HUMAN CAPITAL CONVERGENCE IN LATIN AMERICA: 1950-2000 *

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RESUMEN

Usando la información contenida en las Penn World Table las estadísticas de la CEPAL y la base de datos OLAD para el periodo 1950-2000, y considerando una muestra de 18 países Latinoamericanos, este artículo pretende estudiar el proceso de convergencia que se da entre ellos. Los resultados obtenidos utilizando técnicas de datos de panel nos permiten hablar de convergencia sólo en un sentido condicional. Realmente, encontramos que el principal factor que explica el proceso de crecimiento y convergencia en esta región es el nivel de capital humano. Esta variable ha sido construida usando la metodología de Componentes Principales y tomando en consideración variables tales como la tasa de matrícula en educación primaria y secundaria, el número de habitantes por médico, la esperanza de vida, la mortalidad infantil y la tasa de dependencia.

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Palabras clave: crecimiento económico, convergencia, capital humano, América Latina

ABSTRACT

Using the Penn World Table, the CEPAL statistics and the OxLAD data base for the period 1950-2000, and considering a sample of 18 Latin American countries, this paper tries to test for convergence within the region. The results from a panel data approach only allow us to speak about convergence in a conditional sense. In fact, one of the main factors behind both economic growth and the catching up process in the region is the level of human capital. This variable has been constructed using Principal Components methodology and taking into consideration primary and secondary school enrolment ratios, the number of inhabitants per doctor, life expectancy, the infant mortality rate and the dependency rate.

Keywords: economic growth, convergence, human capital, Latin America
JEL Classification: I23, N36, O4.

1. INTRODUCTION

Since the time of Barro's pioneering proposals, the phenomenon of economic convergence between countries has been widely and empirically studied [1]. The idea underlying the concept of convergence is that, given the existence of decreasing returns in the use of capital and assuming equality of preferences and technology, those countries which begin with lower levels of income per capita will tend to grow more quickly. They will, thus, have the chance of reaching the level of the richest nations, or at least of closing the gap between them. The former situation represents a process of absolute convergence in which all countries under consideration will meet at the same point or steady state. This is known as unconditional convergence (unconditional β-convergence and σ-convergence) [2].

[1] Barro (1991).

[2] The estimate for parameter β indicating the presence of unconditional convergence is calculated using the following estimation: $(1/T)^* \ln(Y_{i,to+T}/Y_{i,t0}) = a-[(1-e^{-\beta T})/T]^* \ln(Y_{i,t0})$; where Y represents GDP per head. A different way to measure unconditional convergence involves the use of the typical deviation of GDP per head over time, which is called σ-convergence.

The latter situation, a closing of the gap, is associated with a concept of weaker convergence known as conditional convergence, arising from the implications of Solow's model which predicts convergence after taking into account the factors which determine the steady state equilibrium (conditional β-convergence). These are the saving rate (physical capital is used as an approximation) and the growth rate of the population. The full version of this model includes human capital as an additional variable of the steady state. Moreover, following Barro's suggestions, other variables are included in the list of determining factors [3].

In this context of conditional convergence, the differences in per capita income between rich and poor countries will tend to decrease, while each country will reach its point of equilibrium [4].

The vast majority of studies in this field focus on developed countries. Convergence hypotheses, either conditional or unconditional, are rarely rejected in the context of OECD members, European countries or among states in the USA. If, in addition, the period under investigation is post Second World War, convergence in terms of levels of per capita income is not only clear, but usually takes place at an annual rate of 2 per cent [5]. This would suggest that when the group of countries studied is homogenous in the sense of sharing the same historical experiences, having similar development patterns and similar starting points, the convergence contrast will almost certainly be successful. Nevertheless, in studies in which the sample is very large and includes developed and developing countries, the result obtained is not so clear and divergence is typically found [6]. In such cases the inclusion of a dummy variable is needed to identify the particular performance of each group of countries. The objective of this type of analysis is normally to attempt to decide whether, in general terms, the least developed countries tend to converge with the most developed [7]. For example, in the particular case of Latin America, it is common to focus attention on the study of economic failure and the rela-

[3] Some authors take into account the role played by some macroeconomic variables such as the inflation rate or the fiscal deficit whereas others highlight the effects of political instability on growth and convergence. See, for example Fisher (1993), Dollar (1992) and Alesina *et al.* (1993) respectively.

[4] As suggested by Barro and Sala-i-Martín, the estimate for parameter β indicating the presence of convergence is calculated using this estimate $(1/T)^* \ln(Y_{i,to+T}/Y_{i,t0}) = a-[(1-e^{-\beta T})/T]^*\ln(Y_{i,t0})$ + other variables; where Y represents the variable GDP per head. See R. J. Barro and X. Sala-i-Martín (1992: 223-251).

[5] See, for example, De la Fuente (1995) and Sala-i-Martín (1996).

[6] See the debate between Baumol (1986) and De Long (1988) and also Baumol and Wolff (1988).

[7] Barro (1991) and Romer (1990).

tive decline of this region in comparison with the USA or the OECD countries [8].

However there are few studies which focus on convergence in developing countries and specifically in the Latin American area [9]. If it were possible to identify the factors underlying convergence among developing countries, we could then make recommendations which would lead the poorest countries in that sample to grow and converge. This is an important matter as it would enable us to tackle the internal dualities present in this zone which hold back the region as a whole and thus facilitate increased possibilities of general convergence with the most developed countries. The study of this region is especially interesting as it is one which does not converge in general terms and in which large regional differences are to be found [10]. In fact, in Latin America, a number of regional development associations have been formed to deal with inter country income disparities, but up to now little is known about the convergence process in this region [11]. This article attempts to make a modest contribution in this field.

The outline of the article is as follows. Section 2 focuses on factors which could explain convergence in this area and sets out a series of questions and hypotheses which are dealt with and confirmed in subsequent sections. The most important previous studies in the field are looked at in section 3. Section 4 presents the econometric analysis and the construction of a Human Capital Index in order to explain the rationale of convergence. The final section offers some concluding remarks.

2. SOME INITIAL QUESTIONS

If, as we have already noted, convergence in Solow's model is sustained by the presence of diminishing returns in the use of capital, then investment in physical capital becomes one of the model's vital components. An increased rate of investment would not only offer the poorest countries in the region the chance of more rapid growth, but would also provide the channel for technological advance. Is this true in the case of Latin American countries? Would it be sufficient for a poor country in

[8] See, for example, Prebisch (1950), Bulmer-Thomas (1994), Coastworth (1998: 33-54), Astorga and Fitzgerald (1998: 307-65) and Prados de la Escosura (2004).

[9] See Dobson and Ramlogan (2002), p. 84, and Holmes (2004), pp. 300 and 316.

