5. SCHOOLING EXPANSION IN DEMOGRAPHIC TRANSITION: A TRANSIENT OPPORTUNITY FOR INEQUALITY REDUCTION IN BRAZIL

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Abstract

This paper explores the connection between Brazil's schooling inequity and deficiency and demographic transition. The most general versions of the Kuznets curve hipothesis highlight the role of supply side factors -demographic transition and the expansion of education- in redistributing assets and modifying the relative prices of skills, with clear effects on income inequality and growth. The dynamics of this process might be perverse, and unless education opportunities are vigorously equalized, developing economies might converge high inequality equilibria (Kremmer et al, 2002 and Lam, 1999). This paper tries to understand how demographic transition in Brazil modifies the time lag required to extend to the whole labor force the educational improvements enjoyed by younger cohorts –the stock-to-cohort time lag- More formally, we want to answer how time correlation between educational efforts and demographic transition affects long term inequality. This paper simulates what would have happened if the educational expansion of the 90s had occurred one decade earlier -before the demographic transition started. Results show that in the long run taking advantage of this window of opportunity to expand education reduced the stock-to-cohort time lag from 25 to 20 years, and long term inequalities of schooling and labor income. However, in the short run schooling inequality overshoots temporarily -induced by rising between inequality-. Another lesson is that, even very strong improvements above the current trend of schooling attainment, take more than two decades to show-up as higher educational endowments for the whole working age population. That is, by taking demographic inertia into account, policy makers conviction about education should be reinforced with patience and the will to monitor educational policy outcomes with a clear long term perspective.

JEL classification: D3, I0, I2, O2.

Keywords: Education: Inequality, Policy evaluation, Kuznets Curve.

Introduction

How long will improvements in schooling of younger cohorts take to change the distribution of educational endowments of the total labor force and, in turn, change the distribution of labor income in Brazil? When rates of return to schooling are significant, as they are in Brazil, the size and distribution of educational endowments determines to a large extent the distribution of labor income. However, improvements in the educational attainment of younger cohorts do not translate immediately into proportional improvements for all cohorts of the economy. Demographics might play an important role in that process.

This paper attempts to develop a demographic model linking the educational profiles of successive cohorts of individuals entering the labor force with the level and inequality of educational endowments of the whole labor force. We ask how the demographic transition might affect the impact of cohort educational profiles on the level and inequality of educational endowments of the entire labor force. For example, an aggressive education policy to improve high school completion should result in large differences between the educational profiles of younger versus older population cohorts in the labor force, with obvious effects on the distribution of the educational stock. However, the size and speed of that

effect will depend on the pace of demographic transition in Brazil. Presumably, if demographic transition has not been completed and the fertility rates remain high, the effect will be larger and faster.

The profile of population growth for Brazil will show how large those effects will be, and how long it will take to observe them. Moreover, it will show whether Brazil's position in the demographic transition provides an opportunity (or makes it more difficult) to reduce the inequality, or improve the level, of the educational stock of the labor force. Hopefully this model could be a device to show how much time is required to recover the full social benefits of sustained investments in education. That is, to understand the links and the lags between current policy actions and future outcomes. In other words, it would enhance the value of current policies in terms of the equity improvements for present and future generations.

Considered within the Latin American context, Brazilian educational outcomes are lacking and the allocation of resources towards education is low. From the outcome side, educational attainment is too low and the differentials in access to education are significant both across regions, and income groups. From the allocation of resources side, public expenditure in Brazil is too biased towards public pension subsidies, while the share of education is small. These characteristics of the educational system of Brazil become particularly worrying given the fact that Brazil has one of the highest levels of income inequality in the world and it is clearly linked to inequality of education. Bourguignon, Ferreira and Leite (2002) show that nearly 30% of excessive inequality relative to the US is explained by educational inequities.

The original version of Kuznets Curve hypothesis emphasized the role of demand-side forces to shape the relation between income inequality and economic development. Basically, the dynamics interaction of technological change and the induced demand for capital skills where supposed to explain why inequality first rise and the fell with development. A more general version adds the role of supply side determinants, namely arguing the impact of demographic transition forces could flood the market with young unskilled workers reducing the rise of inequality. Hence the age-earning curve would be flatten once those fat cohorts reach the pick earning age. [29]

Demographics is particularly relevant for developing countries because as Higgins and Williams (1999) show, the demographic transition in these countries "has generated much more dramatic changes in relative cohort size than did the baby-boom in OECD countries. (p4). Evidence from Higgins and Williams provides support for a link between cohort size aggregate inequality. The estimated quantitative impact is considerable: a one standard deviation increase in the fraction of population in peak earnings would increase in the fraction of population in peak earnings would lower a country's Gini coefficient by 6.5. [30]

However, decomposition exercises show that the demographic transition has two opposite effects on inequality. The first effect which increases inequality, is the change in the composition of the labor force and while the second one, the change in the age-earning profile, reduces inequality.

A more sophisticated perspective by Kremmer and Chen (2002) shows that on its own course, the dynamics of education inequality could lead to a perverse cycle of increasing inequality in a country such as Brazil. Nevertheless, according to their model the timely enhancement of educational opportunities for the poor is critical to avoid this outcome, and position the economy on path leading to a steady state with a more balanced distribution of skilled and un-skilled workers. Empirical evidence -by Kremer and Chen (2002)- suggests that the fertility differentials between educated and uneducated parents is stronger in

[29] The analysis of adverse supply effect on the relative wages of the baby-boom cohort in the United States is presented in Easterlin 1980; Freeman 1979; Welch, 1979; Lam, 1997; Murphy and Welch, 1992; and Murphy and Katz, 1992.
[30] Over time the relation is becoming weaker: stronger in the 1970s and 1980s but non existent in the 1990s.

more unequal countries –like Brazil-.[31] If children of uneducated parents are less likely to become educated, the fertility differential will induce an increasing proportion of unskilled workers in the next generation. Which in turn tend to depress their wages and increase their chances of having more children and so on. [32] Based on a dynamic markovian framework of fertility and education inequality across generations, Kremer and Chen (2002) show depending on the initial conditions the economy might converge to high or low inequality scenarios. "If the initial proportion of skilled workers is too low, inequality will be self reinforcing and the economy may approach a steady state with a low proportion of skilled workers and greater inequality between the skilled and unskilled."

These findings have the most important implications for the timing and efficiency of educational policy. According to their estimates, in middle income economies like Brazil a temporary increase in schooling opportunities for the children of the poor that raise the share of skilled workers above a certain critical value, would induce a virtuous dynamics of education equalization across generations. The key question then is, could the window of opportunity for this policy intervention been expiring?: as time passes, have Brazil reached the point in which for producing the desired outcome the required effort is too large? Moreover, given the fact that lower fertility rates reduces the demographic weigh of younger cohorts, is the leverage of current educational policies to modify the distribution of the whole labor force still available?

Kremer et al (2002) show that any effort to reduce the unit cost of taking the children of the poor to reach high educational attainment has the same consequences. Hence a whole range of policy instruments can produce the desired effect: from improvements in nutrition and childcare to the incentives to reduce unit cost and improve quality in the allocation of public educational funds. Moreover, they also show that if fertility is endogenous to skill wage differentials temporary policy interventions can have even larger multiplier effects.

This paper is organized as follows, section 1 describes the demographic background of Brazil, section 2 presents the methodology and data used in this paper, section 3 depicts the evolution of education between cohorts, section 4 defines the stock-to-cohort lag of educational attainment, section 5 shows the results of the simulations, and finally, section 6 presents the conclusions.

Demographic Background

According to the 2000 Census, the Brazilian population amounts to 170 million people, most of which live in the coastal urban area. Spatial differences are strong. Brazil is divided by geographers into five regions: South, Southeast, Center-west, North, and Northeast. The first two are the most developed and rich, the last one is the poorest. Population density can be considered high in the metropolitan areas of all regions, medium in non-metropolitan areas of the Southern and Southeastern regions and low in rural areas of the Northern and Center-western regions.

