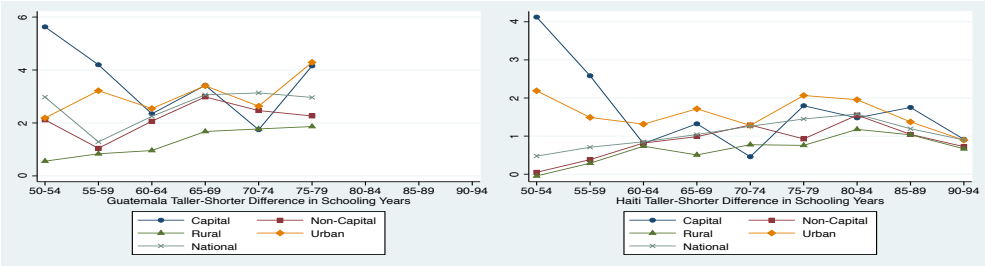


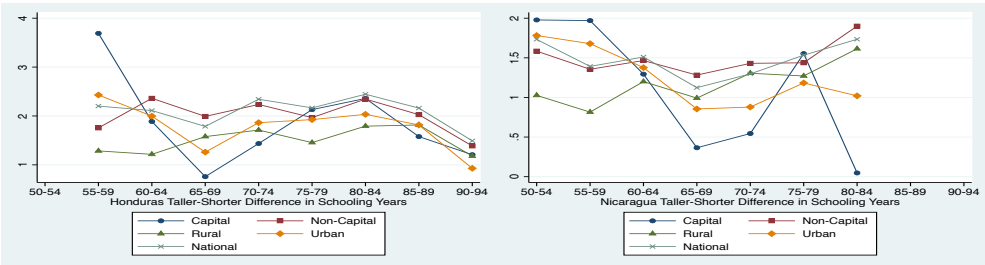
Source: Author's calculation based on the DHS database

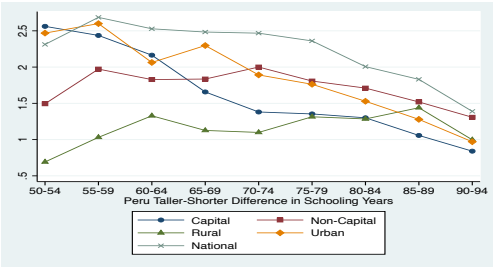
Figure 3. Taller-Shorter Difference in Schooling Years











Source: Author's calculation based on the DHS database

7. Determinants of Educational Inequality at Regional Level

7.1 Variables to Explain Educational Inequality

Liberalisation: trade openness is believed to be the most important signal to distinguish between import substitution industrialisation (de-liberalisation) and liberalisation, because trade restriction is

the essential policy tool of the ISI strategy (Taylor, 1998). Trade openness is measured by the dummy variable from Sachs and Warner (1995). In Sachs and Warner (1995), trade closure is identified by high tariff, trade barrier, state monopoly on commodity export, high black market premium, and/or socialist economic system. Another signal of liberalisation is tax reform. For Latin America, it is a process of shifting from a progressive system to a regressive system. It is measured by whether a country is under the use of value-added tax (VAT), a core tool of Latin American tax reform. Data on the starting year of VAT in each country is from Mahon (2011).

Expansion of Primary Education: Latin America experienced a great wave of educational expansion, especially at lower educational level, in the second half of the 20th century. This generates increasing and eventually universal access to primary education that is most relevant to the poor. Thus, expansion of primary education may have an equalising effect. This variable is measured by the enrollment ratio of primary education. Data are from Barro and Lee (2010).

Educational Expenditure: This is the ratio of current public educational expenditure to GDP. Educational expenditure measures the governmental input in education at all levels and reflects governmental effort. By contrast, enrollment ratio of primary education, as an outcome indicator, reflects a wider range of factors (e.g. changes in parental preference) other than governmental inputs and specifically refers to primary education. In the ISI era, some authoritarian regimes preferred to skew educational expenditure towards higher education, in order to buy the support from university students who are more important to the government, instead of benefiting the poor. Thus, the effect

of overall public expenditure on educational inequality is difficult to predict. Data are from Frankema (2009), and the original data are from various statistical yearbooks of UNESCO and ECLAC/CEPAL.

