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Human Development and Inequality in the 20th Century: the Mercosur Countries in a comparative perspective

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Abstract

This article is in line with the United Nations attempts to approach human development in wider terms than per capita GDP, and in line with an ever lively debate on the historical standard of living and on the role of inequality in development. We focus on three Mercosur countries (Argentina, Brazil and Uruguay) and we view them in comparison with four core countries (France, Germany, USA and UK) along the 20th Century. The paper makes different attempts to construct diverse indices and to change the weights of their different components in order to better explain human development in different periods. A contribution of the paper, so long limited to Uruguay and the USA, is to adjust the historical human development index by inequality measures for all of its components. The results show that Argentine started to diverge, even in human development, at early stages of the 20th Century; that Uruguay diverged from the mid-century and that Brazil continued to tighten the gap up to 1980, diverging afterwards without being able to come close to the levels of the core countries. Total inequality in Uruguay and USA showed similar levels and trends: it decreased until the 1950s, and increased afterwards to similar levels. While inequality affects human development within both countries, it doesn't help to understand the differences between them, due to the mentioned similarity of the Gini-coefficients.

Keywords: human development, education, life expectancy, inequality, catching-up, domestic capabilities.
JEL Classification: N36, N56, N76, N96, O15, 05, Q17.

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Abtsract

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Human Development and Inequality:
the Mercosur Countries in a comparative historical perspective

1. Introduction

Since the United Nations introduced the concept of human development and started to work with the Human Development Index (*HDI*), a lively debate on different measures and variables has been taking place. Moreover, this debate was expanded to the field of economic history, in search for what we know as the Historical Human Development Index.

The aim of this article is to analyze the performance, in terms of human development, of three Mercosur countries (Argentina, Brazil and Uruguay) in relation to four core countries (France, Germany, UK and USA) during the 20th Century.

In doing that, we cannot avoid to discuss the available human development series and some methodological aspects, trying to improve those we consider not to be convincing.

As the *HDI* does, we will mainly rely on per capita income, education and life expectancy series. Nevertheless, we will introduce many changes to the estimates. Per capita GDP will not be transformed into logarithms. With respect to education, we will not only consider literacy rates, as historical estimates have done until now, but we will consider school enrolment as well; moreover, we will explore the results of changing the weight given to the different components of education in order to better approach relative performance in different periods. With respect to life expectancy, no innovations are introduced.

The main innovation of this paper, however, is to take into consideration how inequality affects human development. Assuming that overall welfare is higher if inequality is lower, we will estimate inequality in the distribution of income, years of life, and education, and construct an Historical Human Development Index adjusted by inequality trends, which we will call, in line with Hicks (1997), an Inequality-Adjusted Historical Human Development Index (*IAHHDI*). Because of data constrains, this latter attempt will only be done for Uruguay and the USA.

The results obtained are later discussed. The basic idea is that human development is the result of innovations in the production of goods and services, in the preservation of life and in educating the population. Those achievements may be the result of different and complementary forces: the capacity to produce knowledge, the capacity of learning by doing and the capacity to exploit technological spill-overs from more advances countries.

Our results are to a high degree preliminary and our discussion still is at an explorative level.

2. Background

Economic historians have been working hard on the reconstruction of historical GDP series, on the basis on which the pace of economic growth and its fluctuations could be discussed. If adequately purchasing-power adjusted, these series are also an important way in which levels of per capita income can be compared and the underlying determinants discussed. The efforts made by hundreds of scholars have yielded important results, as shown by the non-exhaustive, non-undisputable but impressive compendia published with short intervals by Angus Maddison (1995, 2000 and 2003).

Many criticisms have been directed towards the use of per capita GDP as a measure of welfare. Besides its technical shortcomings (the coverage of the informal sector, the lack of market prices for non-market production, the lack of consideration of the quality and welfare implications of the goods and services produced, and more), the assumption of an equal distribution of income among people with different social backgrounds and needs is specially criticized by Sen. The doctrinal base for his theory was the concept of human capability, as the ability of human beings to live lives they have reasons to value and to enhance their substantive choices (Sen, 1997).

Sen's approach demands, for empirical work, varied and hardly available information, especially on an historical dimension. Thus, the whole approach has been finally constrained to the construction, since 1990, of the Human Development Index, in which the per capita GDP, as a proxy for the standard of living, has been complemented by life expectancy and education, as proxies for other aspects of the quality of life, probably not reflected by the per capita GDP. The HDI is complemented by a wide variety of indicators tackling many different issues, as gender, knowledge, race and age gaps. The varying quality and availability of these sources of information make them hardly fruitful for comparative long-run studies, as the one we aim to perform here.

In recent years, economic historical research has tried to extend the work on historical national accounts to the field of the historical human development.

For the Latin American countries the first important contribution was made by Astorga & FitzGerald (1998) and the Oxford Latin America Data Base (OXLAD). First published as an appendix to Thorp (1998) it was later upgraded in Astorga, Bergès & FitzGerald (2004). The index combines GDP, literacy rates and life expectancy into a so-called Historical Living Standard Index for 6 Latin American countries during the 20th Century, and for 13 Latin American countries since the 1950s. The Index was also expressed in relation to the achievements of the USA. Their index was as in (1).

$$(1) \qquad Hi = \frac{1}{3}\left[\left(\frac{(\log yi - \log 100)}{\log 40{,}000 - \log 100}\right) + \left(\frac{lifei - 25}{85 - 25}\right) + \left(\frac{liti - 0}{100 - 0}\right)\right]$$

where y_i is per capita income in 1970 international dollars of country (i), $life_i$ is life expectancy at birth in country (i), and lit_i is the literacy rate in country (i).

Their two main conclusions were:

1. "…the main sub-period of development in Latin America during the twentieth century occurred between 1940 and 1980 when there was an unprecedented surge in economic growth and social improvement. That this coincided with the so-called 'import substitution' process is not surprising insofar as public investment and state-led basic education and health initiatives were associated with the rise in growth rates and the improvement in health, despite the inefficiencies and distortions generated by forced industrialisation…It seems clear that this period saw the greatest structural change in the Latin American economy, and was marked by sustained and relatively stable growth and social improvement. In stark contrast, the periods from 1900 to 1940 and from 1980 to 2000 saw lower economic growth and far more instability." (Astorga, Bergès & FitsGerald, 2004:24).
2. "…social convergence occurred in the absence of economic convergence…these patterns of growth and convergence raise some interesting questions regarding the relationship between economic

> growth and social progress, and suggest that the more simplistic endogenous growth models may need some rethinking." (Astorga, Bergès & FitsGerald, 2004:24).

Both conclusions are extremely important. The second one reinforces the idea that welfare cannot be approached by per capita GDP alone and that the evolution of the length and quality of life may have other determinants as well. The first one has great implications for the discussion of the Latin American performance in relation to policy making. While the dominant approach during the 1970s-1990s pointed towards import-substituting policies and state-led growth as the origin of Latin American backwardness, these results seem to show a different picture, in which the late 20th Century, dominated by structural reforms and liberalization, appears as decades of relative stagnation.

Camou & Maubrigades (2005) improved Astorga & FitzGerald (1998) as they not only considered literacy rates in their approach to education, but also took into consideration school enrolment, following Bértola & Bertoni (1998). This attempt was limited to the case of Uruguay. It also incorporated updated per capita GDP and life-expectancy estimates, as well as some changes in the parameters according to earlier versions of Prados (2007), which we will consider next.

A recent and important contribution to Latin American historical human development was performed by Leandro Prados, even if not yet published (Prados 2007). He constructed a database for 1870-2000, including the available Latin American countries and the OECD countries. He mainly relies on the OXLAD data base for Latin America (meaning, among other things, that education is solely approached through literacy rates) and on his own database and own purchasing-parity estimates for per capita GDP figures. Besides advancing a very interesting discussion of the state of the art, Prados innovates in several technical aspects of the construction of the historical human development index:

- a convex achievement function is used to estimate the non-income variables, implying that an increase in the standard of living of a country at a higher level implies a greater achievement than had it been the case if it took place at a lower level;
- the maximum and minimum values of life-expectancy are adjusted to more realistic levels: 80 and 20 years, respectively;
- a geometric average is used: "a geometric average of the index's components has the advantage of reducing their substitutability significantly, somehow avoiding that an improvement in one attribute may offset a worsening in another, with a resulting neutral aggregate effect on the HDI" (Prados 2007).
- It is remarkable that in spite of using a convex achievement function for the non-income variables, the contrary transformation is done in relation to income, so that a marginal welfare unit demands increasing growth in per capita income.

Prados' index can be summarized as in equation (2).