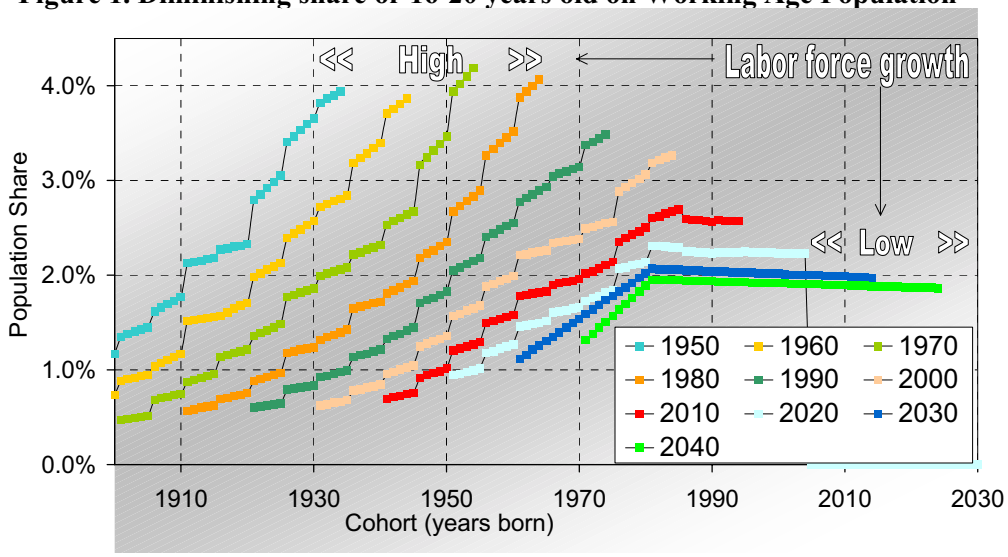
As in other countries, the Brazilian demographic history of the last hundred years can be divided into three periods. The first ranges from the early 1900's to the late 1930's, when birth and death rates were high. However, as mortality balances birthrate, a good part of population growth was due to international immigration. The second period begins after the 1930, when international migration is reduced and the falling mortality together with high fertility became the main reason for rapid population growth. Rates were at their peak, around 2.9% per year, during the decades of 1950 and 1960. The third period begins at the late 1960's, with a rapid fall in fertility rates and, therefore, of the population growth. Mortality keeps

[31] Most Latin American countries show very high fertility differentials. Well above the predicted level conditional on inequality. Those error terms are the highest in the case of Colombia in the 1990s.
[32] Assuming the substitution effect dominates the income effect.

falling during the period but its level is not enough to undo the effects of the reduction in fertility. Population growth rates are estimated at 1.3% in the in the late 1990's.

The story above happened in all Brazilian regions, but not at exactly the same time. Except for migration, the demographic patterns of all regions followed, with some delay, what happened in the Southeast. Furthermore, in the last decades the demographic patterns of all regions became much more homogeneous than before, although we can still identify clear differences among them.

Figure 1. Diminishing share or 16-20 years old on Working Age Population



During the 1990's infant mortality has fallen significantly, but not enough to compensate reduced fertility. As a result, during this decade younger cohorts are smaller than their predecessors. Although the pressures for the supply of schooling caused by total population growth are reduced, other factors of pressure such as short distance migration and the increase of school enrollment are still in effect.

The net effect of the *demographic transition of Brazil* on the age composition of the labor force is shown on Figure 1, below. This Figure shows the composition of the whole working-age population every 10 years from 1950 to 2000, and provides some forecast for the period 2010 to 2040., namely all those between 16 and 70 years of age in any given calendar year, in terms of cohorts. It is clear, that the decreasing demographic weight of the youngest cohort of the labor force –16-20 year olds- that started in the 1980s. It is notable that for the labor force of 1970 the demographic share of the youngest cohorts peaks for the labor force borne in 1954 (4.2 percent) and then falls significantly for the labor force in 1990 and 2000. That is, for the cohorts born in 1974 and 1984 the demographic share fell to 3.5 and 3.2 percent respectively. Up to the year 2000 population, younger cohorts are always more numerous than older ones. From year 2010 onwards, the functions are no longer monotonously increasing and there is a point from which newer cohorts become less numerous.

Our thesis is that the strongest educational expansion should coincide with the peak of demographic "replacement" –when young workers have the largest population share-. This window of opportunity for education should not be missed if there is a concern for closing the educational gap and reach more equitable access to education.

Methodology And Data

The methodology to be used in this paper will be the simplest possible capable of providing an answer to the questions on the interplay between the educational level and inequality of each cohort and the educational level and inequality of the population as a whole in a given calendar year. Let:

T index calendar years (year of observation)

t index cohorts

S_t be the final average educational level of cohort t.

I_t be a decomposible measure of final educational inequality of cohort t.

$d(T,t)$ be the weight of cohort t in the population aged 16 to 70 in year T.

Then:

$S_T = \sum_t d(T, t)\, S_t$ the final educational level of the 16-70 population in year T is a weighted average of the final educational level of each cohort

$d(T,t)$ Weights vary over time due to demographic transition.

$I_T = \sum_t f(T,t)\, I_t + \sum_t g(T,t)\, S_t$ the ***final*** educational inequality of the 16-70 population. We adopt decomposable entropy inequality measure E2.

The methodology consists in (i) Estimating the ***final*** educational attainment --mean and inequality- of each cohort (including those younger cohorts which have not converged yet). (ii) Measuring the stock-vs-cohort time lag for the calendar years 1970-1998. And (iii) Measuring the impact of the ***timing*** of educational: Simulating temporary deviations from the path of cohort education expansion in periods of higher demographic growth and establish its impact on the stock-vs-cohort time lag and on aggregate inequality.

The decomposable inequality measure we decided to use is one of most common: one-half of the squared coefficient of variation. According to Shorrocks (1980), this measure corresponds to the member of the generalized entropy class with an inequality aversion parameter of 2. This inequality measure can be decomposed into within and between components by using the following decomposition weights:

$$W(T,t) = d(T,t) \,.\, (S_t / S_T)^2$$

Henceforth, we will always refer to this inequality measure as I_2.

Keep in mind that the inequality of education is linked to the inequality of labor income *var (log y)*:

$$var\ (\log y) = \eta^2\ var\ (E) + var\ (\sigma),$$

where η is the return to education in a linear Mincerian equation and σ the error term, [33] and

$$var\ (E) = I_2 \,.\, mean\ (E)^2$$

The data we use are all from the *Pesquisa Nacional por Amostragem de Domicílio* (PNADs) from 1977 to 1999. These are surveys covering the whole nation, except for the rural area of the Northern region, where the vast distances make a yearly survey too costly. The sampling scheme has been the same – stratified and clustered – but the strata change every time the Census Bureau Grid changes, which

[33] For a general version see Lam (1999).

happens every 10 years with the national Census. The questionnaire has changed considerably over time, but schooling and age, the only variables important in this study, have been largely spared.

The PNAD imposes two shortcomings upon our analysis. The first is that the same people are not followed over time. This means that we do not have real cohorts but pseudo-cohorts. In principle, this should not be a problem, if we believe in the PNAD sampling scheme. The second problem is that the PNADs exist only from 1977 to 1999. This means that any one cohort was followed only during a part of its evolution.

The Evolution Of Education Between Cohorts: Monotonically Increasing Mean, Decreasing Inequality And Inverted U-Shaped Mean-Variance Schedule

Figure 2 shows educational progress in Brazil. On the horizontal axis is the year of birth of each successive cohort from 1900 to 1983, on the vertical axis is the estimated final average educational level of the cohort. We will explain exactly how this estimate is made later on, but for now what is important is that average education is a monotonically increasing function of cohort date of birth but the rate of increase is not fixed. Figure 2 shows that the education of each cohort increased at a more or less steady rate until about the 1940 cohort, accelerated for those born between 1940 and 1960, slowed its rate of growth for the 1960's cohorts and then accelerated again for the cohorts born after 1970.