Demographic Structure: Higgins and Williamson (1999) find that cohort size significantly impacts on inequality. A larger mature population (those between 40 and 59 years old) leads to lower inequality, because this group normally has the highest income in the whole population. The variable of *Mature* is measured by the share of people aged 40-59 in the total working population (aged 15-69). Additionally, a larger share of school-aged children may either impose heavier burden on education or motivate the government to raise educational input; thus, its role is an empirical question. School-aged children share (*Immature*) is measured as the proportion of people aged 5-14 in the total population. This age range corresponds to primary education that is most relevant to the poor. *Rural Mature*/*Immature* are used for regressions of rural region, *Urban Mature*/*Immature* are used for regressions of urban and capital region, and *National Mature*/*Immature* are used for regressions of non-capital region. The demographic data of rural region, urban region and the whole country are from *The Long-Term Population Estimates and Projections 1950-2100* by the Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL).

Other Controls: People's income level is an important determinant of education. Increasing income may raise the possibility of the poor to send their children to school. But its effect on educational inequality may be still an empirical question. Both GDP per capita and its square are used, in order to capture non-linear relationship (e.g. the Kuznets effect). Other controls include civil war, democracy, inflation, and time trend that reflects technological change that tends to increase skill premium and inequality (Tinbergen, 1975). Civil war and the shift between democracy and

dictatorship deeply influenced some Latin American countries in the second half of the 20th century.

7.2 Empirical Strategy and Results

Many Latin American countries, except for those in the Southern Cone, have complex domestic ethnic composition with great disparity in genetic endowment and socioeconomic status across different ethnic groups, especially between indigenous people of Mongolian origin and European people of Caucasian origin. Because of the lack of ethnic information, it is not possible to directly control for this ethnic complexity. Meanwhile, some unobservable geographical and historical factors that have impacts on educational inequality in the long run also vary across different countries. In order to deal with these unobservable factors, country-specific fixed-effects are included in regressions. This is also a common approach in previous studies. Heteroskedasticity-robust standard errors are applied to solve the problem of heteroskedasticity. The regression equation is expressed as:

$$Edu\_Ineq_{i,t} = \beta_0 + \beta_1 Log\left(GDP\ p.c._{i,t}\right) + \beta_2 Log\left(GDP\ p.c._{i,t}\right)^2 + \beta_3\left(Trade\ Openness_{i,t}\right) + \beta_4\left(Tax\ Reform_{i,t}\right) + \beta_5\left(Enrollment\ Ratio_{i,t}\right) + BX + \varepsilon_{i,t}$$

where *i* refers to country and *t* refers to five-year birth cohort. *X* represents a set of control variables.

Table 6 presents panel regression results for the four types of region. Because most explanatory variables other than dummies are expressed as percentage point, it is possible to directly compare unstandardised coefficients of different variables. It is apparent to see that the model has a much better explanatory power for capital region than for other regions. For non-capital region, rural region and urban region, very few variables are statistically significant. The reason may be that there are

some other determinants that are not exactly known, or these regions are much less influenced by conventional variables discussed in the literature. Another possible explanation to the poor performance of the models for non-capital region and urban region is that these two regions are by definition too heterogeneous. Non-capital region contains all regions other than capital and large cities, and urban region contains capital, large cities, small cities, and towns. Such heterogeneity may generate potential mismatch between educational inequality and its explanatory variables.

Trade openness has a statistically significant equalising effect (negative coefficient) in capital regions. Opening trade can reduce educational inequality by around 0.5 year in capital regions. This is quite large, because the absolute value of average change in educational inequality in capital regions of the nine countries is 0.77 year. Trade openness is not statistically significant in the other three types of region, but almost all coefficients are negative. Tax reform has a large and statistically significant disequalising effect in capital regions after controlling for several more variables, and this effect is also very large (an increase by 0.506 year). This is consistent with prediction. But tax reform is not significant in other regions. Hence, based on the results, liberalisation only has systematic impact on educational inequality in capital regions.