(2) $$Hi = \sqrt[3]{\left[\left(\frac{(\log yi - \log 100)}{\log 40{,}000 - \log 100}\right) * \left(\frac{\log(80-20) - \log(80 - lifei)}{\log(80-20)}\right) * \left(\frac{\log 100 - \log liti}{\log 100}\right)\right]}$$

Prados' conclusions are to a high extent similar to those obtained by Astorga, Bergès & FitzGerald:

- Income inequality (per capita GDP) between the OECD countries and Latin America increased particularly in the last decades of the 20th Century (within country inequality is not considered).
- The gap in human development between Latin America and the OECD countries shrank especially in the central decades of the 20th Century. Even if it continued to decrease afterwards, it did at a much slower rate and the distance still showed to be huge. (Prados 2007).

In other words, Leandro Prados' results reinforce those obtained by Astorga, Bergés and FitzGerald, as well as the comments already made in relation to them.

3. The construction of an Inequality-Adjusted Historical Human Development Index (IAHHDI)

In this section we will explain how we construct our index and why. We will rely on the three basic components of the Human Development Index (life expectancy, education and income), but we will introduce changes in the variables and in the weights of the components. We will use a geometric average of the components following Prados (2007) and we will introduce an inequality adjustment.

Life expectancy

With respect to life expectancy we will follow Prados (2007) in the sense that the maximum and minimum values will be 80 and 20, respectively, and in the sense that we will use a convex achievement function. The basic idea is that "an increase in the standard of living of a country at a higher level implies a greater achievement than had it been the case if it took place at a lower level".

Education

The education component of the HDI is based on literacy rates (2/3) and school enrolment (1/3). This was also the criteria followed by Camou & Maubrigades (2005).

As different from Prados, we will not use a convex achievement function as in the case of life expectancy. As Prados worked with literacy rates alone, his aim was to counteract the fact that differences between countries tended to disappear as the 100% ceiling was approached. As different from life expectancy, however, in the case of education it is difficult to argue that marginal achievements are increasing at higher levels of coverage. Almost the contrary: once almost all the population is literate the existing infrastructure should make it easier to educate new generations. Here we are facing a different problem: the variable itself is not an adequate proxy for the level of education of the population. Once almost all the population is literate, it seems inconvenient that literacy rates answer for two thirds of the education basket (if not 100% as in Prados 2007). Our strategy will be to raise the ceiling itself, through a different education basket, in which secondary and tertiary education weights are higher. We will compare the results obtained using different baskets. It will be argued that different baskets may be used to understand different periods and for the purpose of comparison at different levels of development.

The baskets to be used are as in Table 1.

Table 1. The Education Index: different baskets.

	Model 1	Model 2	Model 3
	%	%	%
Literacy	**0.67**	**0.00**	**0.00**
Enrolment	**0.33**	**1.00**	**1.00**
Coefficients for different education levels			
Primary	1.0	1.0	0.0
Secondary	1.4	1.4	1.0
Tertiary	2.0	2.0	1.4
TOT	4.4	4.4	2.4

Weights: Model 1, UN (2006); others, own assumptions.
Coefficients: Model 1, Goldin (1998);
others, own assumptions mantaining the proportion between levels.

Per capita GDP.

The UN's Human Development Index transforms per capita GDP into logarithms. As stated in the Human Development report 2006:

"In the HDI income serves as a surrogate for all the dimensions of human development not reflected in a long and healthy life and in knowledge. Income is adjusted because achieving a respectable level of human development does not require unlimited income." (UN, 2006: 394).

The concept "respectable level of human development" looks somewhat fuzzy and gives the idea of proximity with the approach that focuses on the satisfaction of basic needs. However, it seems to be a difficult task to define a ceiling for what a respectable level is and, even more, for what human development is. However, the logarithm of the per capita GDP differs from the basic-needs approach, as the index continues to increase with rising income, even if decreasing marginally.

Nevertheless, the transformation into logarithms is somewhat arbitrary and has important implicantions. As was mentioned, Astorga & FitzGerald didn't make this transformation in their 1998 paper, but they did so in the Astorga, Bergés & FitzGerald (2004). The argument is not convincing:

"The use of the marginal utility notion to scale per capita income cannot be anything other than arbitrary, although no more so than not scaling per capita income at all." Astorga, Bergès & FitzGerald (2004:11).

However, a clearly controversial result is implied: the differences in the levels of per capita income between countries are reduced. Besides, and following Prados' point of view with reference to life expectancy, the paradox is that increasing human development should demand an increasing marginal effort, in terms of per capita GDP. Accordingly, it should lead us to a new transformation of the series using a convex achievement function in order to capture this increasing marginal effort.

One argument not always present in the literature, but often mentioned by people working in the field, is that while per capita GDP may always continue to increase, life expectancy and education do not: they have a maximum level to be achieved. The counter argument is: this is the reason why the convex achievement function is used in the case of life expectancy, and this is the reason why it is necessary to change the education basket. As it will be shown, the ceiling of the more ambitious education basket is far from being reached by any country. Per capita GDP has a ceiling too: 40.000 1990 PPP-dollars.

In short: we decide not to transform the per capita GDP series into logarithms, but to work with the original series.

A geometric average

Following Prados (2007) we will also estimate a geometric average. The idea is that there is no perfect substitution between the different components of the index. The geometric average favours an even movement of all the components.

Our index is shown in equation (3).

$$Hi = \sqrt[3]{\left[\left(\frac{(yi-100)}{40{,}000-100}\right)*\left(\frac{\log(80-20)-\log(80-lifei)}{\log(80-20)}\right)*\left(\frac{edui-0}{100-0}\right)\right]} \quad (3)$$

Equity

Early in the history of the HDI some attempts were made to take inequality into consideration. The basic idea could be expressed in a marginalist way: if income was unequally distributed, the above-average income of the rich should yield less welfare than the welfare loss of a similar below-average income of the poor. Other arguments can also be used in order to consider that at a certain level of total GDP, welfare is higher if equally distributed, than otherwise. Values, the existence of positive externalities and the absence of negative externalities may be some of them.

The 1993 Human Development Report made an important attempt to include distributional, inter-individual inequalities into the index. y_i, as in equation (3), was transformed into y_i*(1-G), where G is for the Gini-coefficient. The underlying idea was that life expectancy and education were naturally much less unequally distributed than income (HDR 1993: 101).

Hicks made a strong case for the existence of significant inter-individual inequality also in life expectancy and education: "…years of schooling does vary – from 0 to 20… Life spans actually lived do indeed vary, from less than one year to over 100 years" (Hicks, 1997: 1287). Accordingly, he made estimates of what he labelled the Inequality-Adjusted Human Development Index for some third world countries with data from 1995, based on the UN HDI.[1] However, as different from UNDP (1993), he multiplied the whole numerator of each component of the index by 1 minus the specific Gini-coefficient. His results showed that the Gini-coefficients for education and age were above 30% in the clear majority of the cases, and even higher than income inequality in some countries (Bangladesh, Sri Lanka) (Hicks 1997, table 1, p. 1290).

We will adjust the HHDI by a geometric average of the Gini-coefficients for income, life expectancy and education, as in equation (4),

$$IAHi = Hi*(1-G) \quad (4)$$

where IAH_i is for the Inequality-Adjusted Historical Human Development Index, and G is for the mentioned geometric average of the three Gini-coefficients. The same results are obtained if the whole numerator of each component of the Gini is multiplied by 1-G.

In the case of life-expectancy, similar Gini estimates were performed by Shkolnikov, V. M., E. E. Andreev & A. Z. Begun (2003).

The Gini-coefficients for income will be taken from other sources, while those for the distribution of age and education are our own estimates. In the case of

[1] The data on education was from 1985, taken from Ahuja, V. & Filmer, D (1995) and was classed by "no education", "some primary education", "completed primary education", "some secondary education", "completed secondary education" and "some higher education".

education we construct a series of the stock of knowledge of different sectors of the population above 20 years, classified in 5 groups: illiterates, people who went to primary school, people who went to secondary school, people who studied at the university and professionals. The coefficients applied to the population of these different levels of education were: 1.0, 2.0, 2.8, 4.0, and 5.4, respectively. These coefficients follow the same proportions as in Table 1, but take illiterates as the basic unit.

The total EHHDI is as in equation (5).

(5) $$EHi = \sqrt[3]{\left[\left(\frac{(yi-100)}{40{,}000-100}\right)*\left(\frac{\log(80-20)-\log(80-lifei)}{\log(80-20)}\right)*\left(\frac{liti-0}{100-0}\right)\right]}*\left(\sqrt[3]{(1-Gyi)*(1-Glifei)*(1-Gedui)}\right)$$

4. The data

Per capita GDP.