[10] See, for example, Prados de la Escosura (2004) and Astorga, Berges and Fitzgerald (2005). In this last paper the authors demonstrate that the homogenisation among the larger Latin American economies and the withing group convergence found was insufficient to reduce the gap between Latin America and the US.

[11] Dobson and Ramlogan (2002), p. 84.

this region simply to impulse an intense process of investment in physical capital? If this were the case, then 1950 would appear to be an appropriate starting point for a study of this hypothesis as it marks the beginning of a period of large private capital inflows. It also coincides with the introduction of the process of Industrialization by Import Substitution which, although it initially benefited the richest countries, from the 1960s onwards the process spread to countries such as Bolivia, Ecuador and The Dominican Republic.

Later, in the 1970s the favourable conditions in the international financial markets allowed many Latin American countries to benefit from significant capital inflows which contributed to convergence in this period. This period throws up signs of convergence which were to last until the following decade when they disappeared with the onset of the debt crisis [12]. The stability programmes and financial deregulation of the 1990s, however, brought further substantial inflows of foreign capital which helped to offset the lack of savings and increased the possibilities of convergence [13].

However, it is risky to limit our consideration of the potential process of conditional convergence to investment in physical capital, even in the case of a group of developed countries. In this sense we can look to a series of studies which show that, in many cases, it is only possible to talk of conditional convergence, or catching up, if another form of capital, human capital, is also taken into account. What is more, the results provided by the model improve significantly when this variable is included [14].

The fact that these results have been tested with large samples of countries suggests that it is not unreasonable to think that this factor plays an important part in an explanation of growth and convergence in Latin American countries.

At this point, then, we can ask the following question. Which type of capital has played the most important role as a determining factor of growth and convergence in this region? If the answer were human capital, how would it be possible to measure it accurately? Most studies which include human capital consider primary and secondary schooling rates or the number of years of education of the population between the ages of 15 and 64. However, the use of formal education in isolation as a proxy of human capital has been widely questioned and is considered

[12] Cardoso and Fishlow (1989); Dobson and Ramlogan (2002), pp. 88-89.

[13] Aizenman (2005).

[14] See Barro (1991), Barro and Sala-i-Martín (1992) and Makiw, Romer and Weil (1992) among the most important empirical works in this field. These approaches are based on the previous hypotheses of Schultz (1960), Becker (1962) and Abramovitz (1986).

rather crude, ignoring, as it does, vital aspects of this concept of capital such as the level of health enjoyed by the population and the experience possessed by workers [15].

The education system in Latin America has improved significantly in recent decades and the clearest consequence of this situation is the marked increase in the level of education of the population since the war. Nevertheless, this variable, based on school registration rates, does not reflect the high level of failure at school leading to the repetition of a year, nor does it provide any indication of the quality of the education received [16]. Consequently, it will be necessary to try to measure human capital in this sample of Latin American countries in a broader and more accurate way if we are to show clearly that this type of capital is one of the key factors behind the process of growth and convergence over the period under study in this article.

Finally, it should be noted that, as all the previous arguments are based on neoclassical postulates, it has been assumed that all countries enjoy exactly the same technological level. Is this assumption reasonable in the case of such a heterogeneous sample of countries? In other words, is convergence a natural process in the Latin American region? It is highly unlikely that such a supposition, which in many cases would not even apply for samples of homogenous countries, can be maintained in this particular case [17]. Latin American countries have followed a model of economic, social and political development which, although closely related, has been very different. These differences between countries make it impossible to identify a common historical experience. It would appear that the large, economically developed countries have followed a very different path from the others. There is certainly no guarantee that, for example, the future of Honduras can be seen in the history of Brazil.

However, even if such a situation is considered, as long as we are able to accurately identify specific convergence clubs, the theoretical validity of Solow's model would continue to operate [18].

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[15] A comprehensive and detailed definition of human capital can be found in Becker (1962).

[16] Hofman (2000), pp. 20-23.

[17] See Bernard and Jones (1996). In this paper they argue that, under the assumption of a Cobb-Douglas technology, it is possible to demonstrate the existence of substantial technology gaps between OECD countries.

[18] Durlauf and Johnson (1992) demonstrated that convergence and cross-country growth are better explained by a model of local versus global convergence. They argue that countries converge locally in the sense that economies with similar initial conditions tend to converge with one another. See also Baumol and Wolff (1988).

3. WHAT PREVIOUS STUDIES SAY ABOUT CONVERGENCE IN THE REGION

If we look at the recent research in this field focusing on different samples of Latin American countries we can conclude that none of these studies provides convincing global answers to these questions. The results concerning the influence of the factors affecting growth and convergence are varied.

De Gregorio (1992), in a fairly comprehensive study, analyzes the growth factors in 12 Latin American countries during the period 1950-1985. He reaches the conclusion that unconditional convergence in terms of income per capita was not present in the sample and finds that private investment and, more specifically, foreign investment are the most important factors behind growth and conditional convergence. Human capital, which he measured using literacy and school enrolment rates, was another factor. The use of the literacy rate has a positive effect on growth despite the fact that its significance depends on the specification of the model. Paradoxically, school enrolment rates do not have a positive relationship with growth. Thus, despite the fact that this study is in line with our research and provides answers to some of the questions, it has a weakness which is the result of an incorrect measurement of human capital.

Other variables included in the study, such as terms of trade and the degree of openness, do not have a significant effect on growth while the effect of public spending is negative. Finally, the degree of political stability, measured as an increase in civil and political rights, is seen to have a positive effect on growth.

In a more recent work, Hofman (2000) carried out a study of the Latin American region in which he makes a very brief analysis of unconditional convergence between 9 countries of the region for the period 1950-1998 [19]. This study, however, does not reach any very clear conclusions in this area. The author divides the sample into two sub-periods of time in order to eliminate the possible effects of the debt crisis. Unconditional convergence is found in the period 1950-1980 and divergence is observed in a second period running from 1990 to 1998. Nevertheless, although the author takes great trouble to calculate the three basic variables of Solow's model (labour input growth (hours worked), a measure of the accumulation of capital and the growth and level of education in different periods), he does not estimate and quantify the possible importance of the impact of each of these factors on conver-

[19] The set of countries consists of Argentina, Bolivia, Brazil, Chile, Costa Rica, Jamaica, Mexico and Peru.

gence in this group of countries. This study, then, can be said to work towards our objectives as it highlights the importance of education as a form of investment which increases workers' productivity and favours growth. It does not, however, allow us to draw general conclusions as it only considers nine of the region's countries and fails to test Solow's model empirically.

