Research Paper 1

RELATIVE AND ABSOLUTE DEMOGRAPHIC BONUS IN SCHOOLING

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'A Project RLA5P201: Regional support to Population and
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Brasília DF, August 2007

The author thanks United Nations Population Fund for having funded this research and Jorge Rodríguez and Ralph Hakkert for providing access to data and excellent suggestions. The findings, interpretations, and conclusions expressed herein are those of the author and do not necessarily reflect the views of the United Nations Population Fund (UNFPA) or IPEA.

Research Papers of Project RLA5P201 - Regional support to Population and Development in the implementation of the MDGs in the LAC Region:

1. Sergei Soares – Relative and absolute demographic bonus in schooling
2. André Junqueira Caetano; Durval Magalhães Fernandes & José Irineu Rangel Rigotti - Migration and the Millennium Development Goals: Latin America and the Caribbean
3. Ralph Hakkert - Guide to the Demographic Module for Poverty Analysis and Projection (DMPAP): an EXCEL workbook with applications to Venezuela, Brazil, and Jamaica
4. Project RLA5P201 – Potential contributions to the MDG agenda from the perspective of ICPD: summary and programme implications
5. Proyecto RLA5P201 – Contribuciones potenciales a la agenda de los ODMs a partir de la perspectiva de la CIPD: resumen e implicancias programáticas
6. Ralph Hakkert: Demographic Module for Poverty Analysis and Projection (DMPAP): an application to Suriname
7. Ralph Hakkert: The demographic bonus and population in active ages
8. Ralph Hakkert: Un análisis del efecto de la fecundidad no deseada sobre la pobreza a nivel de los Departamentos y zonas de residencia de Honduras, 2006
9. Ralph Hakkert: Demographic Module for Poverty Analysis and Projection (DMPAP): an application to Bolivia

Introduction

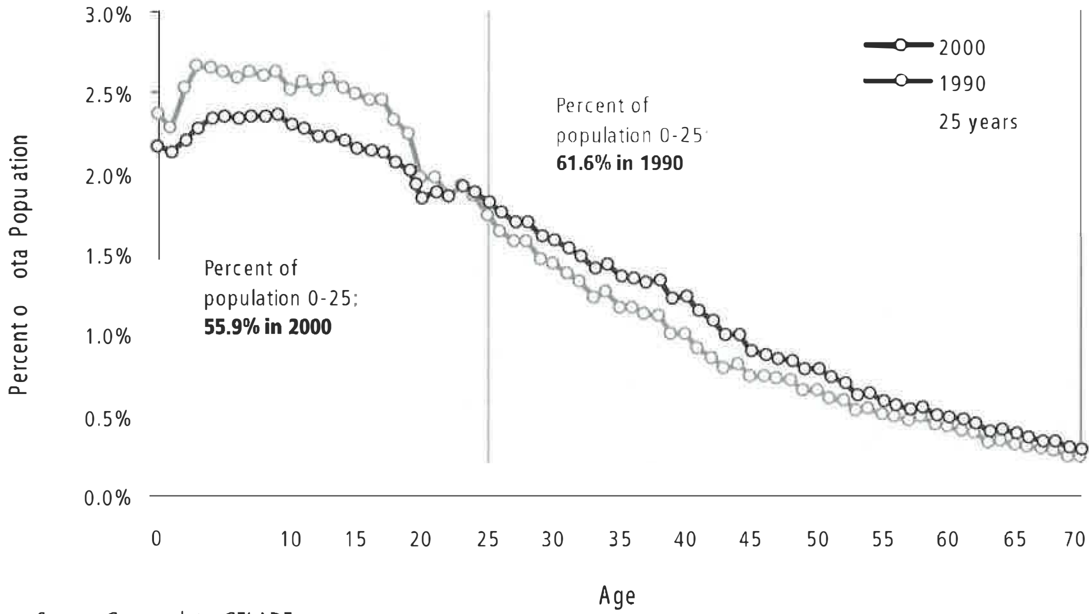
Learning is a lifelong process that begins with birth and ends only when death or senility prevent the incorporation and reorganization of knowledge. The way in which individuals learn, however, is, in any society or culture, highly dependent upon age. The way in which societies are organised largely determines how individuals of a given age will learn. In traditional[1] societies life experience is the most valuable form of knowledge, making the elders the most knowledgeable and respected individuals. Modern societies, on the other hand, have formalised and institutionalised the way in which individuals learn and how others acknowledge the learning process. This text will refer to these formalised and institutionalised learning activities as schooling. In all societies, the fraction of time allocated to learning, production, reproduction and leisure depends upon the age of individuals.

Age dependence of learning, in general, and schooling, in particular, means that the demographic structure of a given society may have important impacts upon the success of the schooling process, both for individuals and for society as a whole. This may occur through a variety of channels. The three that jump to mind are that higher relative weight of the young makes changes in education of the whole population easier, smaller families may devote more resources to fewer children, and that society as whole may have more resources to devote to each child's education when the population is not growing fast.

One effect is that the educational structure of the adult population is more easily changed when young cohorts are more numerous than older ones. This can be seen very clearly in the case of Mexico, comparing 1990 with 2000. Figure 1 shows that the percentage of the Mexican population aged 25 and less dropped by almost six percentage points in ten years. This means that similar schooling outcomes will result in slower educational change among the adult population. For this channel, a younger booming population is better. While this is one of the most important interactions between demography and schooling, it will not be explored here.

[1] Traditional is used to mean a set of very different forms of social organization which would include most tribal societies, rural areas of much of the planet, and many social organization forms of the past such as a medieval village. Modern is used to mean societies with larger populations, often, but certainly not necessarily, having received western influence. The author is aware that both the classification and the terms used are imperfect. The terms traditional and modern are used for lack of a better nomenclature and the classification is merely illustrative.

Figure 1 – Mexico: percent of population by age



Source: Census data. CELADE.

A second effect is within family resource allocation. A family with fewer children may devote more educational resources per child than a more numerous family with similar total resources. There is a considerable volume of work in this "quantity versus quality" approach to educational effort of families. While much of it is controversial, it is an effect that cannot be ruled out a priori, particularly when one takes into consideration the fact that in most standardised evaluations of educational quality, family variables are responsible for about 80% of explained variance, leaving 20% or less for the school[2]. Once again, while this is an important effect, it will not be studied here.

Finally, there is the issue of the potential resources the entire society may devote to educating a given child. The impact of demographics on these resources depends on how young a society is and how fast its population is growing.

In modern societies, almost all income is produced by adults in working age. This means that national income, and by extension, the amount of resources, public and private, available for everything, education included, depends upon the size of the adult population (among many other variables). On the other hand, the volume of resources, public and private, needed to educate children depends upon the size of the school age population. This, of course, means that the higher child: adult ratio, the lower the potential resources per child.

[2] It is likely that these evaluation underestimate school variables because almost all are cross-sections measuring school variables in a single year and family variables that have been constant for the child's entire life. However, even in evaluations that do follow kids, such as Hanushek (1995), family variables are very important.