Per capita GDP figures had to be expressed in purchasing power parity, in order to make them comparable. The sources are Maddison (2003) and Bértola & Porcile (2000).

Life expectancy and life tables

The data on life expectancy is taken from OXLAD and Prados de la Escosura (2007). In order to estimate the distribution of life, life tables of Uruguay (Migliónico 2001) and the USA (National Vital Statistics Reports 2006) were used.

Education and distribution of education

The data on school enrolment is taken from Bértola & Bertoni (1999) and updated with data from UNESCO.

The data on literacy rates is taken from the OXLAD (Latin America and the USA, and from Prados de la Escosura (2007) (France, Germany and UK).

On the basis of this data base the distribution of education was estimated.

Income inequality

The Gini-coefficient of Uruguay was taken from Bértola (2005) while that of the USA is based on Lindert (2000) and the UNU/WIDER *World Income Inequality Database V 2.0b* (2007).

5. Interpreting the results

In this section we will present the relative performance of the three Latin American countries in relation to the four core countries in terms of the HHDI, trying to stylize the main trends and to give a preliminary interpretation. We will also discuss the Uruguay-USA comparison with respect to the *IAHHDI*.

Even if the paper is primarily focused on the construction of the index and the evaluation of the results, thus being of a predominantly empirical character, we will shortly present a simplified theoretical framework which will help us to present and primarily discuss the outcome.

A theoretical framework

Bértola and Porcile (2006) and Verspagen (1993) are focused on the discussion of international differences in per capita GDP levels and growth. The former is an attempt to characterize different convergence and divergence regimes between Argentina, Brazil, Uruguay and the four core countries considered in the present chapter. These regimes are the result of the interaction between supply and demand forces, as well as different policy measures, which finally affect the income

elasticity of demand for exports and imports and the degree of openness of the different economies.

Here, we will make an attempt to expand the application of this theoretical framework to encompass the other components of the *HHDI*.

If we assume that per capita growth finally depends on technical change and innovation, we can go on and identify the main sources for technical change as: (i) those arising from the science and technology efforts of a country proxied by the production of codified knowledge and expressed by the investment in R&D; (ii) those arising from the productive structure and its learning of tacit knowledge by doing and by the technical change induced by demand, proxied both by means of the productive structure in relation to demand growth and technical change; (iii) technological spill-overs from advanced to laggard countries, which in turn rely on the size of the gap and the domestic capabilities of the laggard countries (Verspagen 1993).

These forces may be present at the GDP level, but also with reference to life expectancy and education. With respect to life expectancy: (i) research and development in the sciences of life and in health and nutrition technologies, play a decisive role in the eradication of some mortality sources and the production of a healthy and long-lasting life; (ii) the existence of private or public enterprises and institutions linked to the "production" of health, proxied by the share of these branches in GDP and by health and social expenditures in total expenditures, may tell us about the learning by doing capacity of the population to improve life expectancy; (iii) the existence of a technological gap may be a source for improvements in life expectancy, given the fact that there exist either international or domestic institutions and organizations willing and being able to make catching up to take place.

Education can be approached in a similar way. Its achievements depend on the R&D activities related to educational issues, on the learning by doing by the existent educational institutions, and the international transfers of knowledge and education technologies developed elsewhere. Spill-overs depend, in turn, on domestic capabilities. As different from life expectancy, which is a proxy for an output (years of life expected to live by the population), in the case of education our data is not able to catch any qualitative result, neither other forms of education than the formal primary, secondary and tertiary. Learning in different productive activities and learning in technical schools are out of reach. Likewise, the efficiency of the system is not considered. By that we mean the quality of the education and the time necessary to go through the system.

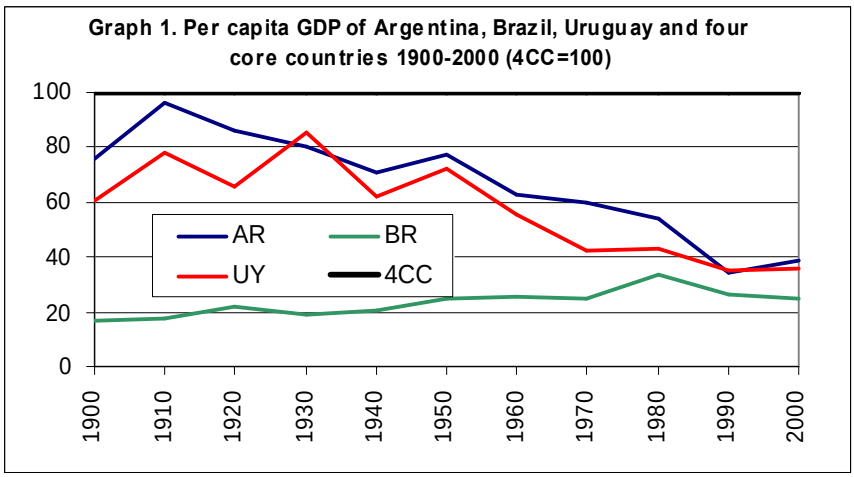
Inequality has been attracting increasing attention from scholars, both at the theoretical and the historical level. While different attempts have been made to connect income inequality and growth in Latin America from an institutionalist point of view (Acemouglu, Johnson & Robinson 2001 and 2006 relying more on wealth inequality and political power, and Engerman & Sokoloff 1997 and 2001, relying more on resource endowments) and from a neo-classical point of view (Jeffrey Williamson 1997, 1998, 1999, for example), not many connections have been established between inequality and technical change. Bértola (2005) was an attempt to empirically approach income inequality in Uruguay and other Southern settler societies, but the connection to the discussion on convergence and divergence regimes was still very timid. In Willebald (2007), an attempt is made to connect recent theoretical links between growth, income distribution and innovation with empirical research, with promising results. In a very broad sense, what may be

important to elucidate is to what extent inequality trends are the result of pure market mechanisms or of different kinds of institutional arrangements.

Per capita GDP[2]

The per capita GDP index is shown in Appendix Table 1 (AP1). The general trends of relative per capita GDP growth reproduced in Graph 1 are very well-known. An interpretation may be found in Bértola & Porcile (2006).[3] The basic stylized facts are as follows:

- Argentina and Uruguay started the 20th Century at relatively high levels of per capita income. Around 1910-1930, the trend changed and a long-lasting divergence trend took place and deepened after the 1960s.
- Brazil, on the contrary, started at very low levels but showed recurrent catching-up cycles until 1980, when a new divergent trend started. In spite of the catching-up trend 1910-1980, Brazil remained a long distance from the core countries, but almost caught up with its Latin American neighbours.



Argentina and Uruguay achieved high relative growth in 1870-1913, associated with a dynamic integration into the golden era of classic liberalism on the basis of inter-industry specialization in meat and temperate agricultural goods facing high income elasticity of demand. Competitive advantages were classical, related to the relative abundance of factors of production. Argentina not only converged but she also forged ahead in relation to the European countries, following a path which, in its early phases, resembled (with less intensity) the successful experience of the United States. Uruguay achieved a short period of convergence on the basis of import substitution after World War II. However, this regime of convergence was inevitably short-lived as the international economy recovered and import-substitution imposed increasingly higher costs. A change in the pattern of trade was therefore necessary to sustain convergence.

Brazil started a process of moderate convergence during a time during which international trade collapsed because of major international crises (the Great Depression, World Wars I and II). Modest convergence was achieved in the 1930s by means of import-substituting industrialization. Brazil continued to converge moderately by means of a structural convergence with the leaders, based on a process of catching-

[2] This section is strongly based on Bértola & Porcile (2006).

[3] For other recent contributions on convergence and divergence between Latin America and the rest and within Latin America, see Edwards (2007) and Sanz (2007) in *Revista de Historia Económica – Journal of Iberian and Latin American Economic History,*1/2007.

up in new metal-mechanical and chemical industries implanted in the late 1950s. Structural transformation in the «developmentalist» period changed the growth trends of Brazil and gave rise to incremental, cumulative industrial learning. Although the domestic market remained as the principal outlet for industrial production, a slow but continuous process of export diversification occurred. By then, international trade grew at very high rates (1960-1973); later on (1973-78) international capital flows expanded, compensating for the loss of dynamism of international trade.

Argentina and Uruguay were not able to move from the first type of convergence regime to the second. Brazil had a wider gap to take advantage of, and adopted policies for structural change in a much more vigorous way than Argentina and Uruguay and this is part of the explanation for the relative success of Brazil until 1980. Argentina and Uruguay suffered significantly from demand-side variables, related to changes in patterns of demand and to institutional arrangements in the international economy which brought an end to the classical liberal era of British hegemony, redefining the rules of the game in international trade. Supply-side variables were related to path-dependency and the failure of Argentina and Uruguay, and to a lesser extent Brazil, to build up an institutional framework conductive to rapid structural change and rapidly growing exports of manufactured goods. The experience of the decades following the debt crisis suggest that, in all cases, policies aimed at structural change in the region were too weak to secure long run catching-up.