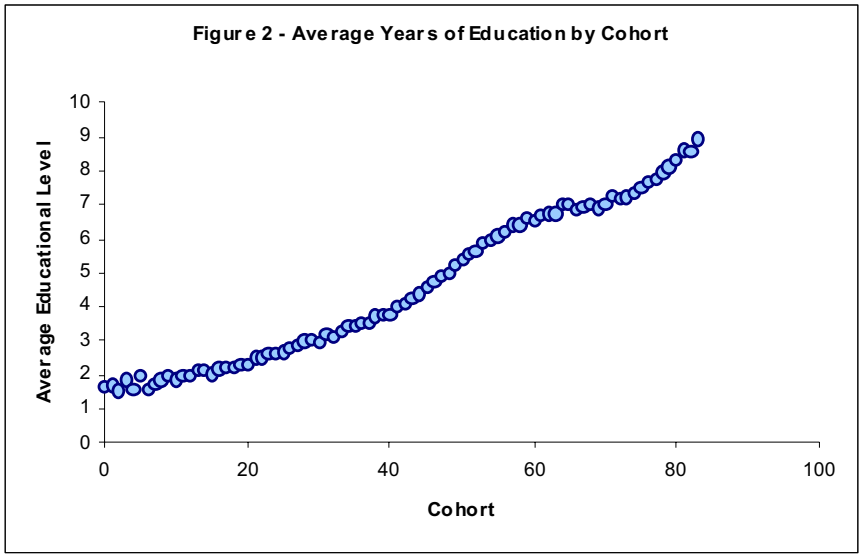
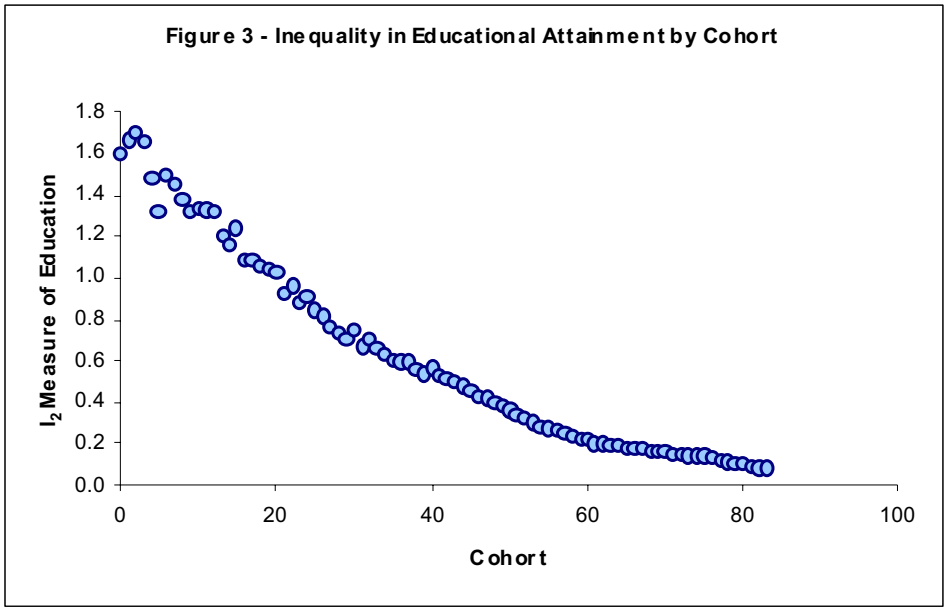


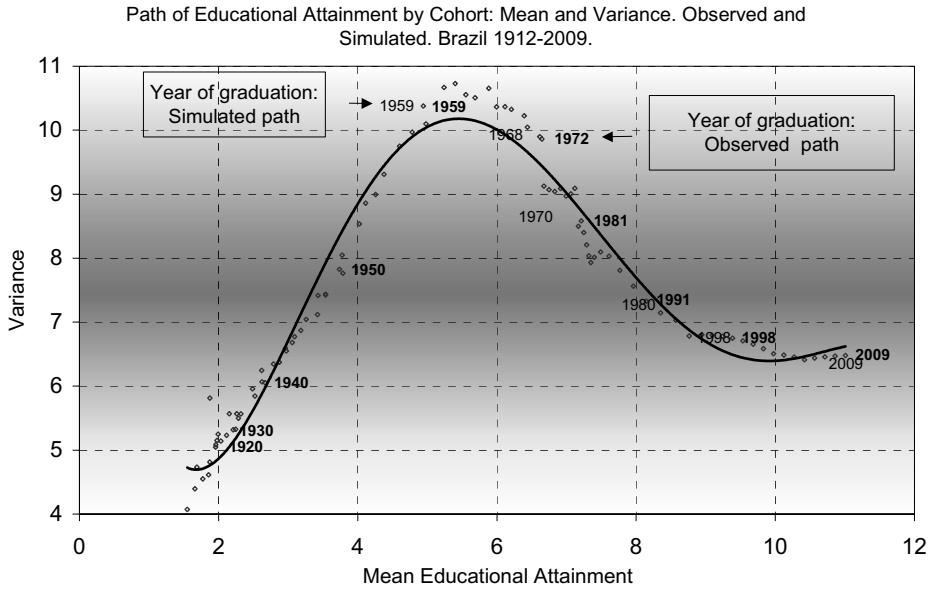
Figure 3 shows the same for the I_2 measure of education of the cohort. Once again, the most important fact is a monotonic relation – each successive cohort has less internal inequality the previous one. It is important to note that the I_2 measure does not bear a linear relation to the amount of income inequality explained by education, and this is due to the highly nonlinear returns to education in Brazil.



As a result of this evolution the educational attainment by Cohorts has taken an interesting shape: an inverted U of the mean-variance schedule , with decreasing variance since the early 1960's. Figure 4 shows a wide range for both mean education and variance and wide oscillations in the variance. The latter would be approximately 65% of the level achieved in 1959. This trend over the last four decades is due to the reduction in education inequality much faster than the increase of average education (square).

Demographic simulations suggest that it takes more than two decades to see the benefits of increasing educational attainment for the younger cohorts reflected on the whole labor force. One way of looking at how contemporary educational policy affects the distribution of educational endowments of the whole labor force is to measure how many years it takes for the whole labor force to reach the level of educational attainment of one cohort. Our observations show that the labor force of 1970s had the same number of years of education of the cohort born in 1940, which on average was finishing school in 1951 (entering school at 7 years of age and attaining nearly 4 years of schooling). Resulting in a gap of 19 years between 1951 and 1970. That gap grew over time to a maximum of 25 years at the end of the century. That is, the labor force of 1998 had 6.5 years of schooling, which was the same educational attainment obtained by the cohort born in 1960 –that on average was leaving school in 1973-74. The fact that the gap -between the cohort and the whole labor force- grew more that the marginal increase in schooling –6 more years for the gap versus 2.5 years of mean school attainment- is associated with the demographic transition. That is, the decreasing demographic weight of the youngest cohort of the labor force of 1990 and 2000 vis a vis the labor force of 1970 and 1980.

Figure 4 Educational Attainment by cohort: Mean-variance schedule. Observed and simulated . Brazil 1920-2009



Note: Year of graduation is equal to cohort year plus 12. That is, the year in which a 12 years old individual graduates from 5th grade if entered school when 7 years old.

Before going into the interactions between the aggregate educational level of the whole labor force and educational inequality of each cohort, its weight in the population and the education levels and inequalities of the whole population by year, it is important to note how education levels and inequality converge within each cohort over time. In principle, all cohorts are born with zero average education, and over time this number increases up to the point at which there is no one in the cohort that still in school and then stabilizes. Basically, early observations of younger cohorts *underestimate* mean educational attainment and *overestimate* inequality of education. Cohorts below 30 years of age are still changing, hence we *model their final convergence levels* for mean and coefficient of variation. In order to associate a unique pair of distributional parameters to each cohort.[34]

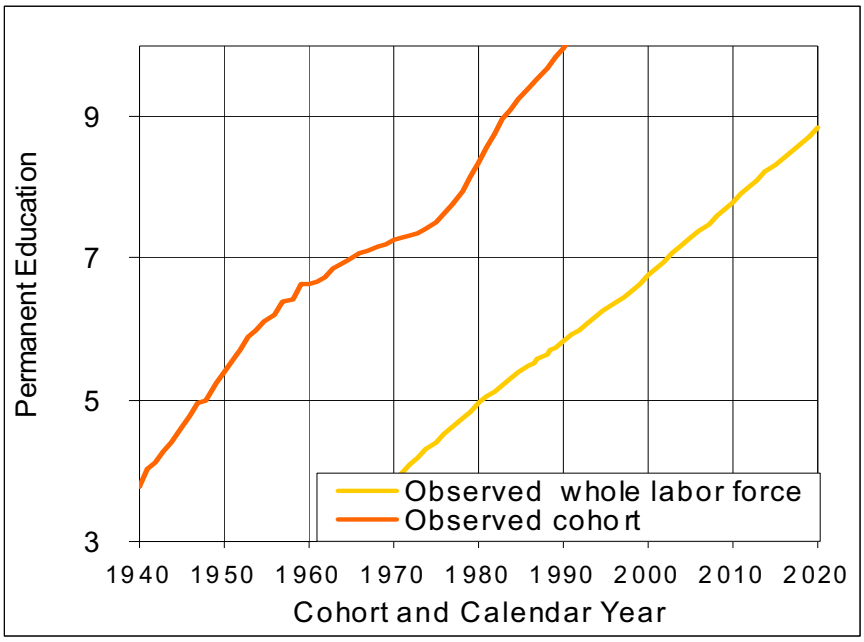
The Increasing Stock–To-Cohort Time Lag Of Educational Attainment

Figures 5 and 6 show how educational levels and inequality have evolved from one calendar year to the next from 1969 to 1999, in addition to a projection to 2013[35]. What is shown does not correspond exactly to what is observed in more recent years because those cohorts still increasing their education are imputed their final educational levels and inequality as explained above. These figures illustrates the increasing stock-to-cohort lag of educational attainment. That is, the time lag required to extend to the whole *labor force* the educational improvements enjoyed by younger cohorts. For comparison, the education of each cohort is also shown on the same graph. These Figures can be thought of as depicting the "permanent education levels and inequality" of people aged 16 to 70 in each year, even if they have not yet achieved these levels. Some interesting things are apparent from these graphs. The first is that educational levels appear to be increasing in very monotonous, slow, and linear fashion. This is not really surprising, given the monotonous and slow increase in educational levels of each cohort.