A second effect is that in a growing population, successive cohorts of children are larger. This means that while in a growing population more resources will be needed to build schools and train teachers to keep up with demographics, in a stable population these same resources may be redirected to improve the quality of education or, as has been the case of many Latin American countries, to incorporate individuals previously excluded from schooling.

This paper will present a very simple decomposition methodology that allows these two effects to be integrated into a single, demographic effect. This methodology will then be applied to a series of Latin American countries using exclusively census data on cohort size and enrolment by age.

Data and methodology

Although analysing the demographic bonus in schooling is nothing new, there is not as much written on the subject as one would expect. A quick review of the literature shows some Brazilian studies on the subject by Marteleto (2002), Paiva and Wajnman (2005), Vélez, Soares and Medeiros (2001), among others; a reasonable production at the IDB, in the form of reports by Behrman, Duryea, Székely (1999 a and 1999 b) and Birdsall and Lustig (1998); a few CICRED articles by Goujon (2006) and Rodríguez Wong and Carvalho (2006), among others; and some articles in academic journals such as *Demography*. Much of this production, such as Goujon (2006) and Lutz and Goujon (2001), is along the lines of demographic projections using flow models. These papers are very interesting, but not of immediate relevance in the present context. Another group, such as Paiva and Wajnman (2005) and Birdsall and Lustig (1998), analyses education together with other changes brought about by demography.

Perhaps the most interesting reference is Preston (1984), who argues that the political process may change resource allocation so as to completely undo the effects of demographic change. The example given is the demographic transition in the US from 1957 onwards, leading to a sharp reduction in the under 15 population. The demographic argument would be that with fewer children, there would be more resources per child and higher educational quality. These higher per-child expenses, however, were channelled into much smaller class sizes, which is perhaps the least cost-effective way to increase learning (Hanushek, 2003). Teacher salaries, on the contrary, fell relative to alternative professions, meaning that less talented individuals were attracted to the profession. The net result was fewer children, slightly higher per-child expenses, and lower-quality schooling. As will be shown below, a twist on the Preston story, although with a happy ending, has been at work in the LAC region.

The data used here are exclusively Census Data from eleven Latin American countries collected between 1971 and 2001. For five countries – Bolivia, Brazil, Costa Rica, Uruguay, and Venezuela – three years are available. For the remaining six – Argentina, Ecuador, Guatemala, Honduras, Mexico, and Panama – only two censuses are available. As will be seen below only the population and enrolment by age are needed in the methodology used.

The data are all provided free of cost by CELADE – the Population Division of the Economic Commission for Latin America and the Caribbean of the United Nations.

Net or gross enrolment rates are usually considered the best simple measure of educational inclusion. There are, of course, more sophisticated measures that take student flow or learning explicitly into consideration, but these are usually more complicated to explain and require more and better data to calculate. An enrolment rate is the ratio between the number of individuals enrolled in school and the total population of a given age:

(1) $$m_k = \frac{M_k}{P_k}$$

where m_k is the enrolment rate for grade(s) k, M_k enrolment in grade(s) k, and P_k the population in k grade(s) school age. Net enrolment rates consider only those in k grade(s) school age when calculating M_k and gross enrolment rates consider students of all ages. This, of course, means that older lagged students are considered in the numerator in gross, but not net, enrolment rates and that net enrolment rates are always equal or inferior to unity while gross rates can assume any value.

In this paper, a slightly different definition of net enrolment rates will be used: M_k will be considered enrolment in any grade of children of age k and the total population in k grade(s) school age. The difference between the definition used here and the usual definition of net enrolment is that lagged students will be considered in the numerator, but different from gross enrolment rates, these are not older students in the same grade but students of the same age in different grades.

The reason for using this peculiar definition is that school systems are organised in different ways in different countries so, while in one, a 15 year-old is expected to be in secondary school, in another, he is still in primary school. By using only age and enrolment in any grade, this problem is circumvented.

Equation (1) can be re-written as:

$M_k = m_k P_k$ which, in turn, can be differenced as: (2) $\Delta M_k = m_k \Delta P_k + P_k \Delta m_k$

This means that equation (2) allows variations in total enrolment to be divided into changes that contribute to increasing educational inclusion, $P_k \Delta m_k$, and those that merely keep up with growth in size of school-age cohorts, $m_k \Delta P_k$.

ΔP_k however, can also be re-written as $P_k = n_k P$ where P is the total population (of all ages) and n_k is the percentage pf the population aged k. Substituting and differencing:

(3) $\Delta M_k = m_k n_k \Delta P + P m_k \Delta n_k + P n_k \Delta m_k$ which is the equation that will be used from here on.

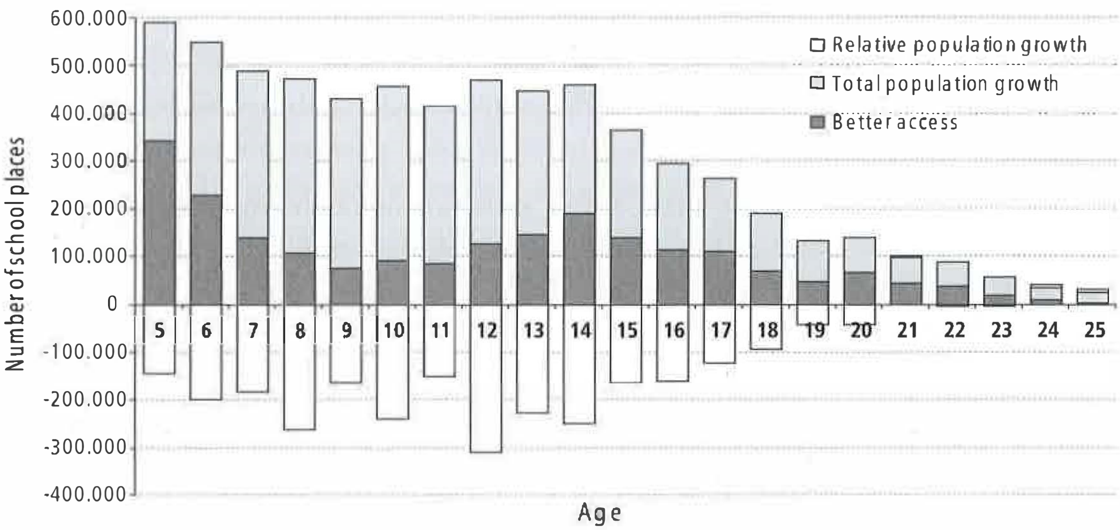
The first term of equation (3), $m_k n_k \Delta P$, represents enrolment that merely accompany total population growth. If the population is growing, this term will be positive and if shrinking, it will be negative. No Latin American country analysed here is losing population.

The second term, $P m_k \Delta n_k$, represents growth in enrolment accompanying the relative weight of age group k, given total population growth. This means that if the school age population is growing more slowly than the adult population, $P m_k \Delta n_k$ will be negative, indicating a relative demographic bonus.

The sum of the first two terms is the absolute demographic bonus. It can also be written $m_k \Delta P_k$. The only country to have a sizeable absolute demographic bonus in the thirty or so years analysed is Brazil.

The final term, $P n_k \Delta m_k$, represents enrolment[3] created that led to more educational inclusion, as it is the only term in which the net enrolment rate changes.