Expansion of primary education measured by enrollment ratio of primary school has a significant equalising effect in capital regions. By contrast, it has a significant but small disequalising effect in non-capital regions and rural regions. Although the coefficients of enrollment ratio is very small (e.g. -0.0313 for capital regions and 0.0177 for rural regions), its actual effect is large. This is because the absolute value of the average change in enrollment ratio for the nine countries is 6.1 percentage points.

Thus, for instance, the absolute value of average change in educational inequality exclusively caused by change in enrollment ratio is 0.11 year (6.1×0.0177) in rural regions and 0.19 year (6.1×0.0313) in capital regions. As mentioned before, the absolute value of average change in educational inequality in capital regions of the nine countries is 0.77, and in rural regions the absolute value is only 0.32. This variable is not statistically significant in urban regions, and the coefficients are trivial. The ratio of educational expenditure to GDP has an equalising effect in capital regions and urban regions (negative coefficients). Although the coefficients are small (partial effects of change by one percentage point in the educational expenditure-GDP ratio are -0.136 and -0.161 in capital regions and urban regions, respectively), the actual effect is large given that the average change in the educational expenditure-GDP ratio is only 0.5 percentage point. But it is not significant in non-capital regions and rural regions (both coefficients are positive). This is consistent with the argument of Birdsall (1985) that in urban regions public educational subsidies serve as substitutes for household conditions (e.g. income) and thus have an equalising effect, while in rural regions educational subsidies are complementary to household conditions and thus tend to only benefit children from richer families. Birdsall (1985) also argues that many other factors also impact on rural educational inequality.

Kuznets effect is only found in capital regions. The absolute value of the (positive) coefficient of the linear GDP per capita is much higher than that of the (negative) coefficient of the squared GDP per capita, and the coefficient of the linear GDP per capita becomes much larger after adding the squared term, which shows a strong concave relationship. Inflation rate has a very negligible but statistically significant equalising effect in all but rural regions. Such an equalising effect is against to the

traditional viewpoint that inflation hurts the poor more than the rich. But the trivial coefficients (all less than -0.0005) only have statistical significance, rather than economic significance. *Mature* does not have significant effect in any region, and *Immature* only has a significant equalising effect in capital regions. Civil war and democracy do not have impact in statistical term. Time trend has an equalising effect in capital regions, which indicates that the disequalising effect of technological change on income distribution (Tinbergen, 1975) may not hold for educational distribution.

Table 6. Determinants of Educational Inequality at Regional Level

Edu. Ineq.	Model 1A	Model 1B	Mode 2A	Mode 2B	Mode 3A	Mode 3B	Mode 4A	Mode 4B
Variables	Capital	Capital	N-Capital	N-Capital	Rural	Rural	Urban	Urban
Log GDP p.c.	40.07**	31.46*	2.680	1.086	-1.577	-2.191	18.07	15.75
	(12.01)	(15.06)	(9.425)	(9.339)	(9.586)	(10.49)	(13.92)	(13.17)
Log GDP p.c. squared	-2.461**	-1.879*	-0.216	-0.115	0.0793	0.110	-1.120	-0.949
	(0.754)	(0.955)	(0.588)	(0.579)	(0.603)	(0.663)	(0.875)	(0.829)
Inflation rate	-0.000465***	-0.000361**	-0.000344**	-0.000356**	-0.0000076	-0.0000088	-0.000400*	-0.000382*
	(0.000125)	(0.000128)	(0.000109)	(0.000143)	(0.000116)	(0.000165)	(0.000192)	(0.000169)
Trade openness	-0.528*	-0.476**	-0.232	-0.204	-0.189	-0.180	-0.201	0.00474
	(0.252)	(0.195)	(0.159)	(0.155)	(0.144)	(0.169)	(0.197)	(0.101)
Tax reform	0.0584	0.506**	-0.179	-0.134	-0.167	-0.164	-0.346	-0.120
	(0.188)	(0.212)	(0.161)	(0.219)	(0.199)	(0.183)	(0.203)	(0.239)
Mature (Urban)	-0.0544	-0.133					-0.0118	-0.0524
	(0.0965)	(0.101)					(0.0903)	(0.102)
Immature (Urban)	-0.269***	-0.175**					-0.0663*	0.0131