Figure 5: Observed Schooling by Cohort and the whole labor force

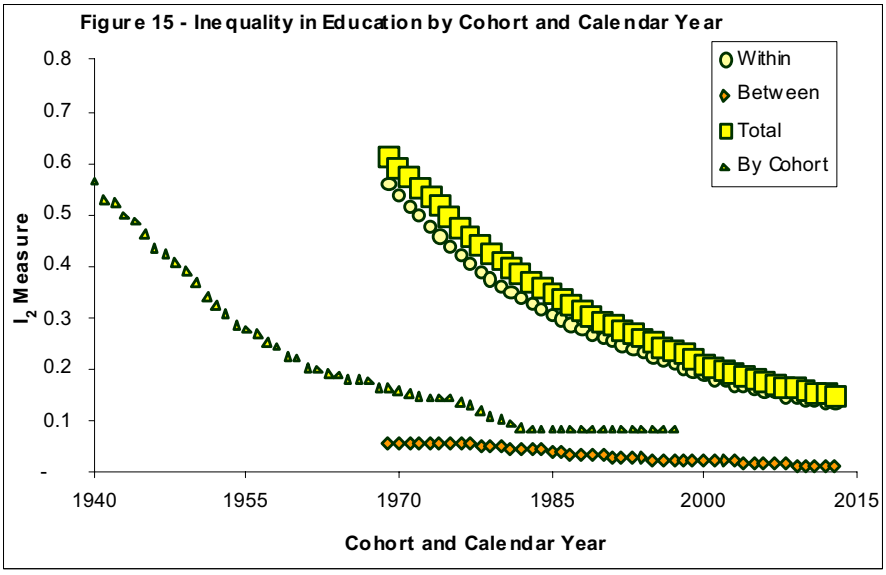
[34] See Appendix 1 explains the convergence of educational attainment within cohorts.
[35] The projection is very simple: the education of cohorts born after 1984 is linearly projected based on those born from 1961 to 1983.

each calendar year



The second interesting fact is that inequality, a measured by the I_2 measure, is falling continuously. This fall is mostly due to within cohort inequality, as between cohort inequality is much smaller.[36] This is surprising, as it is not evident that within cohort inequality dominates total inequality. It is important to note that this fall does not necessarily mean that income inequalities due to education are falling – given Brazil's highly convex returns to education, the two may well go in different directions.

Figure 6: Inequality in Education by Cohort and Calendar Year

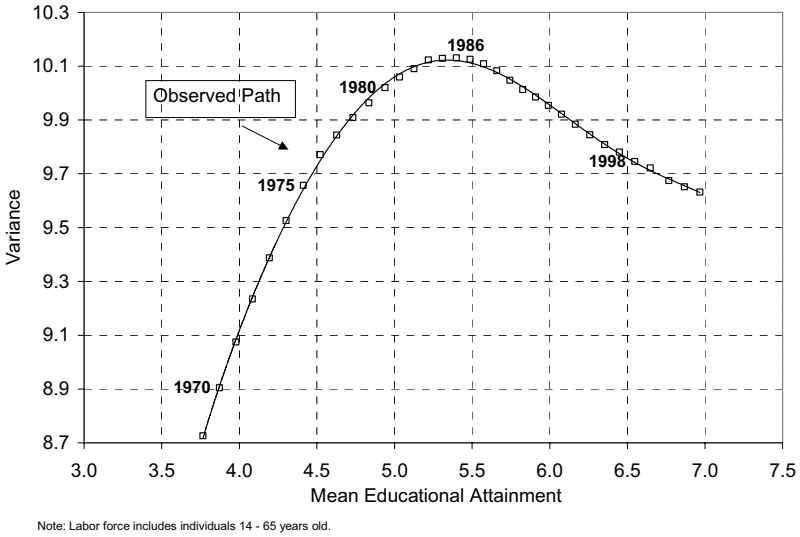


Interestingly, the shape of the Educational attainment –mean and variance schedule- for the *whole* labor force (Figure 7) has the *same* inverted U shape of the corresponding schedule for cohorts (Figure 4).

[36] We have assumed constant within cohort inequality for cohorts born after 1987.

However important differences are evident, the stock-to-cohort time lag –approximately 25 years- and has been increasing during the last decade. Moreover, the range of variation of variance and the mean is much smaller. While the variance for cohorts goes from 7 to 10 in a period of 15 years ending in 1959, the variance of the stock increases from 9 to 10.1 in a similar period culminating in 1986.

Figure 7: Evolution of Educational Attainment of the Labor Force – Mean and Variance. Observed. Brazil, 1962-2013



Note: Labor force includes individuals 14 - 65 years old.

Simulations: Permanent and temporary acceleration of educational attainment

Permanent acceleration of educational expansion

Figures 8 and 9 are identical to Figures 5 and 6, except that they show a simulation as well. In this simulation, we increase the education of all cohorts born after 1959 by (t - 1959)/10 years, where t is the cohort's year of birth. The final impact on average education of this very large increase in education of each is an increase of 1.74 years in 2013. On the other hand, the increase in inequality is very small – in 2013, the I_2 measure would be 0.162, and not 0.148, due to the smaller rate of reduction in between cohort inequality.

Figure 8: Observed and Simulated Schooling by Cohort and Calendar Year

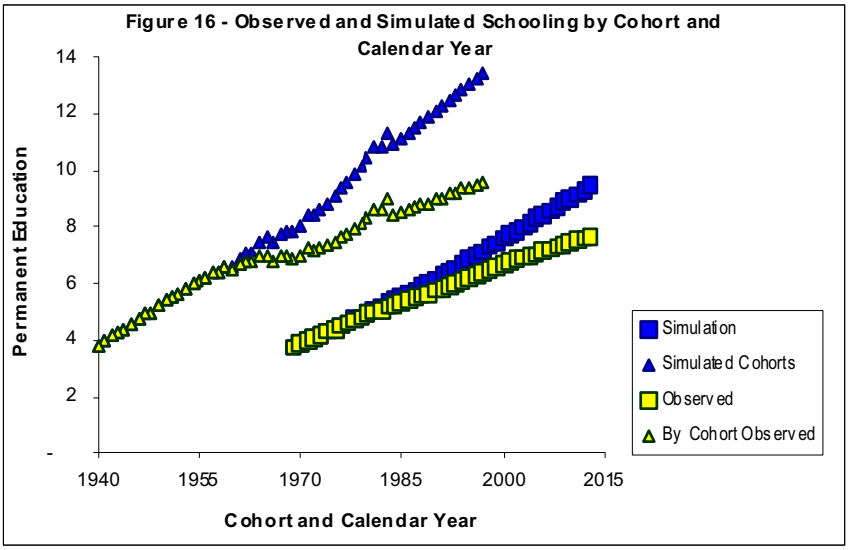
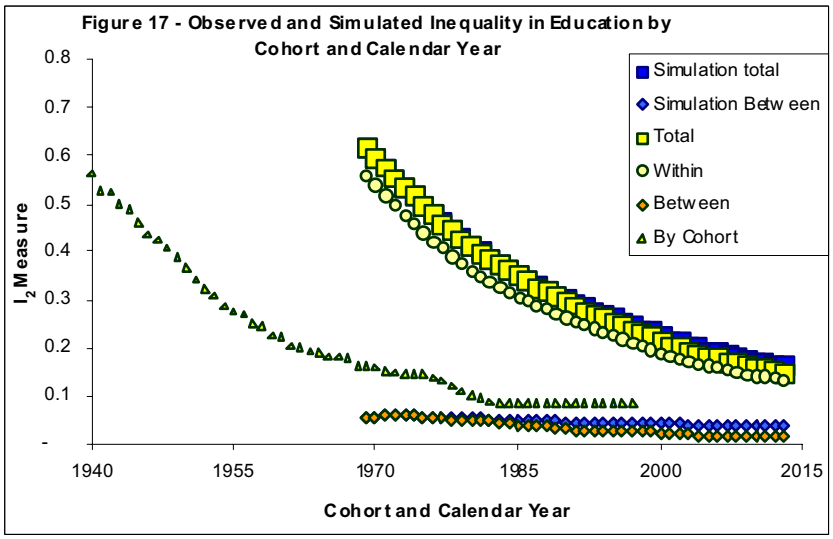


Figure 9: Observed and Simulated Inequality in Education by Cohortand Calendar Year



The fact that even a very large intervention, operated on more recent cohorts, does not significantly affect educational inequality is due to the dominant effect of within cohort inequality. Within inequality, as measured by I_2, is not independent from between cohort inequality because average cohort education composes the weights, but this effect is almost insignificant. On the other hand, average income increases, but relatively slowly, given the dramatic nature of the simulation at the cohort level. Both of these effects suggest the existence of strong demographic inertia.