Figure 2 – Mexico: enrolment created by age



Source: Census data. CELADE.

[3] This article follows the hypothesis that no enrolment is left unfilled and thus that total enrolled population and total enrolment is always the same.

Once again using Mexico as an example, Figure 2 shows the amount of enrolment created between 1990 and 2000, by age, for students with ages between five and 25. The solid grey bars show the part of the enrolment that contributed to better access, 345 thousand in the case of 5-year olds. The bars shaded with slanted lines show the enrolment keeping up with total population growth, a 248 thousand onus in the case of 5-years olds. The white bars show the relative demographic bonus due more adults per child – a 143 bonus in the case of five year olds.

Table 1 – Mexico: Percent of enrolment created by age

Age	Better access	Absolute demographic bonus	
		Total population growth	Relative demographic bonus
5	76.6%	55.3%	-31.9%
6	64.5%	91.4%	-55.9%
7	45.3%	113.8%	-59.1%
8	50.2%	172.1%	-122.3%
9	28.5%	131.0%	-59.5%
10	41.9%	165.7%	-107.6%
11	32.2%	122.9%	-55.1%
12	79.5%	212.6%	-192.0%
13	65.6%	135.3%	-100.9%
14	88.5%	127.0%	-115.5%
15	68.8%	111.0%	-79.8%
16	85.6%	132.5%	-118.1%
17	77.6%	106.0%	-83.6%
18	70.9%	123.4%	-94.4%
19	52.1%	91.4%	-43.4%
20	68.0%	75.8%	-43.9%
21	44.4%	54.5%	1.0%
22	43.8%	59.8%	-3.7%
23	36.1%	66.2%	-2.3%
24	20.3%	69.0%	10.7%
25	12.4%	73.8%	13.7%
5-15	57.4%	121.4%	-78.7%
5-25	58.5%	113.8%	-72.3%

Source: Census data. CELADE.

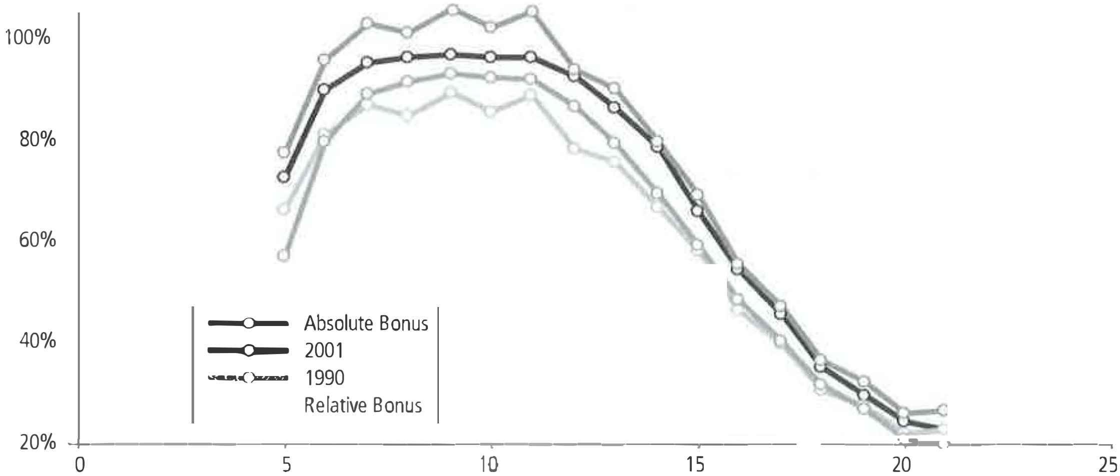
Note that the top of the shaded bars does not represent the total enrolment created, which in the case of five-year olds was 450 thousand. The sum of all three bars adds up to total enrolment creation. Table 1 shows the same data in percentage terms, with subtotals for age five to 15 and 5 to 25.

Finally, a graph can be created to show counterfactual contribution upon net enrolment rates of each term of equation (3). Figure 3 shows net enrolment rates in 1990 and 2000. The difference between the curves represents, evidently, increased access to schooling by age.

The highest curve show what would have happened had there been no population growth at all for each age: net enrolment rates would have gone above 100% as enrolment would have been created for nonexistent children. This shows the absolute demographic onus.

Keep in mind, however, that potential resources also grow with total population. The counterfactual represented by the lowest curve shows the relative demographic bonus.

Figure 3 – Mexico: counterfactual net enrolment rates



Source: Census data. CELADE.

Three cases of interest

The methodology illustrated above for the case of Mexico can also be applied to any country for which we have data on population and enrolment by age. Three cases illustrate extreme patterns from which the others can be inferred.

Brazil: The only case of absolute demographic bonus

Figure 4 shows that, from 1980 to 1991, the population of almost all ages increased, the only exception being those with one or no years of age. Differences of up to half a million children show that the population increase was considerable for age groups up to 15 years. Comparing 2000 with 1991, a different scenario arises: while age 12 onwards the population increase is quite large, there is a considerable drop in population from five to eleven.

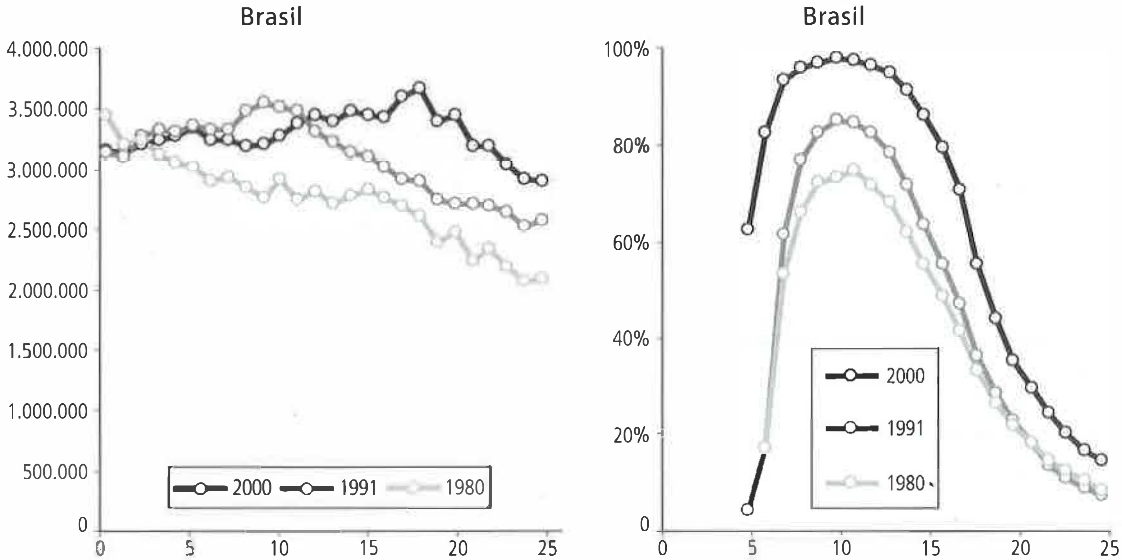
Concurrently, Panel 2 shows that net enrolment increased not very much from 1980 to 1991 and quite a bit from 1991 to 2000. The demographic and enrolment stories appear to coincide.