Due to data availability, from now on we will only report inequality results for Uruguay and the USA alone (Table 2). **Income inequality** in Uruguay and USA shows a "U"-curve (note: not an inverse "U"-curve as in Kuznets; see Bértola 2005), with bottom values in 1970. The increase in inequality does not seem to reach the figures of the early 20th Century. The reduction in inequality 1910-1970 was probably more important in the USA than in Uruguay. The increase in inequality had in Uruguay a decisive turning point in relation to the military dictatorship which increased inequality to levels that later democratic regimes could not revert.

Table 2. Gini-coefficients of the components of the HHDI, Uruguay and the USA, 1910-2000

	Income		Life expectancy		Education		Total Geometric av.*	
	Uruguay	USA	Uruguay	USA	Uruguay	USA	Uruguay	USA
1910	0.472	0.490	0.305	0.291	0.154	0.055	0.323	0.301
1920	0.464	0.440	0.321	0.244	0.142	0.067	0.322	0.266
1930	0.465	0.390	0.287	0.199	0.126	0.096	0.307	0.239
1940	0.455	0.400	0.252	0.159	0.107	0.124	0.286	0.238
1950	0.438	0.360	0.187	0.125	0.096	0.142	0.255	0.217
1960	0.380	0.349	0.169	0.111	0.109	0.150	0.229	0.210
1970	0.363	0.341	0.167	0.108	0.118	0.166	0.224	0.211
1980	0.406	0.352	0.147	0.094	0.127	0.183	0.238	0.217
1990	0.416	0.378	0.125	0.089	0.147	0.197	0.242	0.231
2000	0.433	0.405	0.118	0.082	0.166	0.194	0.253	0.239

* The geometric average of the Gini is estimated as in equation (5): $GAG_i = 1- ((1-Gy_i)*(1-Glife_i)*(1-Gedu_i))^{(1/3)}$.

The impact of inequality on per capita GDP growth is presented in Table 3. The USA received a 20% improvement in the GDP levels due to the reduction of inequality between 1910 and 1930, and a further 10% increase up to 1970. Afterwards, half of these gains were lost as inequality increased. In the case of Uruguay the highest gain in inequality reduction was obtained in 1970 (20%) and again half of these gains had been lost by 2000.

The comparative position of Uruguay in relation to the USA is somewhat worse in the case of the *IAHGDP* than in the case of the *HGDP*, due to in average higher inequality figures.

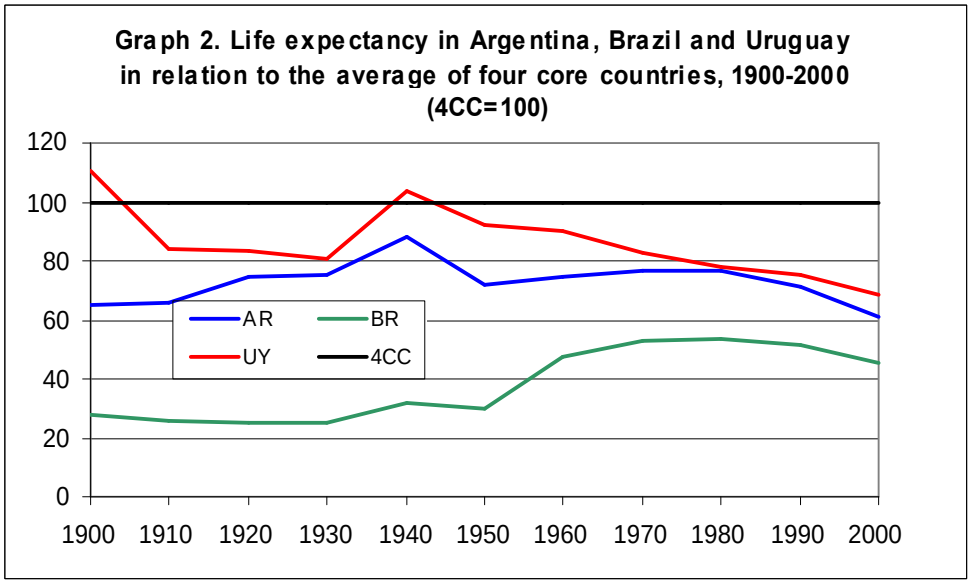
Table 3. Per capita GDP Indices for Uruguay and the USA, 1910-2000 (1910=100)

	HGDP		*IAHGDP*		*IAHGDP/HGDP*		UY/USA	
	UY	USA	UY	USA	UY	USA	*HGDP*	*IAHGDP*
1910	100	100	100	100	100	100	62	65
1920	85	112	86	123	101	110	47	45
1930	138	126	140	150	101	120	69	60
1940	117	142	121	167	103	118	52	47
1950	150	195	160	244	107	125	48	42
1960	160	231	188	295	117	128	43	41
1970	167	307	202	397	121	129	34	33
1980	213	380	240	483	113	127	35	32
1990	210	475	232	579	111	122	28	26
2000	256	576	275	672	107	117	28	26

Life expectancy

Between 1900 and 2000 life expectancy in the core countries increased from 46 to 78 years, on average. While Argentina and Uruguay had slightly lower values at the beginning of the 20th Century, Brazil showed remarkably lower figures: 29. The life expectancy index ($HLife_i$) is in AT2.

As shown in Graph 2, Brazil caught significantly up until the 1970s, specially during the 1950s and 60s. Argentina and Uruguay showed some fluctuations around a similar relative level. After the 1980s, however, the three Latin American countries started a clear divergent trend. By 2000, life expectancy in Argentina, Brazil and Uruguay was 73, 68 and 75, respectively. The convex achievement function makes, however, the differences with core countries appear to be even larger: Brazil, for example, shows values 45% of those of the core countries.



It seems that relative life expectancy and per capita GDP performance show rather similar trends. Life expectancy was originally high in land and resource abundant Argentina and Uruguay. A large amount of immigrants took with them different kinds of knowledge which were combined with easy and relatively cheap access to basic

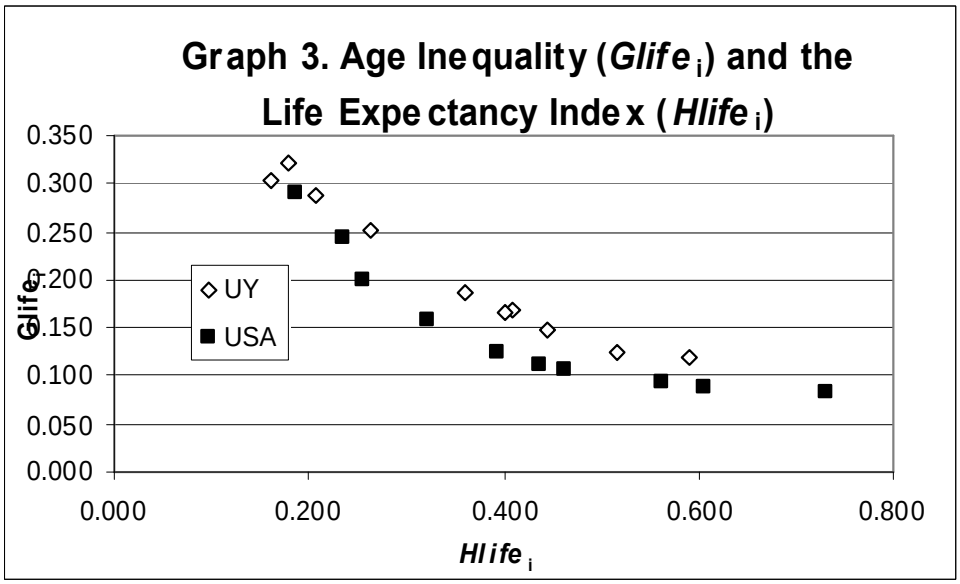
foodstuffs. Even if inequality levels were higher than in Europe and the USA, real wages were relatively high in relation to those of the core countries (between 60 and 70%) and the most important cost was that of housing, while foodstuffs were much cheaper (Bértola, Camou & Porcile 1999). Thus, in terms of nutrition the living standards were similar.