Temporary acceleration of educational expansion before demographic transition

The simulation above supposes very strong and incremental improvements in the educational system, which ignore reasonable fiscal constraints. A second -more interesting- simulation is temporary

acceleration of educational expansion before demographic transition, which basically (i) Maintains the accelerated expansion during the 1970's and 1980's. Which is equivalent to accelerating through the Mean-Variance path of educational attainment for cohorts (Figure 4) when demographic growth of schooling cohorts is at its maximum. In particular, keeping the acceleration observed for cohorts born in the 1940-60 period for the cohorts 1961-72 period (policy period 1973-84). This policy is equivalent to anticipating by nearly one decade the improvements of the educational system enjoyed by younger cohorts during the 1990s – the light blue line versus the yellow line. We should remark that the deviation of the expansion path is *temporary* and after 1998 graduation year (cohort years) simulated and observed paths coincide again.

The expected impact on the educational attainment of the labor force

Because of the fact that the demographic transition has not yet been completed in Brazil, providing a rationale for an "educational push" in the first decade of the XXI century, one would expected that the simulation shows firstly that heavier cohorts have higher mean educational attainment. Secondly, lower *within inequality*. The reason of why *within inequality* falls much faster than *between inequality* is because the largest cohorts receive the lowest levels of inequality. Thirdly, an overshooting of *between inequality,* with a reduction under the historical trend after two or three decades. This behavior is explained because the large cohorts where already more educated, therefore closer to the mean. In the *short run*, the expected effect of the simulations on the *overall inequality* would depend on which component dominates the other. While in the *long run*, one would expect a *lower overall inequality*. The expected effect on variance depends on whether inequality falls enough to compensate the growth of mean educational attainment. Finally, as labor inequality changes are proportional to changes in the variance of education (approximation under linear Mincerean equation). Hence, long term inequality is expected to fall (General equilibrium could reduce B the wage skill gap and reduce inequality even further).

Simulations Results

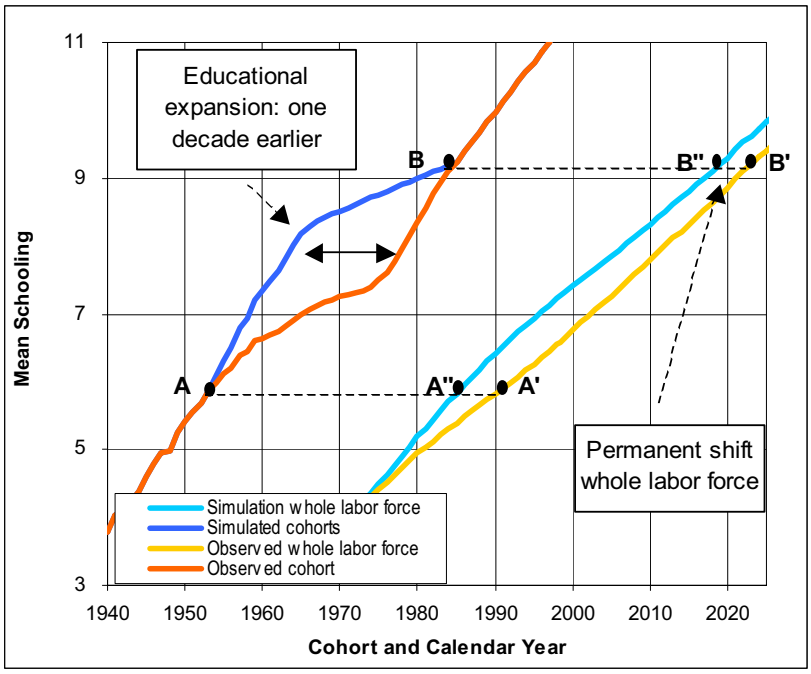
The results from the simulation confirmed our expectations about faster achievement of mean educational attainment goals, overshooting of the inequality and the variance of education with lower long term levels for both and consequently.

The magnitude of shift in the mean educational attainment is considerable, seven years to the left and 0.6 years upwards for the year 2002, which means that the time-gap falls from 25 to 18 years. The results also confirmed the anticipated temporary overshooting of the inequality and variance of education from mean 5.3 to 7.4 years of schooling, maximum 4% at mean 6.5. The long term levels reached by these variables by 2013 are 15% in inequality and 6% in variance of education.

Figure 10 shows the temporary deviations in the cohort-path as the simulation of policy changes that anticipate by nearly one decade the improvements of the educational system enjoyed by younger cohorts during the 1990s –the light blue line versus the yellow line-. That is, maintaining the rate of growth of educational attainment enjoyed by the cohorts borne in the 1940 and 1950's for the generations borne in the 1960's and early 1970's. For example, the simulated average education of the individual borne in 1970 –which was leaving school in 1984- was nearly seven years of schooling, the same as the value observed for the person borne in 1980 -which was leaving school by the year 1994-. The consequences for the school attainment of whole labor force is a permanent North-West shift –the blue line versus the orange line-. The magnitude of the shift is considerable, seven years to the left and 0.6 years upwards for the year 2002, which means that the time-gap falls from 25 to 20 years.

Figure 10: Observed and Simulated Schooling by Cohort and Cal-

endar Year.



Since the transformations are much less dramatic than those in the first simulation, the impact on average education is also much less dramatic. The educational level of the 16 to 70 population in the final calendar year we look at, 2013, rises from 7.7 years to 8.1. The effects on inequality are also not very impressive: there is a small increase as the cohorts whose education was increased come into adult age, but it wears out by the year 2000.

Figure 11 illustrates the temporary overshooting of the inequality of education along with its long term reduction. The black line illustrates the observed the mean educational attainment and the inequality of education, while the gray line depicts the relation for the simulation case. relation between the observed path.