Calculating the three effects from equation (3) using the 1991-2000 period yields Table 2, which shows that the great majority of enrolment created in the period allowed greater access. Since there was population growth from 1991 to 2000, the total population growth component is always positive – i.e it shows a demographic onus. However, for ages six to 11, the relative bonus is greater than the total population growth component, yielding a positive absolute bonus and allowing considerable space for increases in net enrolment rates.

Figure 4 – Brazil: cohort size and enrolment rates

Panel 1: Cohort Size

Panel 2: Enrolment Rates



Source: Census data. CELADE.

Table 2 – Brazil: enrolment created by age

		Absolute demographic bonus		
	Better access		**Total population growth**	**Relative demographic bonus**
6	102.0%	-2.0%	11.3%	-13.3%
7	106.9%	-6.9%	37.7%	-44.6%
8	168.9%	-68.9%	113.1%	-182.0%
9	269.9%	-169.9%	244.8%	-414.7%
10	205.9%	-105.9%	215.1%	-321.0%
11	127.9%	-27.9%	132.3%	-160.1%
12	81.7%	18.3%	74.9%	-56.6%
13	78.7%	21.3%	59.7%	-38.3%
14	69.3%	30.7%	41.7%	-11.0%
15	74.2%	25.8%	35.5%	-9.8%
16	74.3%	25.7%	30.1%	-4.4%
17	65.2%	34.8%	23.6%	11.1%
18	64.1%	35.9%	22.4%	13.6%
19	66.4%	33.6%	22.7%	10.9%
20	64.5%	35.5%	21.4%	14.0%
21	74.1%	25.9%	22.4%	3.5%
22	77.0%	23.0%	19.5%	3.4%
23	81.2%	18.8%	19.8%	-1.0%
24	81.1%	18.9%	18.8%	0.1%
25	85.5%	14.5%	17.9%	-3.4%
6-15	107.0%	36.5%	-63.5%	100.0%
6-25	87.9%	72.2%	-27.8%	100.0%

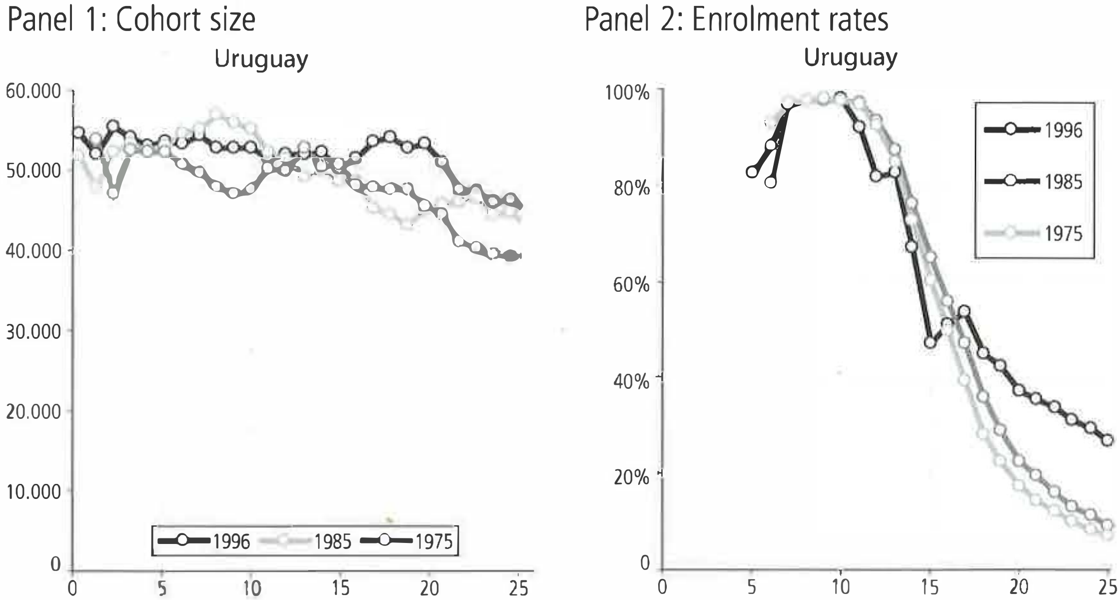
Source: Census data. CELADE.

Brazil is perhaps the classical case of demography lending a hand to attaining near-universal enrolment. Among the eleven countries analysed here, Mexico shows a similar, although weaker, pattern.

Uruguay: Nothing to decompose

The case of Uruguay is similar of the case of Argentina. It is the case of "not much happening" Panel 1 of Figure 5 shows that cohort size is more or less constant since the population size by age did not change much from 1985 to 1996, but also did not change much from 1975 to 1985. Panel 2 shows the same story in enrolment rates from 1975 to 1985. From 1985 to1996, there is a drop in enrolment from 10 to 15 and an increase in the 16 to 25 age group. This is quite curious, but appears to bear little relation to demographic change.

Figure 5 – Uruguay: cohort size and enrolment rates



Source: Census data. CELADE.

The case of Uruguay is similar of the case of Argentina, and, to a lesser extent, Panama. It is the case of "not much happening", Panel 1 of Figure 5 shows that cohort size is more or less constant since the population size by age did not change much from 1985 to 1996, but also did not change much from 1975 to 1985. Panel 2 shows the same story in enrolment rates from 1975 to 1985. From 1985 to 1996, there is a drop in enrolment from 10 to 15 and an increase in the 16 to 25 age group. This is quite curious, but appears to bear little relation with demographic change.

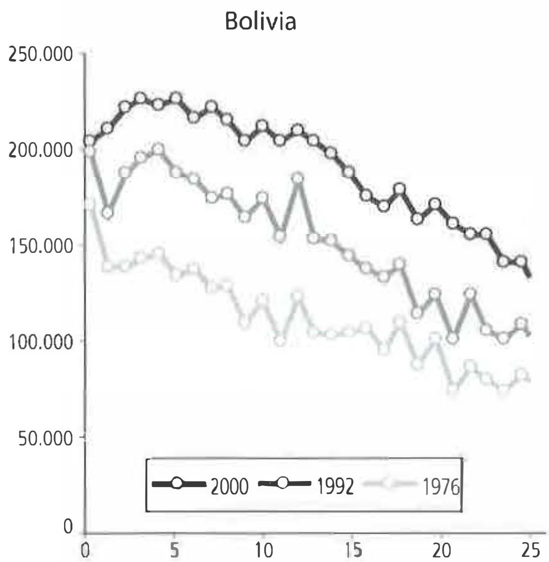
Bolivia: no relief in sight

Bolivia is perhaps the polar opposite of Uruguay. The census data from 1976, 1992 and 2000 show constant and unceasing increases in school-age population. The population increases appear to be on the order of 50 thousand children per one-year age group, which entails growth of from 25%-5-% from one census to the next.