	(0.0632)	(0.0586)					(0.0346)	(0.0308)
Primary school enrollment	-0.0509***	-0.0313*	0.0192*	0.0220**	0.0171**	0.0177*	-0.00867	-0.00148
	(0.0131)	(0.0139)	(0.00846)	(0.00739)	(0.00680)	(0.00840)	(0.0157)	(0.00962)
Time trend		-0.281**		-0.0409		-0.00978(0.0692)		-0.120
		(0.0958)		(0.0840)				(0.0675)
Civil war		-0.128		0.130		0.172		0.345
		(0.266)		(0.264)		(0.146)		(0.247)
Democracy		0.621		0.132		0.0547		0.160
		(0.382)		(0.174)		(0.0916)		(0.105)
Educational expenditure		-0.136*		0.0441		0.0857		-0.161*
		(0.0717)		(0.0999)		(0.0600)		(0.0802)
Mature (national)			0.0260	0.0331				
			(0.0618)	(0.0596)				
Immature (national)			0.00661	0.0120				
			(0.0399)	(0.0406)				
Mature (rural)					0.0344	0.0646		
					(0.0621)	(0.0655)		
Immature (rural)					0.0213	-0.00729		
					(0.0348)	(0.0393)		
Constant	-149.5**	-118.5*	-8.066	-2.302	6.105	8.803	-68.31	-61.63
	(45.81)	(57.98)	(38.45)	(38.48)	(38.04)	(41.13)	(53.96)	(50.65)
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	71	71	71	71	71	71	71	71

R-squared	0.471	0.556	0.327	0.350	0.254	0.297	0.339	0.411

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Ramsey RESET test indicates that there are not omitted higher-power variables, and Pesaran CD test rejects the existence of cross-sectional dependence.

8. Conclusions and Discussions

This paper shows that in the nine Latin American countries capital regions tend to have the highest educational attainment, while rural regions are at the bottom. Educational attainment of both the rich and the poor increases during the considered period, with an exception of Brazil. Moreover, regional disparity in schooling years in the nine countries tends not to increase. However, the evolution of within-region educational inequality is much more complex than that of between-region educational inequality. Rural regions tend to have the lowest educational inequality, although they also have the lowest educational attainment. With respect to the determinants of educational inequality, trade openness has a large equalising effect, while tax reform has a large disequalising effect in capital regions. The equalising effect of trade openness is opposite to its effect on economic inequality found in the literature. This supports the recent argument that educational inequality and economic inequality may have different dynamics. In the other three regions, trade openness and tax reform do not have statistically significant impact. This may indicate that liberalisation only influences capital regions where governmental policies have larger effects, while other regions are less impacted by policies from the central government (decisions of trade openness and tax reform are made at the central level). Educational expansion serves as an equalising force in capital regions, but as a disequalising force in non-capital regions and rural regions. This contradiction may be explained by the “elite saturation” in the sociological literature: because capital regions may already reach a

relatively high level of access to education, especially for children in the upper social class, educational expansion at primary level tends to specifically benefit those from the lower class. As a result, educational inequality between the upper class and the lower class declines in educational expansion. By contrast, in non-capital regions and rural regions, the overall access to education is relatively low and children from the upper class may have not reached the "elite saturation" of access to primary education. Under this situation, educational expansion at primary level firstly benefits those from the upper class and only afterwards is the turn for those from the lower class. This leads to the widening gap between those from the upper class and those from the lower class in non-capital regions and rural regions. In other words, the initial gap in educational attainment between capital regions and non-capital/rural regions may be the reason for the opposite effects of educational expansion in the former and in the latter.

The highly unbalanced explanatory power of the models across different types of region indicates the importance of a region-level study on inequality issue in Latin America. Even the same factor may have opposite impacts in different regions. The low explanatory power of models for non-capital regions, rural regions, and urban regions suggests that some unconventional factors that may not be discussed in the literature should be considered. Another important point for future research is to control for ethnic groups. As discussed previously, many Latin American countries have very complex ethnic composition. Because different ethnic groups, particularly between indigenous people and Europeans, have different genetic endowments, any anthropometric measures of the biological aspect of living standard without considering this ethnic issue may be confounded and may not fully reflect the true regional disparity.

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