Figure 11: Covariance Coefficient Vs Mean Educational Attainment

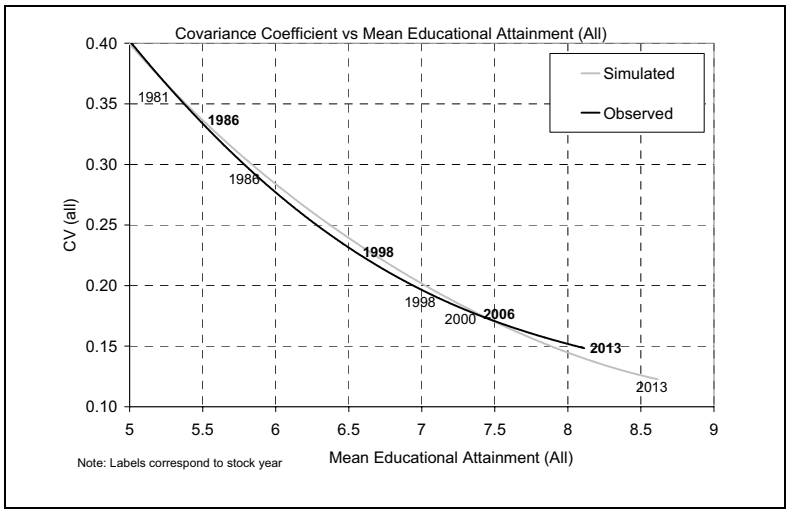
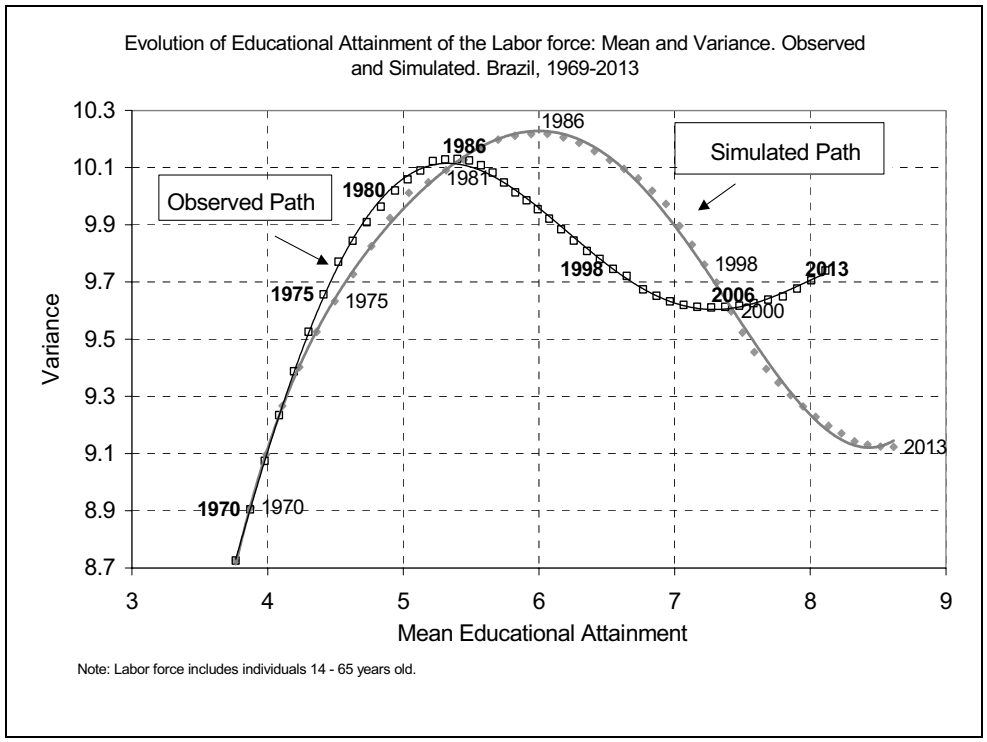


Figure 12: Evolution of Educational Attainment of the Labor Force: Mean and Variance. Observed and Simulated. Brazil 1969-2013



Since the demographic transition will be almost completed in the first two decades of the XXI century there is an opportunity to reduce the lag between current educational policy and its impact on the whole labor force. Therefore, delaying a vigorous "educational push" beyond demographic opportunities would have a significant permanent cost in terms of extending the benefits of current educational policy to the whole populations and catch-up with the rest of the world.

Conclusions

The main conclusion is that demographic inertia is strong in Brazil and improvements in the school system today will take long to translate into more education for the population as a whole. Between cohort inequality will always increase because increasing the educational level of younger cohorts is equivalent to giving more education to those cohorts that already have the most. On the other hand, total inequality would relatively unaffected because within cohort inequality of older cohorts dominates total educational inequality within the population.

The paper gives a response to the implicit question raised in the title: There is a transient window of opportunity for long term inequality reduction via schooling expansion in the short and medium term. Part of that temporary window has already been lost. However, given the slow nature of demographic transition, this window is really wide and there is still time to take advantage of it by expanding education vigorously. The main conclusions of this report are:

- Previous educational policy –specially in the 1980s- did not take full advantage of d*emographic opportunities.* The stock-to-cohort time lag could have been reduced substantially -25%- if a country like Brazil had maintained the historical rate of growth of schooling during the 1980's.
- Educational Policy makers should maintain a patient long term perspective, because the stock-to-cohort time lag is considerable (from two to three decades). Therefore, policy makers should put

in place monitoring mechanisms to follow both the performance of younger cohort and the demographic transition.

- The appropriate time correlation between educational efforts and pre-demographic transition would reduce long term inequality. However there might be a labor income inequality overshoot in the short run, the period in with inequality between cohorts might run dominant. Additional reductions labor income inequality would follow if the wage skill gap responds to the supply changes, and even further if income-fertility differentials persist (Kremmer et al, 2002).*Demographic* opportunities *are still available*, but they are smaller and transient. Since the demographic transition will be almost completed in the first two decades of the XXI century there is still an opportunity to reduce the stock-vs-cohort time *lag* via educational expansion.
- *Delaying "educational push" would have a permanent long term equity cost for Brazil*. Therefore, delaying a vigorous "educational push" beyond demographic opportunities would have a significant permanent cost in *terms* of extending the benefits of educational policy to the whole populations and catch-up with the rest of the world.

Perhaps there is a corollary in terms of the specific role of foreign credit (vis a vis domestic credit) to finance education expansion before demographic transition takes place. Fiscal constraints might be too binding precisely when countries like Brazil face optimal demographic opportunities. Own country resources are the most limited at this point in time because dependency ratios are the highest and productivity per worker is very low. Hence this constraint might be efficiently relaxed via foreign credit from multilateral institution. In summary, the level of schooling of the labor force in Brazil is clearly insufficient and efforts to make educational attainment higher and more equitable should be emphasized. Nevertheless policy makers and policy observers should be aware that any expected impact of education on inequality of income will not be immediate. Hence they should be willing to establish monitoring systems can follow to young cohorts of students trough the different stages of the educational ladder and evaluate educational outcomes with an explicit long term perspective.

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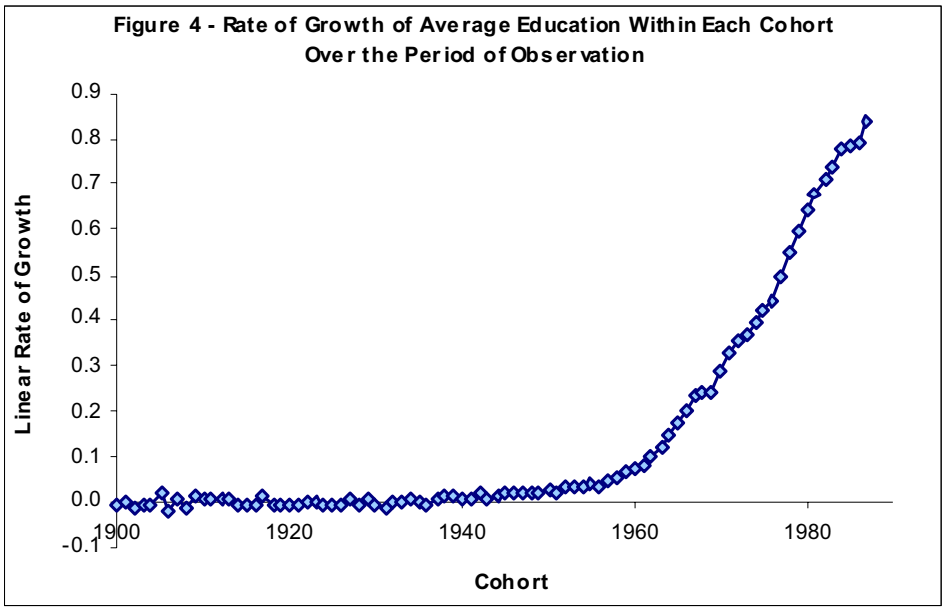
Appendix: Converge estimation for educational attainment (mean and inequality) within cohorts

In principle, all cohorts are born with zero average education, and over time this number increases up to the point at which there is no one in the cohort that still in school and then stabilizes. In Brazil, after 30 years of age, very few people are still in school. In 1999, only 2.9% of the population 30 or over were still in any kind of regular learning. The year of 1999 may be used as an upper bound, given that each successive cohort is completing more education than its predecessors[37].

Figure A1



Since we observed cohorts from 1977 to 1999, this means that any cohort born previous to 1947 should no longer show any increases in education over the period of observation and even those born previous to 1952 (those 25 and older in 1977) should show very little. This is indeed what we observe, Figure A1 shows the slope linear trend line showing the increase in education of each cohort over the 1977 – 1999 period. It is flat for cohorts born from 1900 to the mid-1940s and then increases strongly and monotonously up the last cohort observed – the one born in 1987.