The strong rise in life expectancy took place in the 1940-1980 in Argentina, in 1950-1990 in Brazil and 1940-1960 in the more homogeneous Uruguay. In all cases, the domestic efforts to develop social policies made it possible to learn how to handle risks and to make use of innovations introduced in the core countries, such as the use of antibiotics. The introduction of these innovations and the development of health systems allowed the Southern countries to reduce mortality rates, specially infant mortality, and to conditionally converge with core countries (Brazil) or maintain relative positions (Argentina and Uruguay). However, in the long run, and as the most important factor explaining the increase in life expectancy became the extension of the life of the elderly, the Latin American countries diverged due to their technological and systemic backwardness. Besides the changing demographic problems to be faced, political changes and economic performance weakened the welfare state. The results were noticed from the 1980s and onwards (Argentina and Uruguay) and from the 1990s (Brazil). In Becker, et. al.'s words:

> "Finally, mortality data by cause of death are disaggregated to understand the determinants of the cross-country convergence in life expectancy observed between 1965 and 1995. Changes in mortality due to infectious, respiratory and digestive diseases, congenital and perinatal conditions, and "ill-defined" conditions are the most important factors producing the convergence in life expectancy, whereas changes in mortality due to nervous system, senses organs, heart and circulatory diseases worked against convergence. This evidence suggests that the large changes in mortality observed in the developing world were due to the absorption of previously available technology and knowledge, while developed countries took advantage of recent advances on the frontier of medical technology." (Becker: 2003, p.27).

It looks like a plausible explanation of the divergent trend we find in the late 20th Century. It has to be stressed that our convex achievement function shows a divergent trend rather than stagnation of the Latin American countries' *HLife*.

Inequality in life expectancy follows a similar declining trend with time and with increasing life expectancy, as shown in Graph 3. For every period of time, age inequality was lower in the USA, and for every period of time, the life expectancy index ($HLife_i$) of the USA was higher than in Uruguay. That means that the USA shows a structural lower inequality than Uruguay, i.e., for a similar life expectancy, the inequality levels of the USA are lower. In other words, when adjusted for inequality, the gap in life expectancy between USA and Uruguay increases.



The USA showed a drastic fall in age-inequality levels in 1910-1950; later on the index diminished rather slowly. By contrast, the life expectancy index accelerated after the 1950s, without any spectacular reduction of inequality.

In the case of Uruguay the pattern is somewhat different, as inequality and the life expectancy index moved more smoothly, excepting for a sharp decline of *GLife* and a sharp increase in *HLife* between 1940 and 1950.

It is possible to link the phase of drastic reduction of age inequality in the USA and Uruguay to the phase in which life expectancy increased through the control of causes mortality affecting younger population, while the control of those diseases affecting mainly the elderly didn't affect inequality so much.

The contribution of the reduction in inequality to the improvement of the *HLife* was considerably higher in Uruguay than in the USA, as shown in Table 4. Especially important was the weight of the reduction of inequality in Uruguay in 1930-1950. However, the reduction of inequality was at least as important in the USA as in Uruguay. The difference depends on the more important increase of life expectancy in the USA than in Uruguay.

Table 4. Life expectancy Indices for Uruguay and the USA, 1910-2000 (1910=100)

	HLife		*IALife*		*IAHLife/HLife*		UY/USA	
	UY	USA	UY	USA	UY	USA	*Hlife*	*IAHLife*
1910	100	100	100	100	100	100	86	84
1920	102	121	110	134	108	111	77	69
1930	114	153	133	155	116	102	81	72
1940	132	167	177	206	134	123	82	72
1950	167	210	264	261	158	124	92	85
1960	230	256	305	295	133	115	94	87
1970	260	285	300	313	115	110	87	81
1980	255	302	341	386	134	128	79	75
1990	283	366	407	419	143	114	85	82
2000	329	395	467	509	142	129	81	77

Education

We will report three different estimates using three different models of the education index as presented earlier. The results are shown in Appendix Table 3. In Graphs 4a-d

we show the relative performance according to each model and Latin American country (4a-c), as well as an average of the three (4d).

Model 1 (Graph 4a) uses the United Nations' weights for literacy rates and school enrolment. According to it, Argentina and Uruguay reached absolute convergence with the core countries in 1990. A strong process of convergence took place between 1910 and 1950, when the 90% level was already attained. Brazil, by contrast, had a much lower point of departure, and went through a strong catching-up process since the 1950s. By 2000 Brazil still is 20% below the core countries. This story is almost unbelievable: it's hard to believe that Argentina and Uruguay have similar levels of education to the core countries without straining credulity. It's also hard to believe that Brazil is only 20% below the core countries. However, the result is not surprising when literacy rates answers for 2/3 of total education.

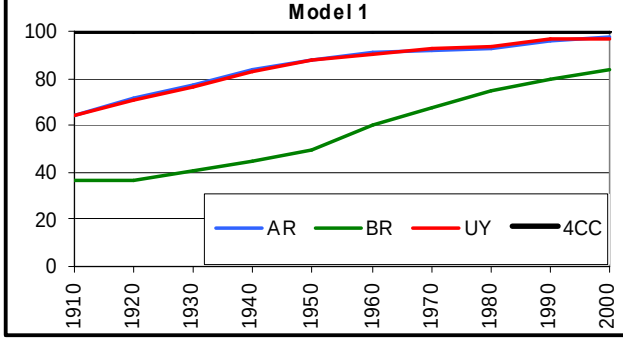
Model 2 (Graph 4b) shows a somewhat different and more credible picture. As literacy rates are neglected, the index is only based on school enrolment at different levels. At first sight, it seems an error to neglect illiteracy. However, the index tries to take into account everything that adds to education and the maximum level is that of the total population with tertiary education. In fact, illiteracy is not neglected: it just appears as people who don't add to the index. The first important difference with Model 1 is that absolute convergence vanishes in the case of Brazil and even Uruguay. Brazil ceases to narrow the gap in the 1980s at a very low level. The spurt of the 1990s in Argentina and Uruguay vanishes; we get instead an important increase in the 1980s, due mainly to the increased population with tertiary education, which to a high extent can be related to political democratization.

Model 3 (Graph 4c) shows a quite different picture. When the index is constructed on the basis of secondary and tertiary education alone, Argentina and Uruguay remain at an important distance from the core countries, even if the trend is positive since the 1940s. Brazil, on the contrary, shows a cyclical movement, with convergence up to the 1950s, divergence afterwards, and recovery in the 1990s, without reaching the levels of 1950. The highly unequal and elitist Brazilian society remains 70% below the core countries.

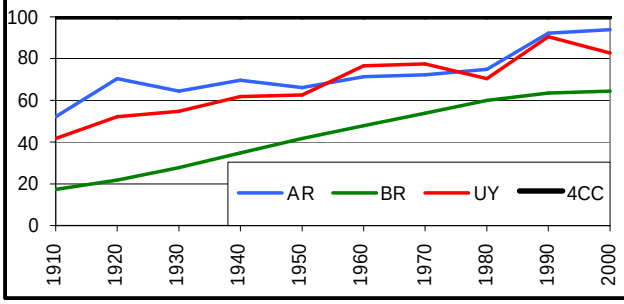
Which of these indices is the good one? Which of them reflects reality in a better way? Ideally, we would like to construct a linked index, which could allow for structural change as average levels of education increase. Even if it could be possible to construct such kind of index for every single country, it's difficult to construct one sole index for comparative purposes, as countries with different levels of development should have, at the same time, different internal structures.

The UN index may adequately reflect education attainment at early stages of development. However, in the second half of the century, as literacy rates approach the 100% level, this education basket seems badly suited to really reflect differences in human development. Besides, there is no need to combine literacy and school enrolment as if they were different things. If adequately used, school enrolment measures the level of education of a society. Model 3 looks especially adequate for the last decades of the 20th Century, as it helps to understand how wide differences are with respect to higher education.

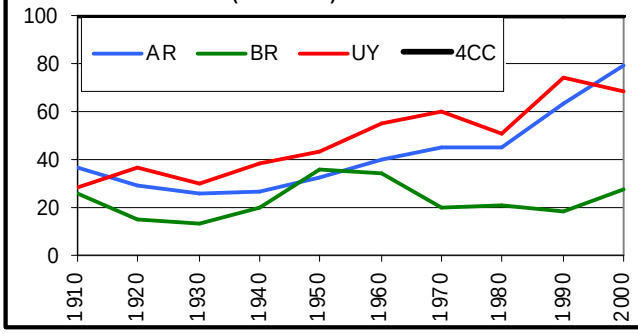
Graph 4a. Education achievements of the three Latin American Countries relative to the average of the four core countries, 1910-2000 (4CC=100). Model 1



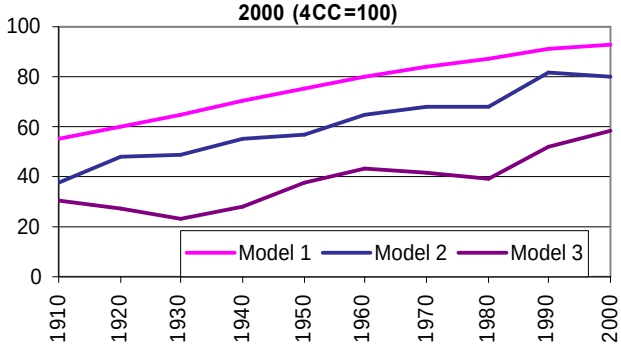
Graph 4b. Education achievements of the three Latin American Countries relative to the average of the four core countries, 1910-2000 (4CC=100). Model 2.