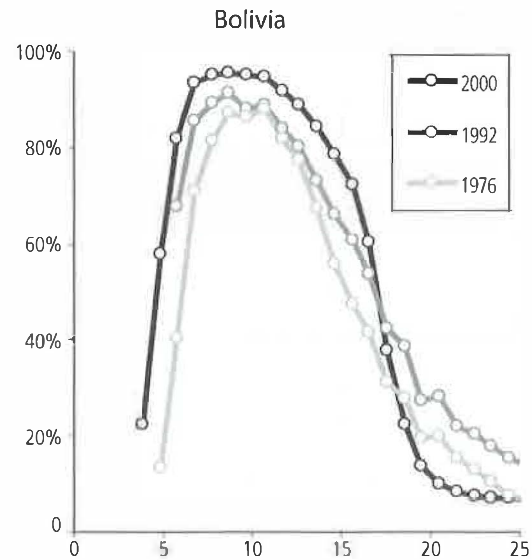
In spite of the demographic pressure, Bolivia has been able to increase net enrolment rates, at least in primary school, by a considerable amount. Between 1992 and 2000, net enrolment rates for six to 15 year-olds increased by between five and ten percentage points, coming close to near-universal enrolment. Since this had little relation with demographic change, what was responsible for these increases in net enrolment?

Figure 6 – Bolivia: cohort size and enrolment rates

Panel 1: Cohort size



Panel 2: Enrolment rates



Source: Census data. CELADE.

Table 3 shows that only from 17% to 41% of the enrolment in the seven to 18 year old range led to increased access. This contrasts to number greater than 100% in the case of Brazil and over 60% for Mexico and shows that the only explanation is that an extraordinary enrolment has been created by the Bolivian school system so that, in spite of its heavy demographic onus, enrolment has increased and is at levels close to that of its wealthier neighbours.

Table 3 – Bolivia: enrolment created by age (1992 - 2000)

		Absolute demographic bonus		
	Better access		Total population growth	Relative demographic bonus
6	54.5%	45.5%	72.6%	-27.1%
7	27.2%	72.8%	75.5%	-2.7%
8	24.3%	75.7%	95.6%	-19.9%
9	17.0%	83.0%	93.9%	-10.9%
10	28.4%	71.6%	92.5%	-21.0%
11	18.6%	81.4%	73.6%	7.8%
12	41.5%	58.5%	114.6%	-56.1%
13	26.7%	73.3%	63.9%	9.4%
14	35.4%	64.6%	61.5%	3.1%
15	39.9%	60.1%	57.6%	2.5%
16	41.8%	58.2%	58.5%	-0.3%
17	31.6%	68.4%	69.0%	-0.6%
18	-94.6%	194.6%	196.6%	-1.9%
19	288.9%	-188.9%	-132.7%	-56.2%
20	185.4%	-85.4%	-66.9%	-18.6%
21	186.2%	-86.2%	-46.3%	-39.9%
22	130.6%	-30.6%	-33.7%	3.1%
23	161.6%	-61.6%	-39.8%	-21.8%
24	155.2%	-55.2%	-40.2%	-15.0%
25	147.3%	-47.3%	-44.9%	-2.4%
6-15	30.2%	89.2%	-10.8%	100.0%
6-25	10.6%	93.4%	-6.6%	100.0%

The case of Bolivia is interesting as it shows that it is possible to swim against the tide. It is particularly interesting that a poor country can achieve these results. Guatemala, Honduras, and, to a lesser extent, Venezuela and (surprisingly) Costa Rica exhibit similar behaviour.

Conclusion

It is possible to decompose any increase (or decrease) in enrolment into components representing access, absolute demographic bonus (onus) and relative demographic bonus (onus). Using this decomposition, this article attempted to classify the eleven Latin American countries whose data were arranged into three groups.

The first group is the classical demographic bonus group and has only two countries – Brazil and Argentina – both which are responsible for a large percentage of the population of Latin America. In these two countries, the demographic slowdown opened space that facilitated an increase in enrolment rates.

The second group is composed of countries that have been going slow for a while – Uruguay, Argentina and, to a lesser extent, Panama. Decomposing change that did not occur is not very useful so there is no much to be said about this group.

The third group is composed of Bolivia, Honduras, Guatemala, and to a lesser extent, Venezuela and Costa Rica. These countries showed increases in enrolment rates, sometimes to very high levels, such as in the case of Costa Rica, in spite of high demographic growth. Even more impressive is that three in five of these rowers against the tide are among the poorest nations in Latin America, showing that while demographic change can help or hamper, it is certainly not the only determinant of educational attainment.

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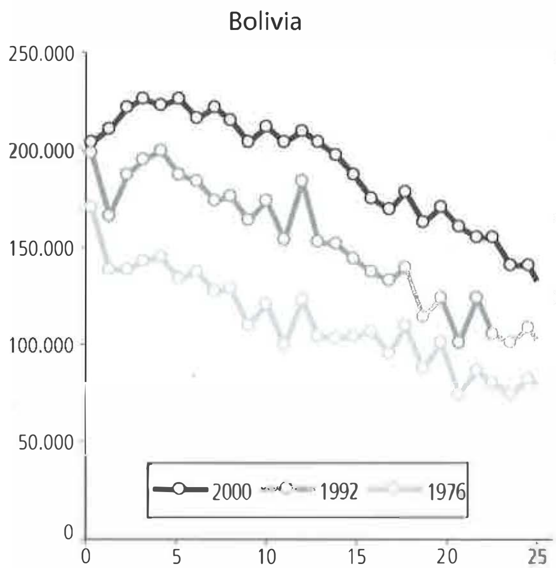
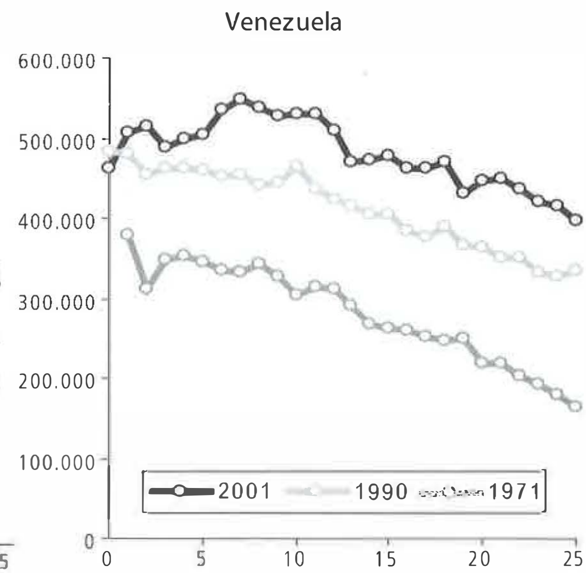
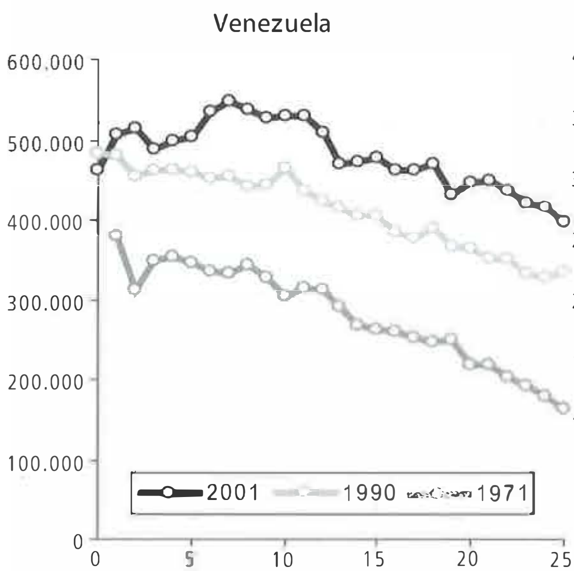
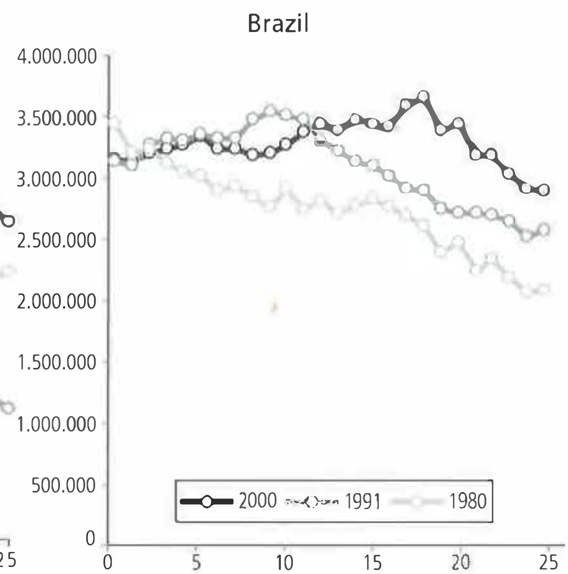
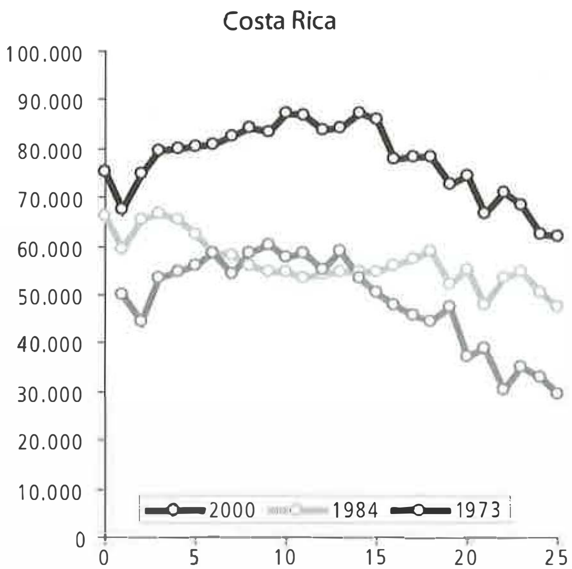
Annex I. Cohort sizes for 11 countries