A more reliable study of convergence in the region is Dobson and Ramlogan's paper (2002) in which they detected conditional convergence between 19 of these countries over the study period 1960-1990 [20]. The authors carry out an empirical analysis of the convergence hypothesis, finding evidence, which is not highly significant, of β-unconditional convergence. But there is no evidence of σ convergence for the overall sample period. Obviously, the presence, at more significant levels, of conditional convergence is found once the variables of the steady state, population growth rate, the savings rate (measured using real investment spending as a proportion of GDP) and human capital investment based on primary and secondary enrolment rates, are considered [21].

The problem of this study, however, lies in the fact that the authors focus exclusively on an estimate of the β parameter [22] without taking into account the parameters of the other variables. Once more, this does not allow us to learn anything new about the importance of any of these variables.

A recent analysis which tests for convergence within the region, on one hand, and with the USA, on the other, using a panel data analysis, was produced by Astorga, Bergés and Fitzgerald (2005). These authors consider a homogenous sample of six countries covering the period 1900-2000 [23]. They assume that the fact that this group of countries has similar institutions and a common history, few language barriers, and similar lags in assimilation of technology should facilitate the process of convergence. Such intuitions are, in fact, confirmed by the location of an unconditional β-convergence. However, what is new about this particular study is to be found in the way in which the conditional convergence

[20] Donson and Ramlogan (2002). The article also shows that the estimates of convergence are sensitive to the way in which GDP per capita is measured. The countries included are: Argentina, Bolivia, Brazil, Chile, Columbia, Costa Rica, Domin Rep., Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.

[21] What is more, when the sample period is divided into periods of five years, they find that the process of convergence was more rapid during the 1970s and early 1980s, while from the mid 1980s convergence disappeared.

[22] The parameter which measures the existence of convergence in the equation is expressed in footnote 4.

[23] Argentina, Brazil, Chile, Colombia, Mexico and Venezuela.

exercise is approached using other variables as well as the typical variables of Solow's model [24]. In particular, the fact that these authors use life expectancy to represent the initial level of health, and the illiteracy rate instead of primary and secondary schooling rates as proxies for human capital should be highlighted.

In fact, the authors reach the conclusion that the six main economies in the region did converge considerably over the century due to improvements in resource allocation, advances in health and education and increased investment effort [25].

The main problem of this analysis is that it only takes into consideration the six largest Latin American economies and its conclusions cannot, therefore, be extrapolated to the whole region.

Another very recent article in this field is that of Holmes (2005) in which convergence is addressed in an alternative way with the application of principal components and cointegration analysis. Using a sample of sixteen Latin American countries, long-run convergence is only found in the cases of the Central American Common Market over the period 1960-2000. However, the test confirms a weaker long-run convergence in the case of Latin American Integration Association countries [26]. This leads the author to the affirmation that it is possible, within the sample, to identify groups of countries, according to the trade agreements established. This type of analysis suffers from the limitation that it does not investigate conditional convergence and, therefore, its determining factors are not identified.

Given the scarcity of studies of the convergence process in Latin America and the fact that those which do exist are not wholly convincing, this paper will make a modest attempt to fill this gap by taking a group of 18 countries as a sample.

What, then, will be the result if we analyse convergence processes in such a group of countries? Will the convergence hypothesis be fulfilled? What are the determining factors of growth and, assuming it exists, of convergence between the Second World War and the present for the Latin America region? How can the previous scarce analysis in this field be improved and reinforced?

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[24] They consider the average share of public spending on GDP, the barter terms of trade, the US interest rate, the share of agricultural value added on GDP, the share of value exports on nominal GDP and the share of customs taxes on fiscal revenues.

[25] Astorga, Bergés and Fitzgerald (2005), p. 24.

[26] The first sample of Central American Common Market is formed by Guatemala, Honduras, Nicaragua, El Salvador and Costa Rica. The Latin American Integration Association sample includes Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, México, Paraguay, Peru, Uruguay and Venezuela.

4. THE CONVERGENCE PROCESS IN LATIN AMERICA

The objective of this analysis is to contrast the existence of both unconditional and conditional convergence, improving Solow's equation with the inclusion of a series of variables. Thus, as well as the steady state variables, active population growth, investment rate and human capital will also be taken into account. The importance of human capital in explanations of growth and convergence processes has been crucial since the proposals put forward by Schultz (1961), Becker (1962) and Abramovitz (1986) among others. Since then, and as previously mentioned, it has been one of the main additional variables included in this kind of analysis [27].

As has been made clear in the section which reviews the studies focusing on Latin America, the human capital variable was calculated using primary and secondary schooling rates, the illiteracy rate or, at best, by the number of years of formal education of the population between the ages of 15 and 64. We have seen that the results thrown up by this variable for the various samples of Latin American countries included in these studies are not always as robust as would be hoped. This leads us to doubt the appropriateness of the measures of formal education used to estimate the concept of human capital.

Unlike the situation in other studies of the Latin American region, in this paper human capital will take into account other factors as well as enrolment rates in primary and secondary education as a proxy. This figure alone could be inaccurate as we would also require information regarding failure rates, the percentage of pupils who successfully complete their studies and an indicator of educational quality, among other factors [28]. In fact, the concept of human capital is broad and includes other elements such as levels of health, nutrition and professional experience of the workforce [29].

This is why additional variables have been included in an attempt to provide more reliable results for human capital. These extra variables are infant mortality and the number of inhabitants per doctor, life expectancy and the dependency rate. The latter is defined as the percentage of the population under the age of 15 or over the age of 64 compared with those between the ages of 15 and 64. The Appendix offers an explanation of the

[27] See Shultz (1960), Denison (1985), Romer (1989), Barro (1991) and Mankiw, Romer and Weil (1992) for pioneering empirical studies in this field in which human capital plays an important part in the explanation of growth and convergence.

[28] See Barro and Lee (1993, 2000), De la Fuente and Doménech (2000) and Barro (2001) for studies in which attempts are made to estimate human capital more accurately using measures of educational attainment, quality and quantity of education.

[29] See Becker (1962) for a broad definition of the concept of human capital.

appropriateness of using these variables as components of human capital and treats the problem of multicolinearity presented between them.

Given that the level of correlation between this set of variables is very high, it will be necessary, when constructing the human capital index, to deal with the problem of multicolinearity present in the data. To this end, Principal Components methodology will be employed. The construction of this index for the particular case of Latin America will be one of the main tasks of this paper. The index will subsequently be applied to a growth model in order to test its ability to explain the convergence process in the region.

Additionally, in line with many empirical studies and to test for the robustness of the index constructed, the degree of openness of the economy, measured as the percentage of imports plus exports compared with GDP, is included in the model [30]. The level of government intervention in the economy, using the weight of public spending in GDP as an approximation is also included [31].

4.1. Data analysis

The sample consists of 18 countries of the region for which the necessary information for the period 1950-2000 is available. A list of the countries analysed and information regarding the sources used can be found in the appendix.