Graph 4c. Education achievements of the three Latin American Countries relative to the average of the four core countries, 1910-2000 (4CC=100). Model 3.



Graph 4d. Education achievements of the average of the three Latin American Countries relative to that of the four core countries, 1910-2000 (4CC=100)



We think Model 2 is the best one to catch the education in the long-run and we will use to construct our *HHDI*. The performance of the Latin American countries at the end of the 20th Century will probably be over-estimated.

Inequality in the access to education increased steadily in the USA. However, the original inequality levels were extremely low, given the fact that illiteracy was almost non-existent but secondary and higher educational were not yet generalized. The final inequality levels were still lower than those of the other components of the *HDI* and reflect a permanent increase of the access of new groups to higher education. In Uruguay, inequality in the access to education went through similar trends as income inequality: a decreasing trend until 1950, and increasing inequality afterwards to similar levels to those of the starting point. While the egalitarian trend may be interpreted as the result of the strong reduction of illiteracy and the generalization of primary school enrolment, the second trend may be seen as the result of the expansion of secondary and tertiary education, so long limited to some groups of the population. This latter trend is similar to the trend of the USA during the whole century. As shown in Table 5, the impact of inequality trends on the *IAHEdu* is not as important in the other indices: the result is a relatively better performance of Uruguay. Nevertheless, as it was stated before, we have many doubts about this almost absolute convergence.

Table 5. Education Indices for Uruguay and the USA, 1910-2000 (1910=100)

	HEdu		*IAHEdu*		*IAHEdu/Hedu*		UY/USA	
	UY	USA	UY	USA	UY	USA	*HEdu*	*IAHEdu*
1910	100.0	100.0	100.0	100.0	100	100	37	33
1920	120.3	112.5	122.1	111.1	101	99	40	37
1930	142.8	136.8	147.6	130.9	103	96	39	38
1940	177.4	152.8	187.3	141.7	106	93	43	44
1950	213.8	167.7	228.6	152.2	107	91	48	50
1960	289.0	181.1	304.5	162.9	105	90	60	62
1970	345.0	223.8	359.7	197.4	104	88	57	61
1980	335.3	238.8	346.2	206.5	103	86	52	56
1990	438.0	204.4	441.8	173.8	101	85	80	85
2000	489.2	202.2	482.8	172.5	99	85	90	93

The Historical Human Development Index (HHDI)

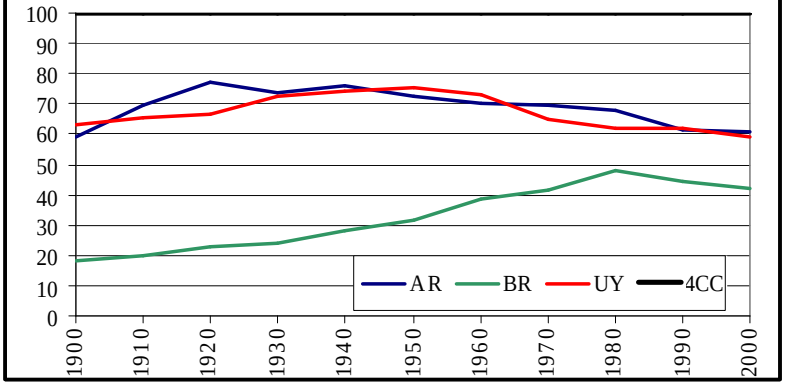
Graph 5 shows the performance of Argentina, Brazil and Uruguay in terms of Human Development and in relation to the four core countries. The index is constructed using Model 2 for education and a geometric average of the components.

Argentina reproduces a well-known story: her performance was very successful in the first decades of the 20th Century, converging with core countries; afterwards she experienced a long-run divergence. The steep fall of per capita GDP was partly counterbalanced by improvements in life expectancy (education remaining stable). Divergence advanced slightly until the 1980s, when the well-known “lost decade” left important scars. The relative improvement of education couldn’t match the negative trend in GDP and life expectancy.

The Uruguayan case is very similar to the Argentine, but there exist some nuances: starting from a lower level, its convergence with core countries advanced up to the 1950s, due to an acceptable GDP performance and improved life expectancy and education figures. The divergent trend started with a steep fall in the 1960s, when GDP stagnated and was followed by relatively falling life expectancy and stagnating education figures. Since the 1980s only education could resist the downwards trend.

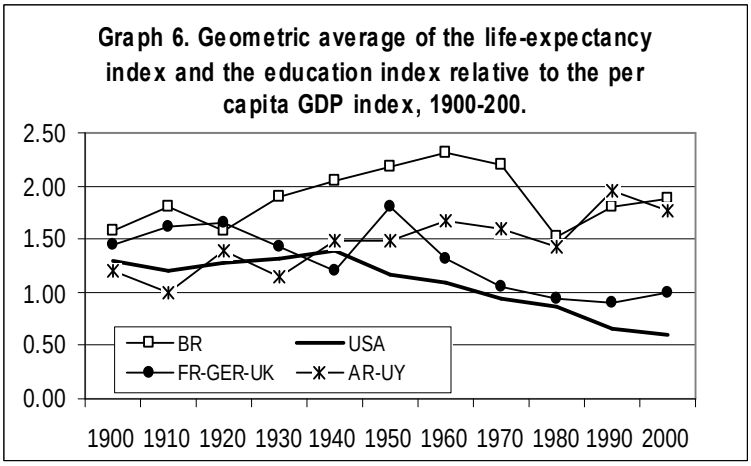
Brazil, on the contrary, started at very low levels catching steadily up, until 1980. All variables contributed to that movement: education did it steadily, per capita GDP with spurts in the 1940s and 1870s, and life expectancy especially in the 1950s. The lost decade not only interrupted, but also changed the trend. Brazil not only started to diverge from core countries, but it also lost ground in relation to its Southern neighbours. Only in education was its performance acceptable.

Graph 5. Historical Human Development Index: Argentina, Brazil and Uruguay relative to four core countries, 1900-2000 (4CC=100)



If we think in terms of an input-output relation, in terms of how much life expectancy and education were produced with help of the per capita GDP, i.e., what kind of lives we produce with the income we have at our disposal, the Latin American countries show an apparently better relation: best is Brazil and worst are the USA (see Graph 6). An alternative way to think about it is giving technology transfers an important role: technical change and GDP growth in the core countries are not able to dramatically increase human development, but the transfer of knowledge, technology and innovation to laggard countries have a higher impact there than what was possible to achieve on the basis of domestic GDP growth. As it was earlier sustained, the capacity of laggard countries to make an intelligent and effective use of the technological gap directly depends on the domestic capabilities and efforts to develop educational and wealth systems.

Graph 6. Geometric average of the life-expectancy index and the education index relative to the per capita GDP index, 1900-200.



Finally, we have to mention that our results diverge from those obtained by Astorga & FitzGerald (1998), Astorga, Bergès & FitzGerald (2004), and Prados (2007). What we obtain is a divergent trend in human development of Southern Cone countries, which started early in the 20th Century in Argentina, in the middle of the century in Uruguay and in the 1980s in Brazil. What our colleagues found was a process of convergence in the central decades of the century and a relatively stable situation afterwards.

The differences may partly arise from the different group of countries considered. It's well known that Argentina and Uruguay were among the most successful Latin American countries during the first globalisation. The Brazilian timing (not the growth rates) is more representative for the average of the Latin American countries. However, the way in which our index is constructed surely explains a great part of the differences found.