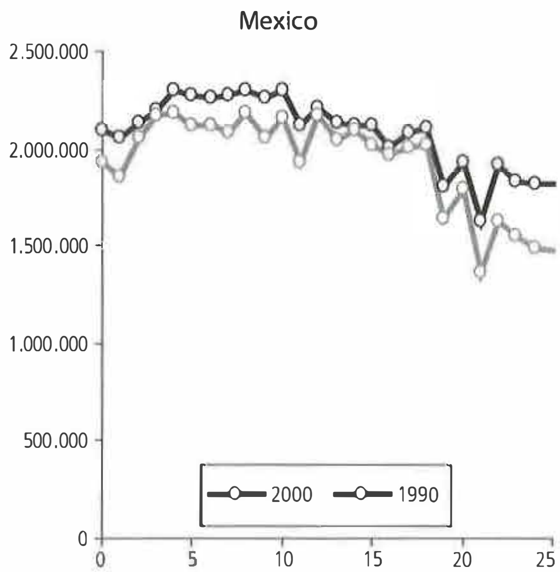


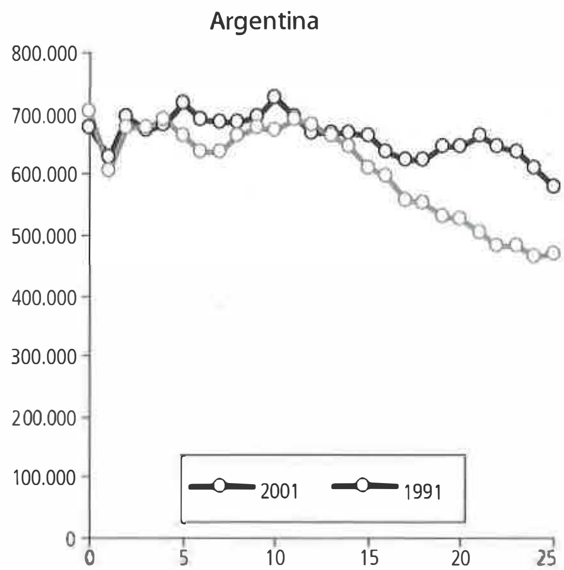


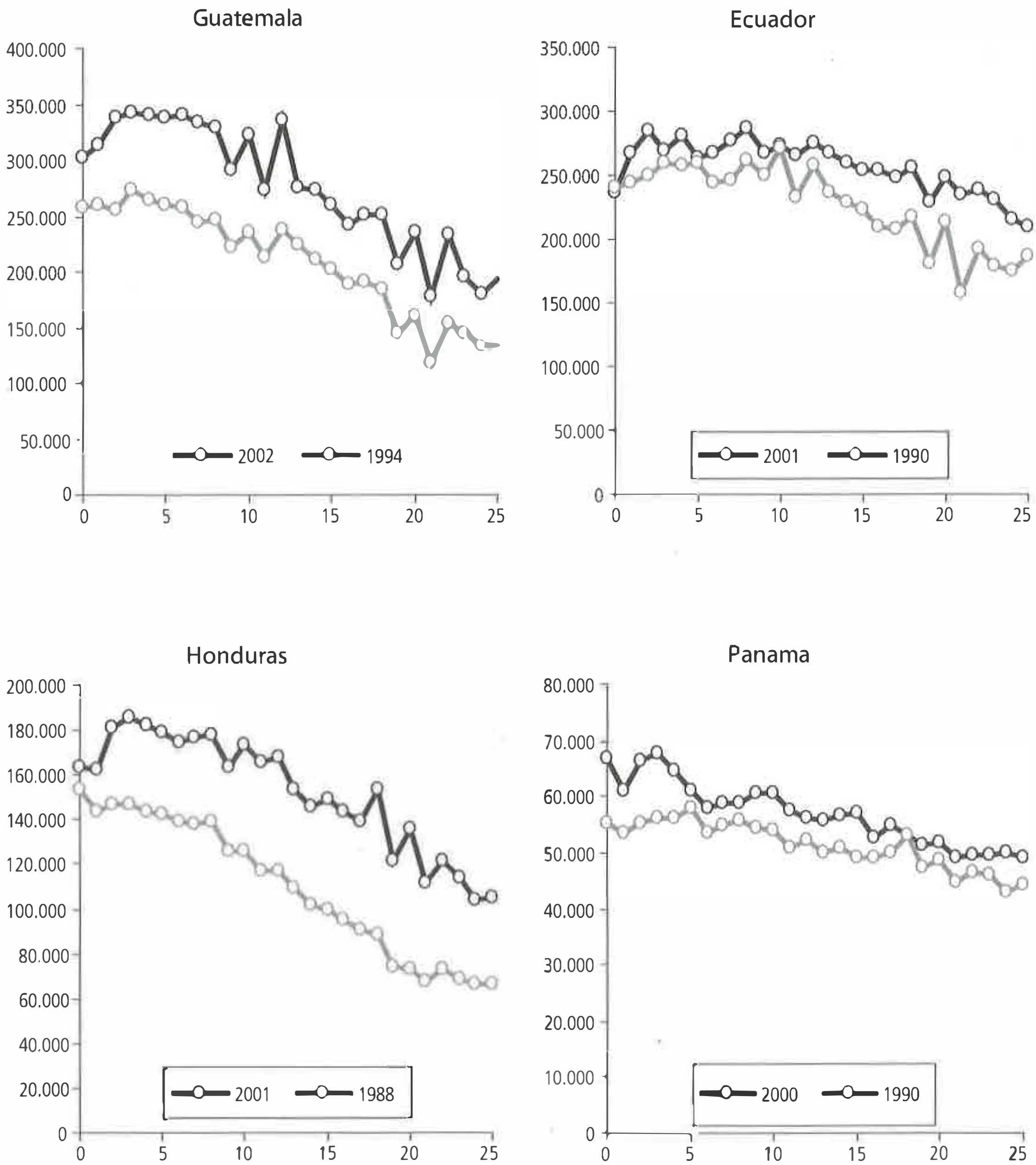




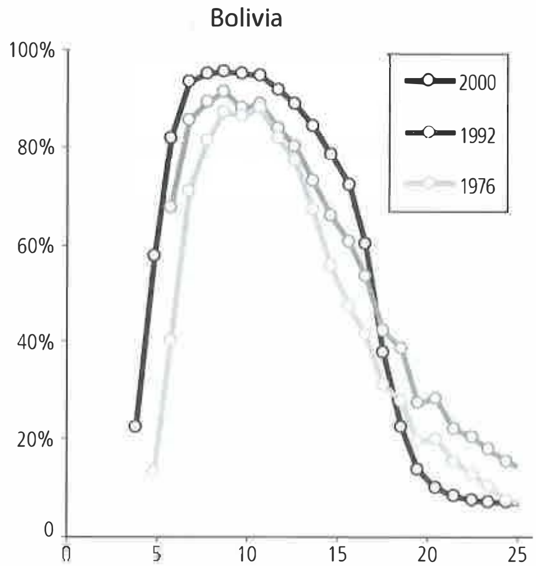

Costa Rica
100.000
90.000
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
0
0 5 10 15 20 25
2000 1984 1973

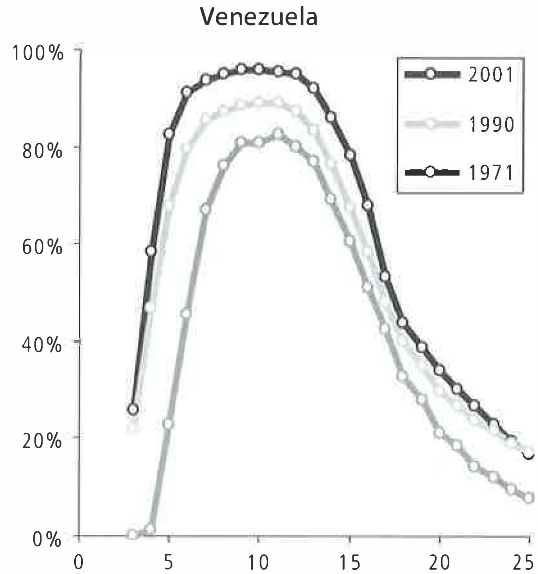

Mexico
2.500.000
2.000.000
1.500.000
1.000.000
500.000
0
0 5 10 15 20 25
2000 1990

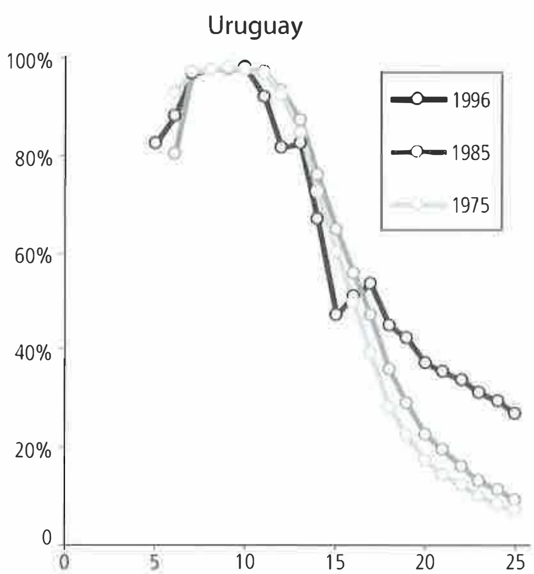

Argentina
800.000
700.000
600.000
500.000
400.000
300.000