Is there any slight possibility that an unconditional convergence process has taken place in these countries during this period of time?

The information presented in the following graph would seem to suggest a negative response to this question. Although levels of GDP per capita rose in all the countries, we observe, with the exception of Bolivia, that there are no significant changes in their relative positions. So the countries which were wealthier in 1950 —Argentina, Chile, Mexico, Uruguay and Venezuela— were also wealthier in the year 2000. The same situation applied to the poorest group of countries. The clearest exception is the case of Brazil which can be included in the most developed group by the end of the period.

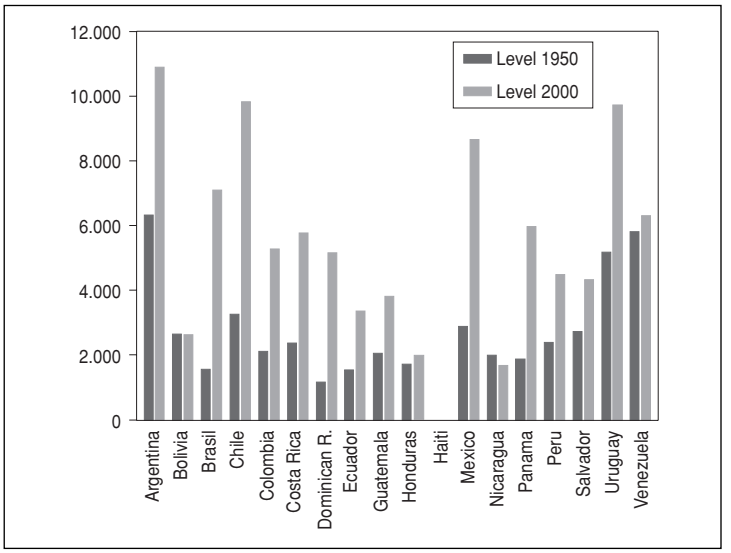
So, this preliminary and intuitive analysis casts doubt upon the unconditional convergence hypothesis.

Nevertheless if we focus on the information contained in Table 1 we can see how some poor countries registered a higher rate of growth than

[30] See, for example, Castles and Dowrick (1990).

[31] See Dollar (1992), Ben-David (1993), Sachs and Warner (1995), Edwards (1993, 1998), De Gregorio (1992) and Rodríguez and Rodrik (2001).

GRAPH 1
GDP PER CAPITA LEVELS IN LATIN AMERICA:
1950 AND 2000 (1985 INTERNATIONAL PRICES)



Source: PWT 6.1.

TABLE 1
ANNUAL AVERAGE GROWTH RATE, 1951-2000

Country	(%)	Country	(%)
Argentina	0.47	Guatemala	0.52
Bolivia	0.01	Haiti	0.12
Brazil	1,27	Honduras	0.11
Chile	0.96	Mexico	0.93
Colombia	0.77	Nicaragua	-0.15
Costa Rica	0.75	Panama	0.98
Domin Rep.	1.26	Peru	0.53
Ecuador	0.66	Uruguay	0.52
El Salvador	0.39	Venezuela	0.07

Note: the calculation for *The Dominican Republic* starts in 1952 and the growth rate for Haiti corresponds to the period 1968-1998.

other richer countries during the period under consideration. This feature is clearly the case for countries such as the Dominican Republic, and Panama and, to a lesser degree, for Costa Rica and Ecuador. This

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finding suggests the possibility of a conditional convergence process in which every country would have reached its steady state but, in the end, the differences in levels of GDP per head between richest and poorest would have diminished.

Additionally, we have detected a potential process of unconditional convergence within the sample formed by the richest countries. The fact that Brazil, Chile and Mexico —the countries in this sample with lowest levels of GDP per head— present a higher rate of growth than Argentina, Uruguay and Venezuela —the countries in this sample with highest levels of GDP per head— supports this possibility.

Obviously, a more in-depth analysis using accurate econometric techniques is required in order to confirm all these intuitions. This is the main task of the next section.

4.2. Econometric analysis

Many of the empirical studies have used cross-section data in order to contrast the convergence hypothesis. The drawback of this type of data is that time is not taken into account, eliminating the information contained in the sample regarding the effects of changes in growth and showing only differences between countries. The intention of the present study, though, is to make maximum use of the available information using a panel of data organized into sub-periods of five years [32].

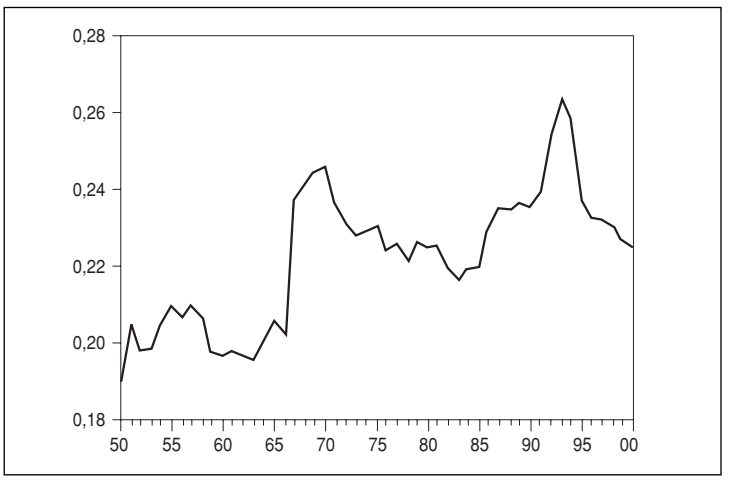
Given that this paper attempts to explain the joint performance of 18 Latin American countries, it would seem appropriate to use a model based on a *pool estimate* (Table A.5) or on a *fixed effects* (Table A.6) despite the fact that the latter would lead to a substantial reduction in the degree of freedom.

As can be seen in Table A.5 of the appendix, the results obtained are very clear. The estimate numbered (1a) in this table, which shows the absolute relationship between growth rates and initial levels of GDP per capita, is clear evidence that, in this group of countries, unconditional convergence does not exist as the coefficient of the variable Initial GDP per head (the logarithm of GDP per capita at the beginning of each five-year sub-period) is neither negative nor significant (estimation (1a) from Table A.5). The following graph, showing dispersion in per capita income in time, confirms this result.

In this graph it can be observed that dispersion increases with time, except for the period between 1970 and the onset of the 1980s, when the

[32] The appropriateness of this kind of approach is demonstrated by Islam (1995). In our case, the last period includes 6 years.

GRAPH 2
CONVERGENCE S IN LATIN-AMERICA: 1950-2000



trend is inverted. After that, the dispersion started to increase again at the beginning of the famous «lost decade», as the 1980s are referred to in Latin America. In this period most of these countries had negative growth rates which could cause an increase in dispersion [33]. Moreover, these negative growth rates explain why the dummy variable (DUM), introduced in the estimates in order to reflect the differential performance of the 1980s is highly significant throughout the different specifications of the model.