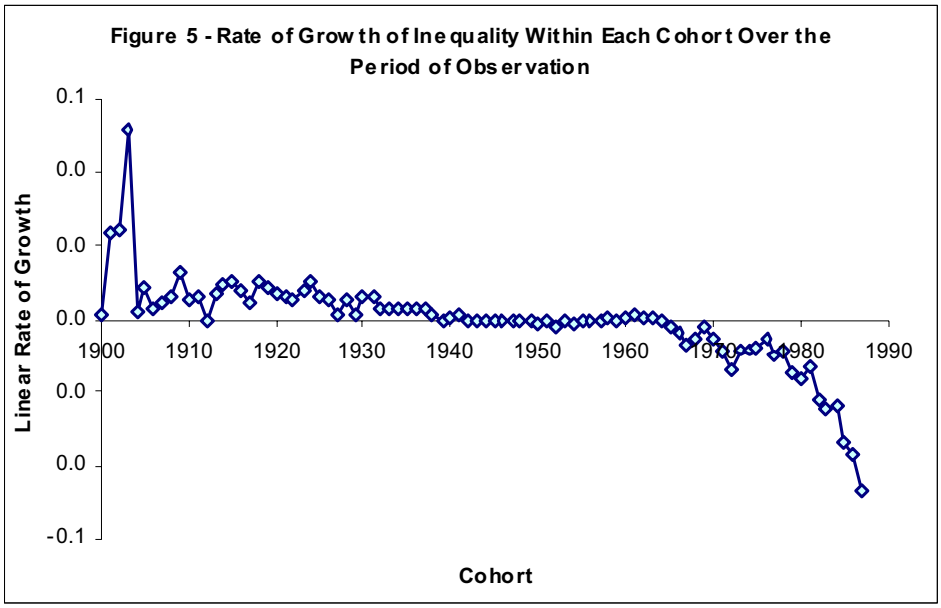
A related pattern can be seen in the evolution of inequality. Figure A2 shows that the I_2 measure does not change significantly until the 1965 cohort and then there is a strong downward trend for all successive cohorts. In other words, cohorts aged 12 have already achieved their final inequality, as measured by one half of the coefficient of variation squared. This is not as intuitive as the effect on average education.

The I_2 measure is one-half of the variance divided by the square of the mean. When each cohort comes into the world none of its members has any education, the mean is zero, and I_2 is not even defined. Once at least one child finished one year of schooling, I_2 becomes defined and then increases very quickly as a part of the cohort acquires some education, yielding a positive denominator, but the numerator, average years of education, remains very low. I_2 then falls mostly because this denominator is increasing. Since we only observe each cohort after it is 10 years old, we do not observe the increasing part of the curve, only the downward part. We will also see later on that it becomes stable within each cohort before average educational level does. This is why we observe changes in the I_2 measure over the 1977-1999

[37] For example, in 1995 only 1.6% of people 30 or older were involved in education.

period only with the 1965 cohort while the average changes over the same period for all cohorts after the one born in 1945.

Figure A2



Another way to observe the evolution within cohorts and over time is to look at the average education of each cohort from 1977 to 1999. Figures A3 through A5 show this for ten cohorts born from 1920 to 1975. Figure A3 shows that the cohorts born in 1920, 1930, and 1940 show no increase at all in average education over the period; Figure A4 shows very slight increases for cohorts born in 1945, 1950, and 1955; and finally Figure A5 shows the large increases in the education of cohorts born from 1960 onwards, whose members were still overwhelmingly in school during the observation period. Finally, each successive cohort attains a final educational level superior to that of its predecessors

Figure A3

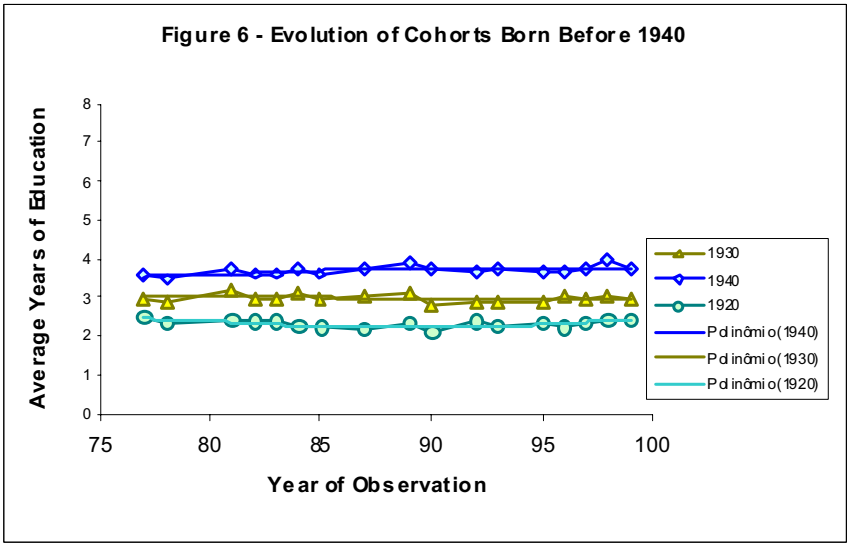


Figure A4

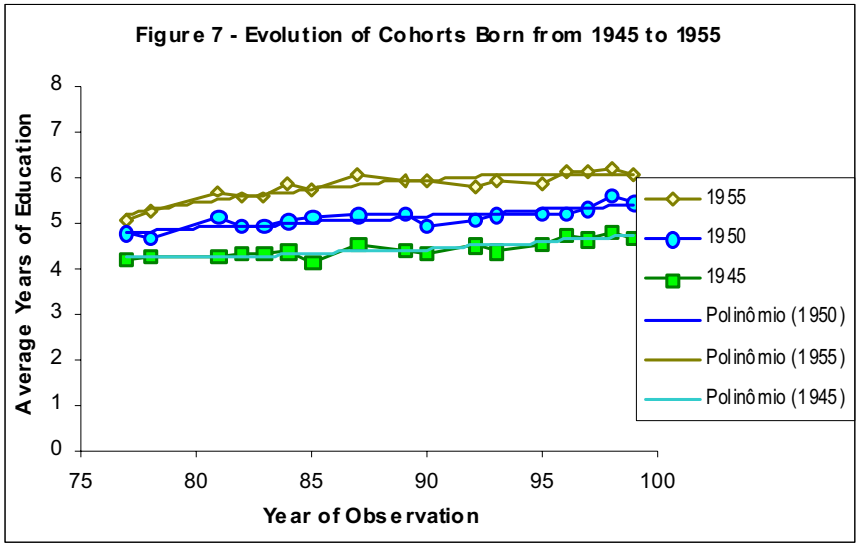
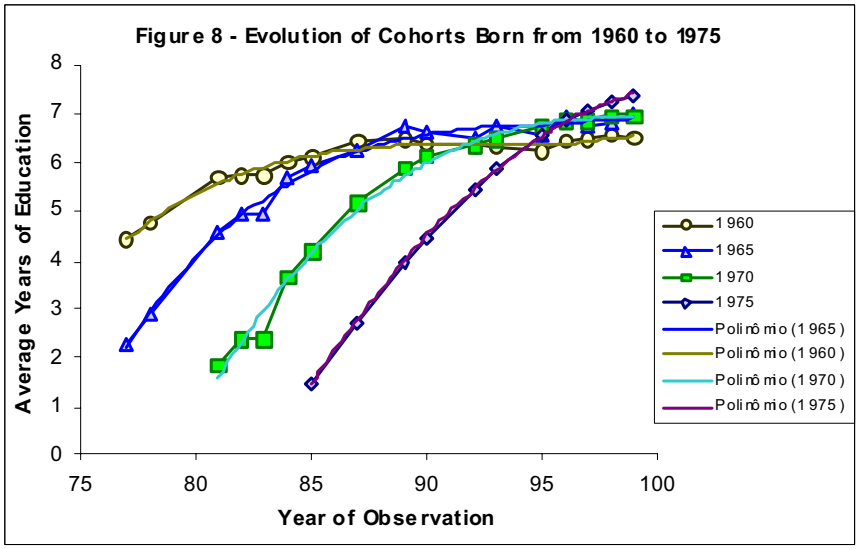


Figure A5



Figures A6 through A8 show the I_2 measure for the same cohorts as Figures A3 through A5. The message is again clear: the inequality of education is stable from 1977 to 1999 for cohorts born until 1965 but falls over the observation period for those born after 1965. Of course, the final value of I_2 for each cohort is lower than for its predecessor.