200.000
100.000
0
0 5 10 15 20 25
2001 1991

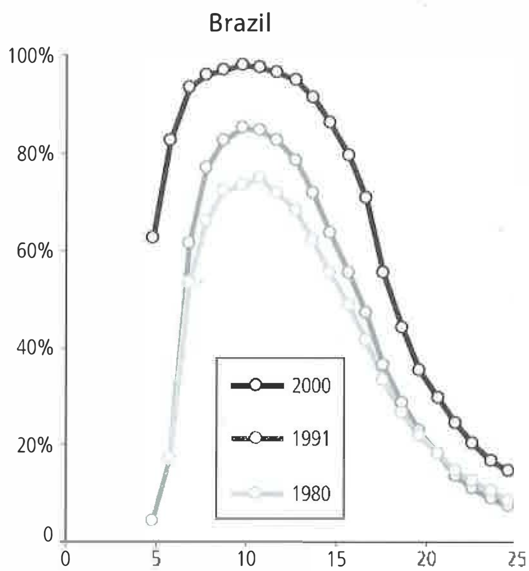

Guatemala
400.000
350.000
300.000
250.000
200.000
150.000
100.000
50.000
0
0
5
10
15
20
25
2002
1994
Ecuador
350.000
300.000
250.000
200.000
150.000
100.000
50.000
0
2001
1990
Honduras
200.000
180.000
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
2001
1988
Panama
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
2000
1990

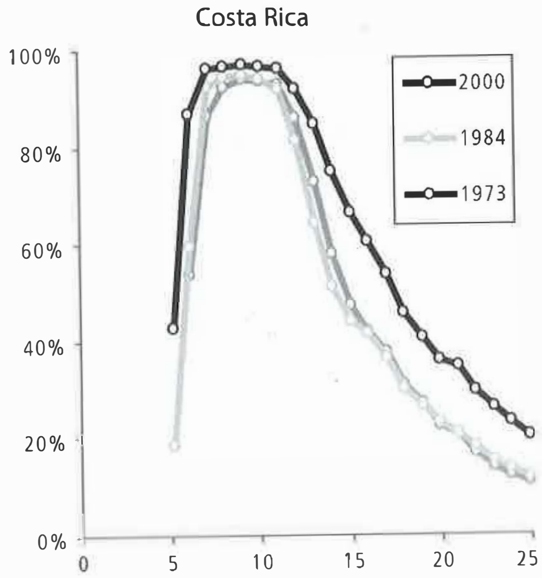
Annex II. Enrolment rates for 11 countries