The fact that dispersion of GDP per capita falls again through the mid 1990s is also a relevant finding as it occurs during a period of increased economic stability affecting almost all the countries in the area, once a package of reform policies had been implemented [34].

These two analyses lead us to the conclusion that Latin American countries do not follow a common path leading to a common steady state during the period under study. In fact, and as we can see in Tables A.7 and A.8, unconditional convergence is only present in the sub-

[33] This result is in line with the conclusions reached by Dobson and Ramlogan (2002) who observe a process of weak convergence during the 1960s, strong convergence during the 1970s and early 1980s, while from the mid 1980s they observe a process of divergence. A conclusion mentioned in footnote 21.

[34] This result contrasts with that observed by Hofman (2000) who observed divergence during the period 1990-1998. His results, however, are not strictly comparable with ours given that his study only takes into account nine countries of the region.

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sample consisting of the richest countries in the area. The negative and significant estimate for the initial level of GDP per head justified this assertion, whereas the insignificance detected for that parameter in the sub-sample containing the poorest nations leads us to the conclusion that this kind of process does not exist between them. Moreover, this finding is corroborated by Graphs A.1 and A.2 in the appendix where we can observe the representation for sigma convergence. The deviation in levels of GDP per head declines with time in the richest sub-sample while, on the contrary, in the poorest it increases.

This involves taking the equation resulting from the movement towards equilibrium in Solow's model and, after the introduction of a wide range of conditioning factors, checking whether there is evidence of a process of conditional convergence between all 18 countries. If so, each country would have reached its particular point of equilibrium but, in the process, the differences in per capita income between countries would have decreased.

Nevertheless, the outcomes shown in Table A.5 do not initially support this idea.

As we can see in estimate (2a), the coefficient of the level of GDP per capita at the beginning of the period is negative but not significant. It only shows a negative and significant value when we estimate the model under the assumption of fixed effects (equation (2b)) from Table A.6). But, in fact, this result confirms the possibility of a conditional convergence process due to the fact that this kind of estimate is, by definition, a conditional inference in which we are assuming that every country reaches its particular steady state equilibrium.

In both approaches the investment rate has a positive effect on growth, as Solow's model would predict, and its significance is unchanged throughout. The estimated value of the variable which represents the growth rate of the active population is positive. Despite the fact that this variable is considered instead of total population growth, it is impossible to draw any conclusions regarding the effect produced by this variable as its value is neither significant nor robust. Its sign changes with variations in the specification of the model as can be observed in successive estimates [35].

The lack of conditional convergence once the main steady state variables are considered suggests the possibility of introducing other additional and crucial variables in order to obtain a more accurate explanation of the process. Consequently, in equations (3a) and (3b) we have expan-

[35] Bloom and Williamson (1998) maintain that the inclusion of total population growth in the growth model leads to errors and that it is better to distinguish between working population and total population.

ded the model introducing some variables relating to the human capital concept [36]. However the results obtained suggest the possible presence of a multicolinearity problem. The wrong sign in variables such as primary and secondary enrolment, infant mortality rate and dependency rate in (3a) from Table A.5 and the insignificance of all variables except inhabitants per doctor in (3b) from Table A.6 would confirm this possibility. For this reason and in order to avoid this problem we have applied principal component methodology which is appropriate in such cases.

Estimates (4a) and (4b), from Table A.5 and A.6 respectively, present the results obtained after incorporating the variable which attempts to represent the concept of human capital more accurately. This variable is calculated as a synthetic index based on a series of variables using the principal component method. The variables which make up this index are enrolment rates in primary and secondary education (PRIM and SEC respectively), the infant mortality rate (MORINF), the number of inhabitants per doctor (SAN), life expectancy (ESP) and the dependency rate (DEP). It should be highlighted that all these variables are considered at the beginning of each of the five-year sub-periods identified. The results provided by the index, logically, will refer to the level of human capital at the beginning of each of these sub-periods.

The analysis of principal components included in the appendix leads to the conclusion that these variables have fairly high correlations (Table A.1) which indicates the appropriateness of the methodology used. In such cases it is better to consider a linear combination of correlated variables in order to avoid possible biases in the individual estimates of the values caused by the multicolinearity problem present in the data [37].

The signs adopted by the variables in the first component, on which the global index is based, are coherent. Enrolment rates in primary and secondary education and life expectancy have positive signs while infant mortality, number of inhabitants per doctor and the dependency rate are negative (Table A.4). This first component explains 67.5 per cent of the variance (see Table A.3), a percentage considered sufficient given that although the inclusion of a second component would lead to a proportional increase in this figure, it would also make the interpretation of the results more difficult. What is more, as can be seen from the analysis, all the variables have a greater weight in this component which prompts us

[36] See, for example, Barro and Lee (1993) for the case of Latin America.

[37] If the variables which make up the human capital index are considered in isolation when calculating an estimate, the results obtained are not coherent due to the bias caused by the presence of multicolinearity. Thus the variable which represents infant mortality has a positive value although it is not significant and the primary and secondary schooling rate variables are negative and, therefore, incorrect.

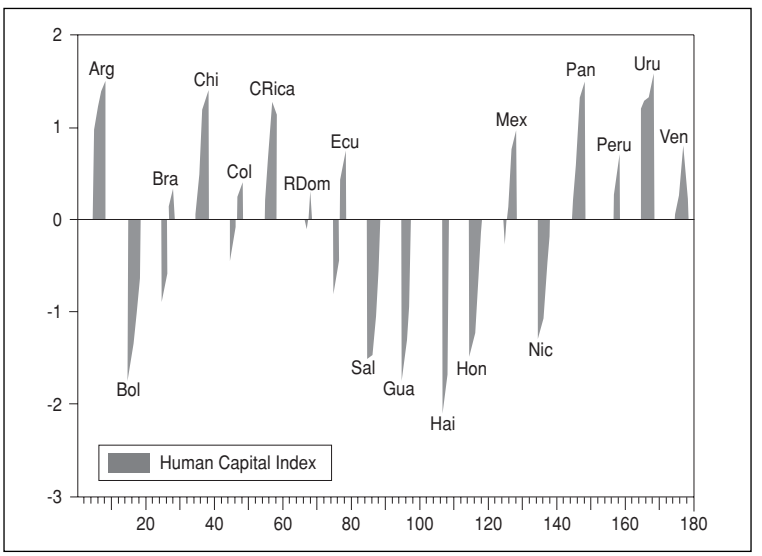
to consider only a linear combination of variables in which their respective weightings are provided by the values indicated in this first component. The fact that only the first eigenvalue is greater than one justifies this decision.