The Inequality-Adjusted Historical Human Development Index (*IAHHDI*) of Uruguay and the USA

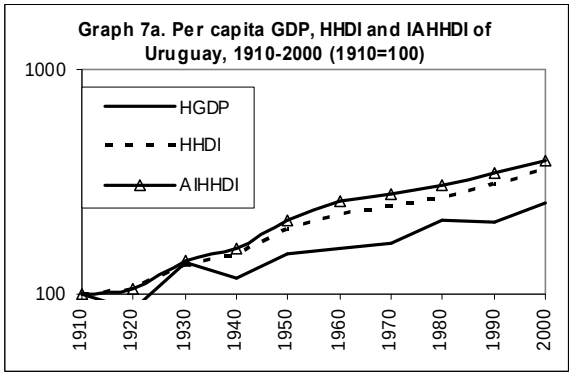
This section is devoted to the discussion of the impact of inequality on human development. The basic idea is that human development is higher if equally distributed. The procedure, according to equation (5), is to adjust human development by an inequality index. The geometric inequality index was presented in Table 2. Inequality levels in Uruguay and USA do not differ significantly (somewhat higher in Uruguay) and show a similar trend: decreasing inequality between 1910 and the 1960s; increasing inequality afterwards. Both the downwards and the upwards trends were slightly more pronounced in Uruguay than in the USA. Thus, the way in which inequality will correct human development is rather similar in both countries: increasing growth up to the 1960s and reducing it afterwards. This is a somewhat undesired result of this paper, as the importance of the inequality adjustment should be more important if the two countries showed different inequality levels and trends.

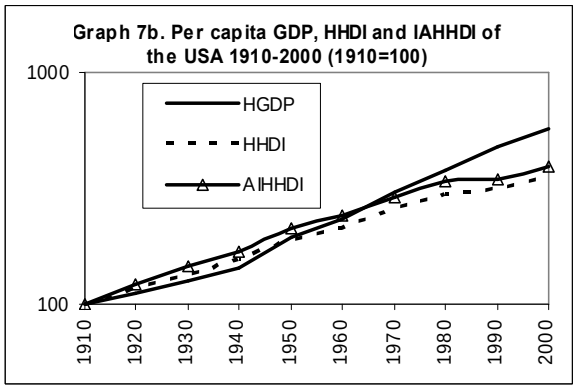
Appendix Table 5 summarizes the results. As the maximum level of the *IAHHDI* is achieved when all the components of the *HHDI* reach the maximum values **and** all of them are equally distributed (Gini=0), the levels of the index are significantly reduced. The best record of the USA, for example, was 0.377, in 2000.

In order to avoid the differences in levels of the *HGDP,* the *HHDI* and the *IAHHDP* we show the three in Graph 7a-b with a similar starting point in 1910. The graphs may be read as an approach to different growth models, featured by different combinations of the indices.

In the case of Uruguay it's noticeable that the *HGDP* shows a clearly lower performance than the other two. The *HHDI* grows much more, and even higher is the growth performance if distribution is considered. It is also interesting to notice that the gap widened in 1930-1960, when policies promoting education and wealth were especially strong and when inequality diminished because of policy-making after the 1940s. The gap widened again in the 1980s, when the country moved to democracy after a decade of dictatorship.

In the case of the USA, the picture is quite different. Both the *HHDI* and the *IAHHDI* grew faster than the *HGDP* until 1940. By then, infant mortality was eradicated and primary schooling generalized. Life expectancy and inequality decreased significantly. The second part of the century was featured by very fast per capita GDP growth with increasing inequality. *HEdu* was the weakest component of the *HHDI* of the USA and helped to widen the gap with *HGDP*, together with the inequality trends.





6. Conclusions

This paper presented a 20th Century Historical Human Development Index (*HHDI*) for three Latin American countries (Argentina, Brazil and Uruguay) and four core countries (France, Germany, UK and USA), and an Inequality-Adjusted Historical Human Development Index (*IAHHDI*) for Uruguay and the USA, based on the idea that human development is higher if inequality is lower.

The ***HHDI*** has different features which, considered together, make it different from previous attempts: the per capita GDP series were not log-transformed; life expectancy adopted a convex achievement function with maximum and minimum values 80 and 20 years, respectively; the education series was estimated with data on school enrolment alone, neglecting the use of literacy rates. A geometric average of the indices was estimated.

The ***IAHHDI*** is based on available inequality series for income distribution and own estimates of inequality series for education and life expectancy of Uruguay and the USA.

The results were discussed and presented in comparative terms.

Relative **per capita GDP** growth is a well-known story. This paper doesn't add to Bértola & Porcile (2006) in that respect: Argentina and Uruguay show a divergent trend since the early 20th Century while Brazil converge up to 1980, diverging later on. When adjusted for **inequality** USA's per capita GDP was increased 20% between 1910 and 1930, and a further 10% increase up to 1970. Afterwards, half of these gains were lost as inequality increased. In the case of Uruguay the increase added to 20% in 1970, while half of it was lost by 2000.

In terms of **life expectancy** Brazil caught significantly up from very low levels until the 1970s. Argentina and Uruguay showed some fluctuations around similar levels. After the 1980s, however, the three Latin American countries started a clear divergent trend to levels below 75% of the core countries. The strong rise in life expectancy

(1940-1980 in Argentina, 1950-1990 in Brazil, 1940-1960 Uruguay) were mainly due to social investment which made possible to learn how to handle risks and to take advantage from technological spill-overs from core countries and reduce mortality rates, specially infant mortality. As further increases in life expectancy became more related to the extension of the life of the elderly, and as social investment and economic growth weakened from the 1970s and onwards, life expectancy was relatively reduced. **Inequality in life expectancy** follows a similar declining trend with time and with increasing life expectancy. The phase of drastic reduction of age inequality in the USA and Uruguay is related to the phase in which life expectancy increased through the control of mortality causes affecting younger population. By contrast, the control of diseases affecting mainly the elderly didn't affect inequality so much. When adjusted for inequality, the gap in life expectancy between USA and Uruguay increases.

Our **education index** is more credible than the one used by the UN, as it takes into account the contributions to the education of the population at different levels. The results themselves look more reliable. Argentina shows a stable position relative to the core countries in 1920-1980. During the 1980s some convergence is achieved due to increasing population in secondary and tertiary education and to democratization. Brazil caught up significantly in 1910-1980, but could not surpass the 60% level. Uruguay caught up until 1960 and remained fluctuating around similar levels afterwards. We suspect that the Latin American countries' indices are over-valued at the end of the period.

Inequality in the access to education started at very low levels and increased steadily in the USA. In Uruguay, inequality in the access to education went through similar trends as income inequality: a decreasing trend until 1950, and increasing inequality afterwards to similar levels to those of the starting point.

When we finally geometrically combine the three components into the ***HHDI*** we find that: Argentina started to diverge at early stages of the 20th Century, Uruguay diverged from the mid-century, and Brazil continued to tighten the gap up to 1980. They all diverged after the mentioned dates. Our results diverge from those obtained by Astorga & FitzGerald (1998), Astorga, Bergès & FitzGerald (2004), and Prados (2007). They all found convergence in the central decades of the century and a relatively stable situation afterwards.

If we think in terms of an input-output relation between per capita GDP as input and, on the other side, education and life expectancy as outputs, the Latin American countries show an apparently better relation: best is Brazil and worst are the USA. Alternatively, technical change and GDP growth in the core countries are not able to dramatically increase human development at home, but technological spill-overs to laggard countries have a higher impact there. Laggard countries potential to make an intelligent and effective use of the technological gap directly depends on the domestic capabilities and efforts to develop educational and wealth systems.

Total inequality in Uruguay and USA showed similar levels and trends: it decreased until the 1950s, and increased afterwards to similar levels. While inequality affects human development within both countries, it doesn't help to understand the differences between them, due to the mentioned similarity of the Gini-coefficients. In both cases different models may be noticed. Up to the mid-century increasing inequality made the IAHHDI to grow faster than the HHDI. The contrary is valid for the second part of the century.

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Appendix Table 1. Per Capita GDP Index, Hy_i 1900-2000.