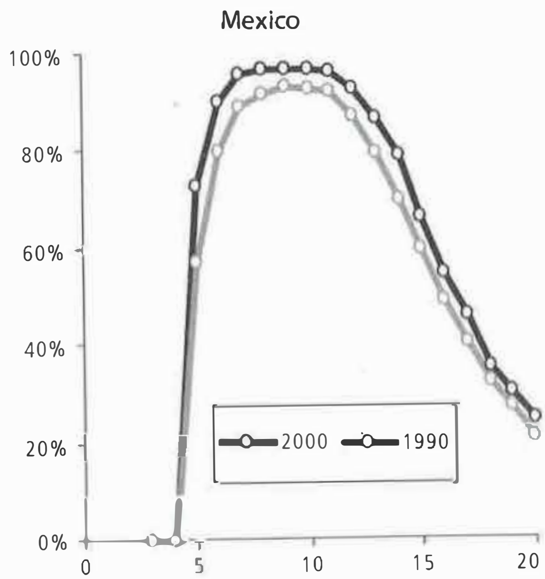


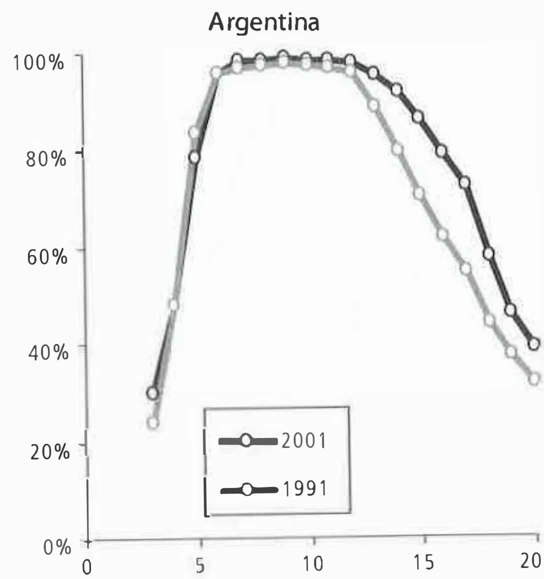


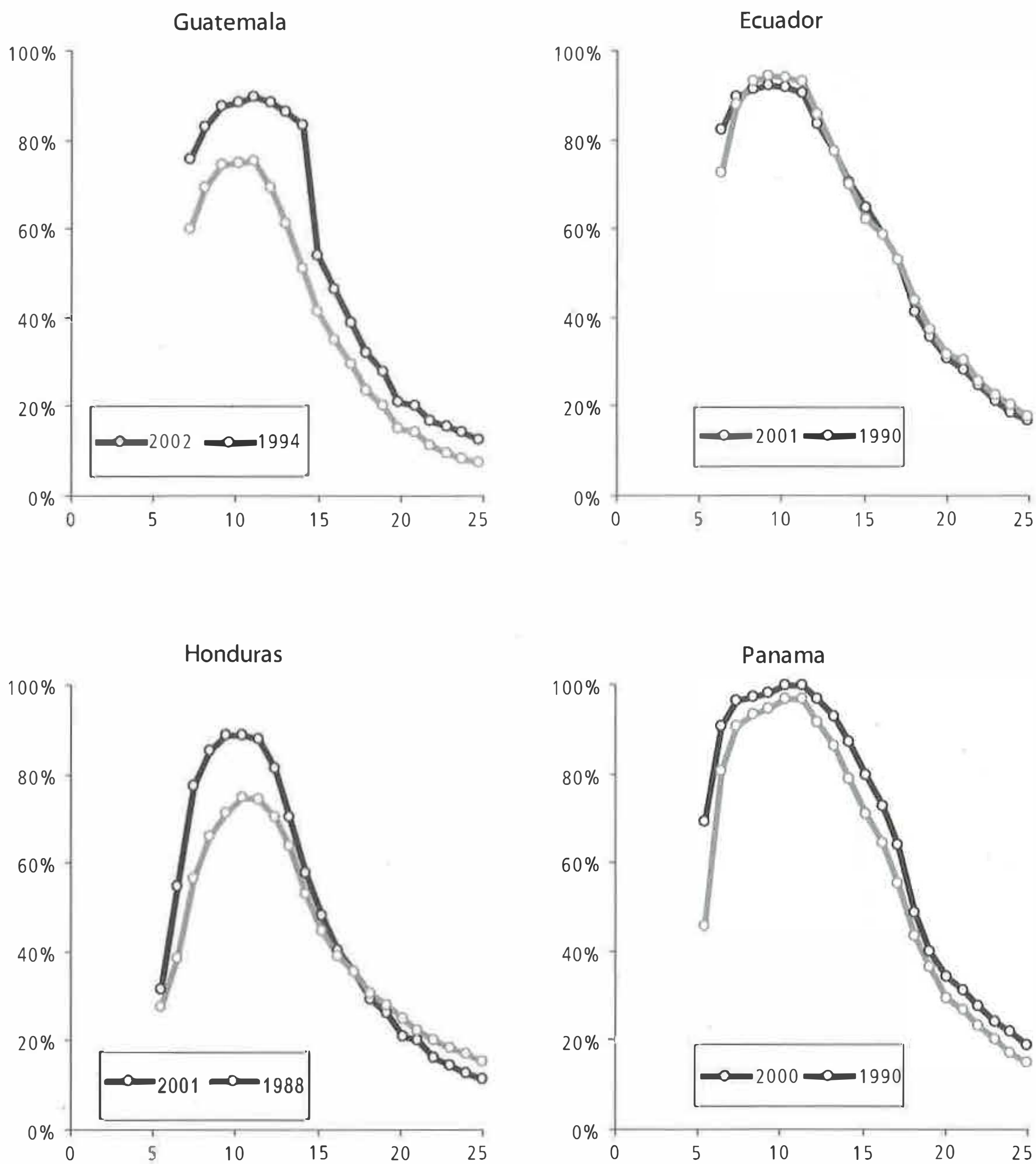





Costa Rica
100%
80%
60%
40%
20%
0%
0
5
10
15
20
25
2000
1984
1973


Mexico
100%
80%
60%
40%
20%
0%
0
5
10
15
20
2000
1990


Argentina
100%
80%
60%
40%
20%
0%
0
5
10
15
20
2001
1991


Guatemala
100%
80%
60%
40%
20%
0%
0
5
10
15
20
25
2002
1994
Ecuador
100%
80%
60%
40%
20%
0%
0
5
10
15
20
25
2001
1990
Honduras
100%
80%
60%
40%
20%
0%
0
5
10
15
20
25
2001
1988
Panama
100%
80%
60%
40%
20%
0%
0
5
10
15
20
25
2000
1990

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UNFPA
United Nations Population Fund