Figure A6

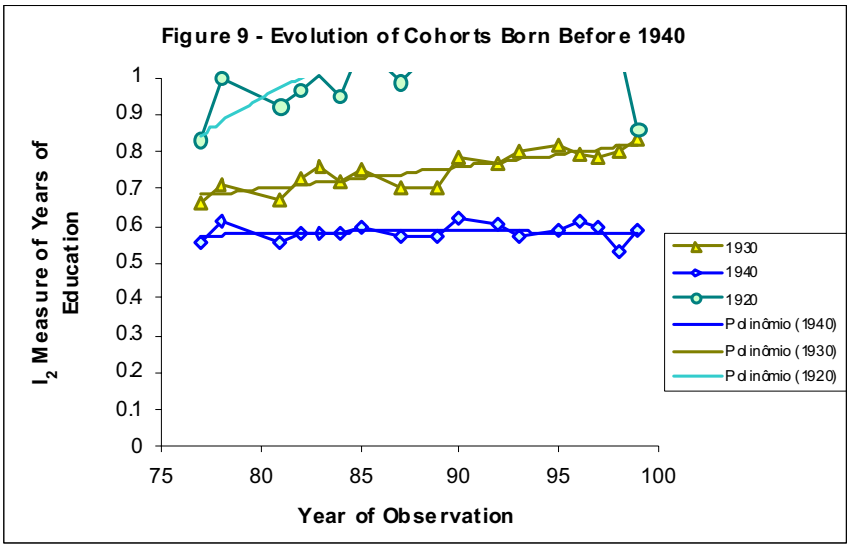


Figure A7

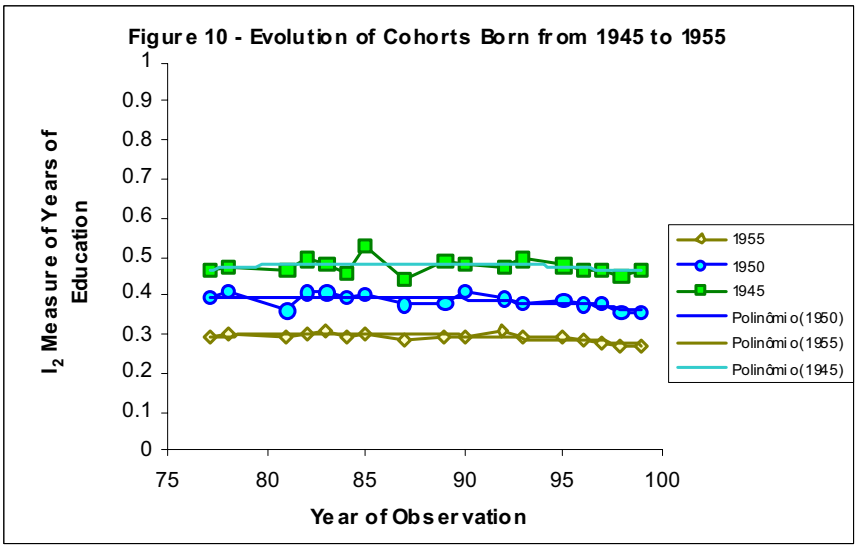
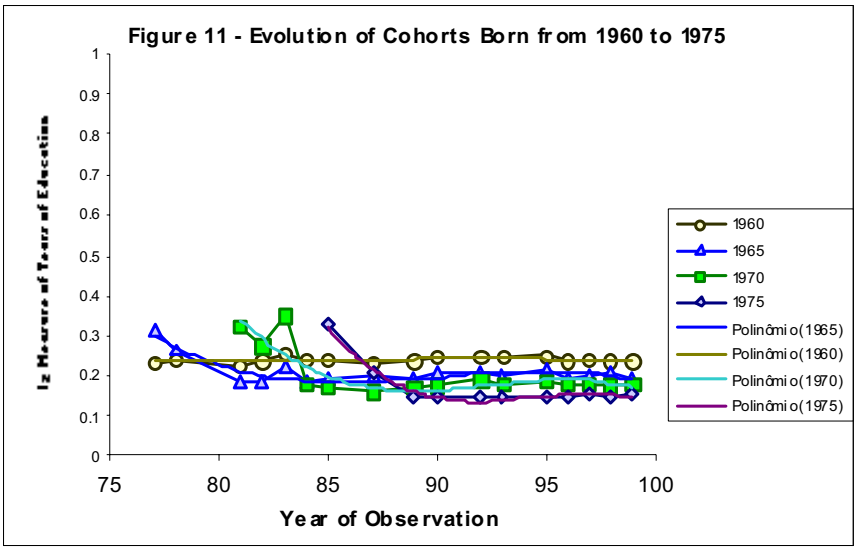


Figure A8



Finally, if we shift the curves on graphs A5 and A8, we can see how the level and inequality in education vary as different cohorts age. This is what is shown on Figures A9 and A10, which may be the most important figures thus far. Let us start with Figure A9.

Figure A9

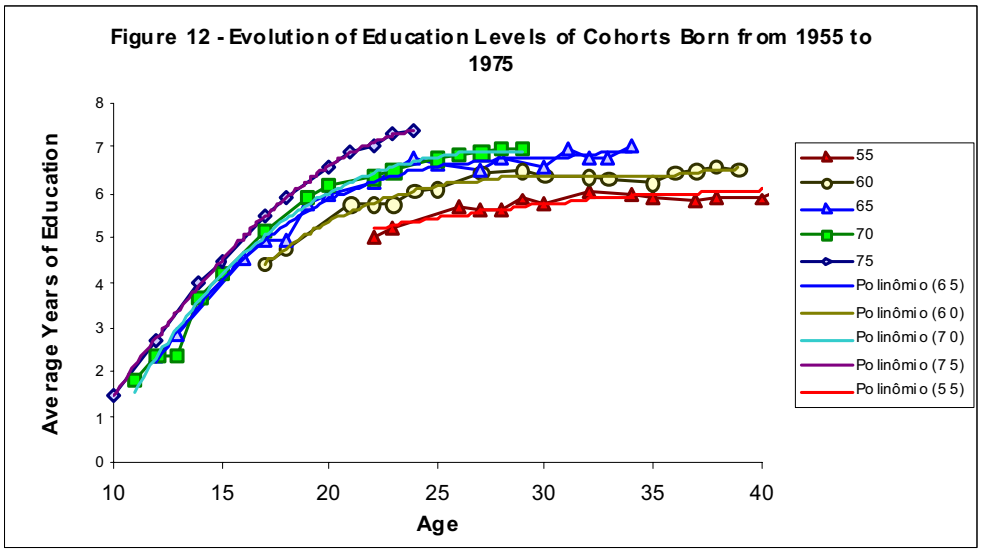


Figure A9 appears to show that successive cohorts, at least those born from 1960 to 1975, have higher education levels at any given age and appear to level off at more or less the same age. This is equivalent to saying that most educational improvement involves advancing further in the educational ladder in the same time rather than staying longer in school. In other words, kids are doing better because they are repeating less. This is coherent with most analysis in the education literature in recent years.

The practical impact of this upon our analysis is on how we will model final educational level of the cohorts born from 75 to 83, whose years of schooling had not yet reached its final value in 1999. What we

do is take the 1974 cohort as a baseline and see how much more education a given younger cohort has at each observed age and then attribute to these newer cohorts the 1974 cohort final value multiplied by the average percentage difference between the two over the years of observation.

Figure A10

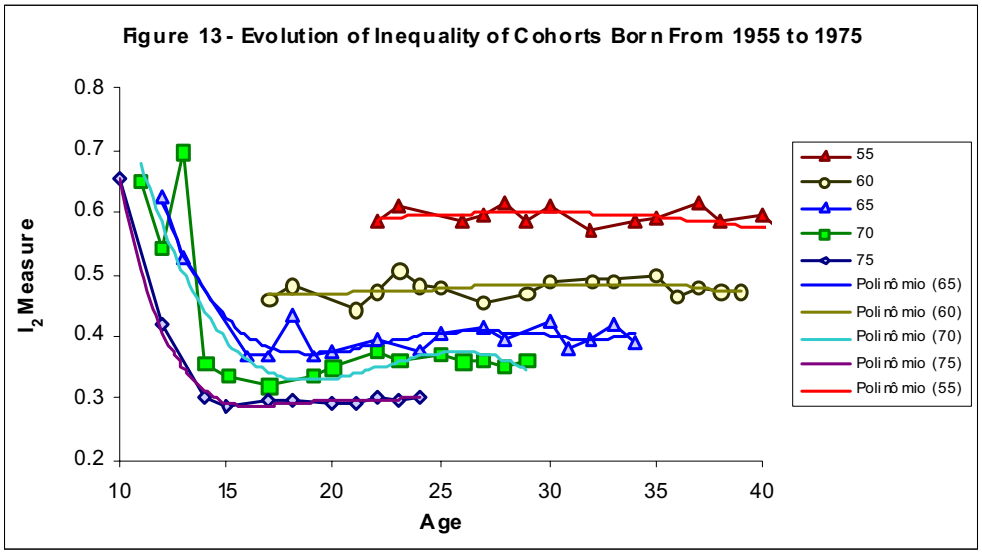


Figure A10 is easier to interpret. By age 20, educational inequality, as measured by the I_2 measure, levels off. This means that additional increases in the variance of education are matched by equal increases in the square of average education, leaving this inequality measure unchanged.