The Human Capital variable is calculated in this way and included in the growth model in equation (4a). Given that the index, due to its design, reflects the level of human capital at the beginning of each of the five-year sub-periods identified in the sample, it enters into the model with a lag of five years. In other words, the explanation of growth for the sub-period 1950-1955 is based on the level of human capital of 1950 and so on.

This leads to a positive value indicating that those countries in the sample with the highest levels of human capital —in other words, highest rates of schooling and life expectancy and lowest rates of infant mortality and dependency and lower numbers of inhabitants per doctor— have a greater possibility of growth and of closing the gap separating them from the richer countries. The graph representing the different levels of human capital obtained for each country is shown below:

As can be seen in Graph 3 some rich countries, such as Argentina, Chile, Mexico, Uruguay and Venezuela, present high levels in the index of human capital. Brazil is an example of a country which has become

GRAPH 3
INDEX OF HUMAN CAPITAL



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wealthy and has experienced a reasonable level of human capital in recent years. But, at the same time, we can observe other poorer countries with a considerable value for the later period. These are The Dominican Republic, Ecuador, Panama and Peru. In line with the theory, this last group of countries would have higher possibilities of growth and convergence. In fact, with the exception of Peru, they are among the poor countries with higher rates of growth, as we can see in Table 1. There is a fairly high degree of correlation between the growth rates and the level of human capital, at least among the poor countries. This fact suggests that human capital is one of the forces behind convergence in the region.

The importance of human capital is so crucial that if we focus on model (4a) from Table A.5 we can only speak about convergence in a conditional sense (a process of catching up) once this index has been included in the model —as in Barro (1991) and Makiw, Romer and Weil (1992). It is also worth drawing attention to the high significance of the index when the fixed effects approximation is used (equation (4b) from Table A.6).

Combining these results with the information contained in Graph 3, we can say that those poor countries with a high level of human capital will be able to reduce the gap with the richest. This result is in line with Abramovitz (1996) who sustains that the possibilities for a country of reducing the distance with richer ones are higher when it is technologically backward but socially advanced, a concept compounded, among other factors, by the country's level of human capital. This finding is corroborated by a separate analysis of each of the determinants of growth and convergence contained in the two sub-samples, —richest and poorest—, into which the total sample has been divided. As seen in Table A.9, investment in physical capital plays a key role alongside human capital in the sub-sample of wealthy countries. This means that, for a wealthy country in this region, the accumulation of more physical capital is sufficient in order to grow more and converge with the other countries in the richest sub-sample [38]. Nevertheless, in line with the results shown in Table A.10, we can observe that human capital constitutes the basic driving force behind growth and convergence in the case of the poorest countries [39]. This is made clear by the fact that the inclu-

[38] This is obvious due to the fact that this group of countries convergences in an unconditional sense. They can do so better in a conditional sense, considering any conditional variable.

[39] In the poorest sub-sample the active population growth appears as a positive and significant force behind growth and conditional convergence. This result was not found for the whole sample and for the richest sub-sample where the estimation of this variable is not robust.

sion of investment in physical capital alone is insufficient to detect convergence in the case of this sub-sample of countries and, in some estimations this variable is not significant. What is more, as has already been seen, human capital constitutes the key element which allows these countries to close the gap with the wealthiest nations of the region.

This finding could lead to the conclusion that human capital is one of the driving forces behind economic development in these countries. In order to be more certain, however, its robustness will have to be investigated.

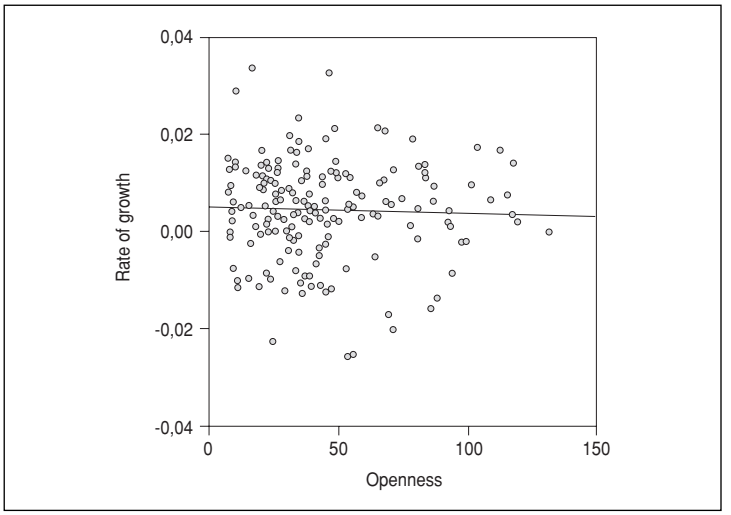
4.3. The robustness of the estimate

Any doubt surrounding the robustness of the human capital estimate will be clarified by the following estimates in which its significance is maintained once additional variables are included. The degree of openness and the percentage of GDP provided by the public spending rate are added to estimate (5a), (5b) and (6a), (6b) respectively, both giving negative values. These results mean that a greater percentage of public spending hinders economic growth and the possibility of convergence. However if we look at estimate (6b) it is not possible to reach a conclusion regarding the effect of this variable in this group of countries as its coefficient is not significant. The impossibility of distinguishing between current expenses and the rest of public spending makes this variable unreliable, a fact which should also be noted. This distinction is crucial for Castles and Dowrick (1990), for example. According to their studies, current expenses exert a significant, negative impact on the growth of 18 OECD countries in the period 1960-1985, while public spending other than current expenses had a positive value.

The variable degree of openness has a negative effect on the rate of growth of these economies, and this effect is significant at least in estimate (5a) from Table A.5 (but not in estimate (5b) from Table A.6). This contradicts the theory and findings of other empirical studies which maintain that the degree of openness is one of the key factors behind economic growth and convergence. Our findings go in the opposite direction. This means that in general, the growth rates of Latin American economies have been higher during periods when the economies were less open and vice versa. This can be seen in the following graph where higher degrees of openness are not associated with higher growth rates.

This result, however, is not new, especially in the case of Latin America. Dollar's study (1992), which can be highlighted among the most significant in the field, considers two different indices of openness

GRAPH 4
THE RELATIONSHIP BETWEEN GROWTH RATES
AND ECONOMIC OPENNESS IN LATIN AMERICA: 1950-2000



and shows that both correlate negatively with growth in a sample of 95 developing countries in the period 1976-1985 [40]. Other more recent and global studies investigate this field further. Rodriguez and Rodrik (2001), for example, carry out a critical review of all the main studies and confirm an unmistakeable, positive relation between openness and growth. They affirm, on the contrary, that:

> «We suspect that the relationship is a contingent one, dependent on a host of country and external characteristics».
>
> and that
>
> ...«What we believe we have shown is that the challenge of identifying the connections between trade policy and economic growth is one that still remains before us» [41].