	AR	BR	UY	FR	GER	UK	USA
1900	0.067	0.014	0.053	0.070	0.072	0.110	0.100
1910	0.093	0.017	0.076	0.072	0.081	0.113	0.122
1920	0.085	0.022	0.065	0.078	0.068	0.111	0.137
1930	0.100	0.024	0.105	0.111	0.097	0.134	0.153
1940	0.102	0.029	0.089	0.099	0.133	0.169	0.173
1950	0.122	0.039	0.114	0.130	0.095	0.171	0.237
1960	0.137	0.056	0.122	0.187	0.191	0.214	0.281
1970	0.181	0.074	0.127	0.290	0.269	0.267	0.374
1980	0.203	0.128	0.162	0.376	0.351	0.322	0.463
1990	0.159	0.121	0.160	0.451	0.397	0.409	0.579
2000	0.212	0.137	0.194	0.519	0.464	0.494	0.702

$Hy_i=(y_i-100)/(40000-100)$

Appendix Table 2. Life-expectancy Index, $Hlife_i$, 1900-2000

	AR	BR	UY	FR	GER	UK	USA
1900	0.093	0.040	0.157	0.132	0.142	0.141	0.154
1910	0.125	0.049	0.160	0.181	0.190	0.204	0.186
1920	0.161	0.055	0.180	0.183	0.216	0.230	0.234
1930	0.195	0.065	0.208	0.233	0.258	0.286	0.256
1940	0.224	0.081	0.263	0.165	0.255	0.276	0.323
1950	0.281	0.118	0.361	0.364	0.392	0.419	0.393
1960	0.339	0.214	0.409	0.463	0.453	0.458	0.438
1970	0.374	0.256	0.401	0.505	0.487	0.492	0.463
1980	0.438	0.308	0.446	0.593	0.572	0.562	0.562
1990	0.492	0.355	0.518	0.776	0.690	0.687	0.607
2000	0.525	0.393	0.590	1.000	0.863	0.856	0.732

Function: $Hlife_i=(\log(80-20)-(\log 80-life_i))/\log(80-20)$

Appendix Table 3. Education Index, $H_{edu\ i}$, 1900-2000

MODEL 1.	Literacy	Enrolment (enr	Primary (p)	Secondary (s)	Tertiary (t)
weights	α	β			
	0.67	0.33			
coefficients		ε	π	σ	τ
		4.4	1	1.4	2

	ARGENTINA	BRAZIL	URUGUAY	FRANCE	GERMANY	UK	USA
1900	0.35	0.24	0.35	0.59	0.67	0.65	0.63
1910	0.42	0.24	0.41	0.62	0.68	0.65	0.65
1920	0.48	0.24	0.47	0.63	0.68	0.67	0.67
1930	0.52	0.28	0.52	0.66	0.69	0.68	0.69
1940	0.58	0.31	0.57	0.68	0.70	0.69	0.70
1950	0.62	0.35	0.62	0.69	0.70	0.71	0.71
1960	0.65	0.43	0.64	0.71	0.70	0.71	0.72
1970	0.67	0.49	0.67	0.72	0.71	0.72	0.75
1980	0.68	0.55	0.68	0.72	0.72	0.73	0.76
1990	0.71	0.58	0.71	0.73	0.73	0.72	0.75
2000	0.73	0.62	0.72	0.74	0.76	0.74	0.74

MODEL 2.	Literacy	Enrolment	Primary	Secondary	Tertiary
weights	α	β			
	0.00	1.00			
coefficients		ε	π	σ	τ
		4.4	1	1.4	2

	ARGENTINA	BRAZIL	URUGUAY	FRANCE	GERMANY	UK	USA
1900	0.04	0.01	0.04	0.10	0.09	0.11	0.11
1910	0.05	0.02	0.04	0.10	0.10	0.09	0.12
1920	0.07	0.02	0.05	0.07	0.10	0.10	0.13
1930	0.07	0.03	0.06	0.10	0.10	0.10	0.16
1940	0.09	0.04	0.08	0.11	0.11	0.11	0.18
1950	0.10	0.06	0.09	0.12	0.12	0.15	0.20
1960	0.12	0.08	0.13	0.15	0.11	0.18	0.21
1970	0.14	0.10	0.15	0.17	0.16	0.19	0.26
1980	0.15	0.12	0.15	0.17	0.17	0.21	0.28
1990	0.20	0.13	0.19	0.21	0.21	0.18	0.24
2000	0.24	0.17	0.21	0.25	0.31	0.25	0.24

MODEL 3	Literacy	Enrolment	Primary	Secondary	Tertiary
weights	α	β			
	0	1			
coefficients		ε	π	σ	τ
		2.4	0	1	1.4

	ARGENTINA	BRAZIL	URUGUAY	FRANCE	GERMANY	UK	USA
1900	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1910	0.00	0.00	0.00	0.01	0.02	0.01	0.02
1920	0.01	0.00	0.01	0.01	0.02	0.01	0.03
1930	0.01	0.00	0.01	0.02	0.03	0.02	0.06
1940	0.01	0.01	0.02	0.02	0.03	0.03	0.10
1950	0.03	0.03	0.03	0.05	0.04	0.10	0.12
1960	0.04	0.03	0.05	0.07	0.05	0.14	0.13
1970	0.07	0.03	0.09	0.13	0.09	0.14	0.22
1980	0.08	0.04	0.09	0.14	0.14	0.18	0.25
1990	0.13	0.04	0.15	0.20	0.22	0.16	0.22
2000	0.20	0.07	0.18	0.24	0.34	0.23	0.22

Function: $Hedu_i = lit_i * \alpha + ((p_i * \pi + s_i * \sigma + t_i * \tau)/\varepsilon) * \beta$

Appendix Table 4. The Geomteric Historical Human Development Indexes, 1900-2000

	AR	BR	UY	FR	GER	UK	USA
Model G1							
1900	0.086	0.032	0.094	0.122	0.128	0.150	0.149
1910	0.114	0.037	0.112	0.139	0.150	0.168	0.172
1920	0.127	0.042	0.116	0.138	0.147	0.175	0.197
1930	0.147	0.050	0.150	0.176	0.176	0.201	0.218
1940	0.161	0.061	0.160	0.153	0.196	0.218	0.251
1950	0.191	0.082	0.201	0.223	0.206	0.267	0.303
1960	0.218	0.121	0.225	0.283	0.271	0.305	0.338
1970	0.254	0.151	0.235	0.343	0.327	0.339	0.396
1980	0.284	0.202	0.263	0.397	0.383	0.383	0.460
1990	0.285	0.212	0.290	0.480	0.441	0.433	0.492
2000	0.335	0.240	0.331	0.563	0.543	0.526	0.557
Model G2							
1900	0.064	0.020	0.068	0.096	0.098	0.119	0.119
1910	0.086	0.025	0.081	0.111	0.117	0.130	0.139
1920	0.099	0.029	0.085	0.100	0.114	0.135	0.162
1930	0.113	0.036	0.111	0.137	0.136	0.155	0.185
1940	0.126	0.047	0.122	0.121	0.153	0.171	0.216
1950	0.150	0.066	0.157	0.180	0.165	0.223	0.264
1960	0.176	0.098	0.185	0.236	0.215	0.263	0.297
1970	0.212	0.126	0.198	0.290	0.274	0.292	0.357
1980	0.240	0.170	0.220	0.338	0.326	0.335	0.418
1990	0.248	0.179	0.251	0.422	0.386	0.372	0.438
2000	0.300	0.208	0.291	0.504	0.500	0.470	0.496
Model G3							
1900	0.017	0.000	0.016	0.023	0.023	0.026	0.041
1910	0.037	0.014	0.035	0.043	0.065	0.053	0.073
1920	0.043	0.015	0.044	0.048	0.070	0.070	0.103
1930	0.054	0.019	0.059	0.076	0.088	0.088	0.136
1940	0.066	0.028	0.075	0.072	0.098	0.114	0.179
1950	0.095	0.050	0.111	0.131	0.112	0.193	0.225
1960	0.122	0.074	0.139	0.185	0.165	0.240	0.249
1970	0.164	0.082	0.165	0.263	0.231	0.266	0.335
1980	0.192	0.114	0.187	0.313	0.306	0.321	0.402
1990	0.215	0.117	0.231	0.414	0.392	0.359	0.426
2000	0.283	0.156	0.272	0.502	0.517	0.458	0.480

Source: Tables AT1, AT2 and AT3.

Appendix Table 5. The Inequalit-Adjusted Historical Human Development Index of Uruguay and USA, 1910-2000

	UY			USA			UY/USA		
	HGDP	***HHDI***	***AIHHDI***	***HGDP***	***HHDI***	***AIHHDI***	***HGDP***	***HHDI***	***AIHHDI***
1910	0.076	0.081	0.055	0.122	0.139	0.097	62.4	58.5	56.6
1920	0.065	0.085	0.058	0.137	0.162	0.119	47.2	52.5	48.5
1930	0.105	0.111	0.077	0.153	0.185	0.141	68.7	60.1	54.7
1940	0.089	0.122	0.087	0.173	0.216	0.164	51.5	56.7	53.1
1950	0.114	0.157	0.117	0.237	0.264	0.206	48.2	59.5	56.6
1960	0.122	0.185	0.142	0.281	0.297	0.234	43.3	62.2	60.8
1970	0.127	0.198	0.153	0.374	0.357	0.282	34.1	55.4	54.5
1980	0.162	0.220	0.167	0.463	0.418	0.327	35.1	52.6	51.2
1990	0.160	0.251	0.190	0.579	0.438	0.337	27.6	57.3	56.5
2000	0.194	0.291	0.217	0.702	0.496	0.377	27.7	58.6	57.6

Source: Tables 2, AT1USA