Similarly, in the specific case of Latin America, the work of De Gregorio (1992), previously commented in section 3, should also be men-

[40] These are an «index of real exchange rate distortion» and an «index of real exchange rate variability».

[41] Rodríguez and Rodrik (2001), pp. 5 and 54 respectively.

tioned. He finds that the degree of openness of the economy, measured in three different ways —the share of exports in GDP, the share of trade in GDP and an index based on a World Bank classification—, is discovered not to have significant effects on growth. De Gregorio justifies this finding by observing that the time period used in his study (1950-1985) may not be the most appropriate, given that most of the growth in these Latin American countries during the sample period had taken place under the auspices of strong import substitution policies which lasted until the 1970s. After that date, we can see a sustained outward orientation policy but corresponding with lower rates of growth for the region [42].

The same explanation could be used to justify the result obtained in this article as, in spite of the fact that our study extends as far as the year 2000, the process of openness has continued until the present but without signs of increased growth.

On the other hand, an additional explanation for the negative relation found between growth and degree of openness, measured as the share of imports and exports in GDP, could lie in the simple fact that this way of measuring openness is not the most appropriate [43]. A precise measurement of the degree of openness and the detection of its connection with growth in Latin America is not, however, the objective of this article, although it does point towards a possible avenue for future research.

5. CONCLUSIONS

This article has attempted to focus on the factors behind convergence between 18 Latin American countries during the period 1950-2000. The interest of this field stems from the fact that it has received insufficient attention from researchers in the past. The studies which do exist in the field have thrown up varied results which are not always conclusive. Our study can be seen as a review of previous analyses focusing on highlighting the role of human capital as a key component in the explanation of economic convergence in the Latin American region.

This article reinforces the previous work in the field from several points of view: it considers a broad sample of Latin American countries and contemplates a longer time period [44]. Our study also uses a more accurate econometric analysis of convergence which leads to a compact

[42] De Gregorio (1992), pp. 75-76.

[43] See the work of Dollar (1992), Ben-David (1993), Sachs and Warner (1995) and Edwards (1998) who use different and more accurate ways of measuring openness.

[44] The work of Astorga, Bergés and Fitzgerald (2005) is an exception, covering a longer time period (1900-2000) although this study is limited to six countries in the region.

index of human capital including elements not considered in other studies in the field, such as life expectancy, infant mortality, health levels and the dependence rate.

Consequently, although our conclusions are in general agreement with previous studies, we do point out some clarifications. The ambiguities found in De Gregorio's study (1992) regarding the effects of the illiteracy rate and school enrolment, which had incorrect signs and lacked significance, have now been clarified. We have also extended the method of measuring human capital employed by Astorga, Bergés and Fitzgerald (2005), who only used two independent proxy variables, life expectancy and the illiteracy rate. Finally, our paper completes the studies of Hofman (2000), Dobson and Ramlogan (2002) and Holmes (2005), in which the determining factors of conditional convergence are not made explicit and therefore the results of conditional and unconditional convergence are mixed.

In conclusion, we can state that although evidence of unconditional convergence for these 18 Latin American countries was not found, there are signs that conditional convergence did take place. Our results suggest that investment in physical capital and, especially, investment in human capital were the variables which favoured this situation. In fact, if we consider model (4a) from Table A.5, we can say that a standard deviation increase in the human capital index would lead to an increase in the growth rate of nearly 0.2 per cent and a standard deviation increase in investment would have increased growth by 0.3 per cent. If we use model (4b) from the fixed effects approximation the contribution of these variables are higher. The estimates from model (4b) indicate increases in growth of 0.60 per cent and 0.50 per cent as a consequence of increases of one standard deviation in human capital and investment respectively. Despite the fact that, in quantitative terms, the impact of investment is as important as that of human capital, the latter is the main force behind conditional convergence in this set of countries to the extent that it is only possible to speak about convergence once this variable has been included in the model. The main conclusion to be drawn from our results, in line with Abramovitz's hypothesis, is the idea that as long as a poor nation has a reasonable level of human capital, it has the chance of catching up with wealthier countries.

An increased degree of openness, on the other hand, acts as a hindrance to convergence although it should be noted that the variable used to measure this factor may not have been the most appropriate. No clear conclusions regarding the effect caused by growth of the working population can be drawn for the whole sample due to the fact that its estimation is not robust. Something similar can be said about the role played by the public expenditure rate.

APPENDIX

DISCUSSION

This appendix discusses and justifies the appropriateness of using primary and secondary enrolment, infant mortality, the number of inhabitants per doctor, life expectancy and dependency rate as measures of the human capital concept and deals with the problem of multicolineality presented between them.

The aforementioned variables have been seen, in one way or another, as components of human capital in diverse empirical studies and, especially, in theoretical studies based on Ram and Schultz's (1979) pioneering global proposal. Their analysis, which focuses on low-income countries and more particularly on the case of India, highlights the importance that an increase in life expectancy, as a consequence of an improvement in health, has on the accumulation of human capital and, by extension, on economic growth. The study puts forward the following argument: an improvement in health leads to a decrease in the mortality rate and an increase in life expectancy. At first, there is a small decrease in the fertility rate which allows a spurt in population growth, setting off a demographic transition which, in the end, will lead to a larger increase in the working population than that experienced by the dependent population.

The study also shows that an increase in life expectancy leads to a rise in the incentives to receive more formal education and improved health. For that reason, the stock of human capital in the form of better health and more schooling becomes larger, and enhances the quality of labour.

So, they conclude that one important channel through which demographic trends affect growth is obviously the size and the quality of labour forces.

Within this context, later theoretical studies such as that of Barro and Sala-i-Martín (1995) stress the importance of life expectancy. The authors think that life expectancy has a strong, positive relation with growth as it proxies features reflecting human capital. These authors show that when life expectancy is short, the depreciation rate of human capital is high, making its accumulation more difficult, and *vice versa*. Due to the fact that human capital is an important driving force of growth, we should expect that the growth rate depends upon life expectancy.

This variable is also seen, in a theoretical model, by De la Croix and Licandro (1999) as one of the factors explaining growth via its effects on the accumulation of human capital. They show that life expectancy is positively correlated with human capital because favourable shifts in

survival probabilities always induce longer schooling and later retirement. Nevertheless, they point out that the effect of life expectancy on growth is positive for economies with a relatively low life expectancy, but could be negative in more advanced economies. This would be possible in some cases because the positive effect of longer life on growth could be offset by an increase of the average age of the working population.

Similar results are to be found in Boucekkine, De la Croix and Licandro (2002). This study includes additional variables in order to reflect the effects of the main demographic parameters on the accumulation of human capital and economic growth. These authors show that, theoretically, if in addition to taking life expectancy into account, the mortality and fertility rates are also considered, more ambitious conclusions can be reached.

For these authors, the way longevity increases is important: improvements in longevity have different effects depending on whether the reduction in death rates affects young or old agents. So, for these authors there is a «growth-maximizing» fertility rate, implying an adequate percentage of students and pensioners.

Mortality and fertility rates are two of the variables given serious consideration in this type of theoretical study. For example, Kalemli-Ozcan *et al.* (2000) present analytic results demonstrating that a decline in mortality produces economically significant increases in schooling and thus in the level of human capital.

The relationship between fertility and human capital investment, and its implication for economic growth, focusing on the effects of declining mortality is also considered by Kalemli-Ozcan (2002). He shows how lower mortality encourages educational investment in children and leads parents to have fewer children. Thus we can observe a quality-quantity trade-off in the demand for children. This result supports the earlier proposals put forward by Rosenzweig (1990) and Becker, Murphy and Tamura (1990). The former shows that fertility has a direct influence on human capital. Fertility and mortality may be positively correlated because parents living in unhealthy environments are more aware that their children might die. Consequently, they invest less in each child and bear more children which reduces the human capital level of the economy [45]. Becker, Murphy and Tamura (1990), in the second of the aforementioned studies, move in the opposite direction taking the fertility rate as an endogenous variable which depends on the abundance or scarcity of human capital existent in a given society and show that societies with abundant human capital invest more in each children and have small families and vice versa.

[45] Rosenzweig (1990), p. 58.

On the other hand, the level of health enjoyed by workers as a form of human capital is considered, at a theoretical level, in a pioneering study by Grossman (1972) as an element leading to an increase in the productivity of the workforce.

Similarly, Knowles and Owen (1995) emphasized the «health capital» component of human capital too, taking life expectancy as a proxy for the stock of health capital and considering the former variable as an indicator more directly relevant to the production of output. The introduction of this proxy in Makiw, Romer and Weil's model (1992) gives results which suggest a stronger and more robust relationship between income per capita and health capital than between income per capita and educational capital. In particular, for the less developed sub-sample they demonstrate empirically that health capital is significant whereas educational capital is not [46].

Bloom and Canning (2000), following a similar line of argument to that of Ram and Schultz (1979) but extending it to embrace a broader sample of countries, look at the way in which healthier populations tend to have higher labour productivity. Healthier people tend to have more education because people who live longer have stronger incentives to invest in developing their skill and good health also promotes school attendance and enhances cognitive function. These authors also show how health has an indirect effect on an economy's level of human capital and on its rate of growth via a transitional demographic effect which would lead to a faster growth in the workforce than in the dependent part of the population. Such an economy would then enjoy an increased global level of human capital and would be capable of more rapid growth. The opposite situation would result from more rapid growth of the dependent population than that experienced by the workforce. This situation is clearly logical if we consider that old non workers as part of the dependent population represent part of the total human capital which is withdrawn from the productive process. On the other hand, young non workers included in the dependent part of the population do not represent human capital for the economy.

We see, then, that in all previous studies, life expectancy, health, mortality and fertility rates are the factors which explain the level of human capital as estimated by schooling which would appear to act as a dependent variable in all cases. We have also observed that all these variables display high levels of correlation, to the extent that they are often used as proxies of each other, life expectancy and health or mortality and fertility being examples.

[46] Knowles and Owen (1995), p. 105.

The objective of this article is to bring together all these ideas and variables, without the intention of explicitly analyzing internal causality, in order to create a compact global index of human capital for the sample of Latin American countries under observation. In this line, other variables in addition to primary and secondary schooling rates will be taken into account. The number of inhabitants per doctor will be considered as a measure of the level of health care, a measure which could act as a proxy for health capital. Moreover, we take into account the infant mortality rate as a proxy for fertility and, finally, the dependency rate, which is considered in order to reflect the possible effect of the demographic transition on the process of accumulation of human capital.

SAMPLE OF COUNTRIES AND SOURCES

List of Countries in the Analysis

1. Argentina; 2. Bolivia; 3. Brazil; 4. Chile; 5. Colombia; 6. Costa Rica; 7. The Dominican Republic; 8. Ecuador; 9. Guatemala; 10. Honduras; 11. Haiti; 12. Mexico; 13. Nicaragua; 14. Panama; 15. Peru; 16. El Salvador; 17. Uruguay; 18. Venezuela.

The Richest sub-sample: Argentina, Brazil, Chile, Colombia, Mexico, Uruguay, Venezuela.

The Poorest sub-sample: Bolivia, Costa Rica, The Dominican Republic, Ecuador, Guatemala, Honduras. Haiti, Nicaragua, Panama, Peru, El Salvador.

Variables included in the model and its sources

Gross Domestic Product per head: PWT 6.1.

Investment Rate: PWT 6.1.

Active population rate of growth: Oxlad data base.

Primary and Secondary enrolment: CEPAL 1990 and 2001, and Oxlad data base.

Number of Inhabitants per Doctor: CEPAL 1990 and 2001.

Infant Mortality rate: CEPAL 1990 and 2001.

Dependency rate: CEPAL 1990 and 2001.

Life Expectancy: CEPAL 1990 and 2000.

Public Expenditure: PWT 6.1.

OPEN: Imports and Exports in reference to GDP: PWT6.1.

DUM: *dummy* which takes the value of 1 for the 1980s and 0 otherwise.

Terms of Trade: OxlaD data base.

EMPIRICAL ANALYSIS

Principal Component Analysis for the Construction of the Human Capital Index

TABLE A.1
CORRELATION MATRIX

	MORINF	SAN	PRIM	SEC	ESPV	DEP
MORINF	1.000					
SAN	0.500	1.000				
PRIM	–0.593	–0.469	1.000			
SEC	–0.638	–0.541	0.809	1.000		
ESPV	–0.949	–0.591	0.705	0.757	1.000	
DEP	0.507	0.334	–0.407	–0.617	–0.569	1.000

TABLE A.2
COMMUNALITIES

Variable	Initial	Extraction
MORINF	1.000	0.751
SAN	1.000	0.469
PRIM	1.000	0.674
SEC	1.000	0.798
ESPV	1.000	0.888
DEP	1.000	0.470

TABLE A.3
TOTAL VARIANCE EXPLAINED

Factor	Initial Auto values		
	Total	% from the variance	% accumulated
1	4.050	67.497	67.497
2	0.677	11.289	78.785
3	0.560	9.326	88.112
4	0.536	8.935	97.047
5	0.146	2.428	99.475
6	3.150E-02	0.525	100.000

TABLE A.4
FACTOR MATRIX

Variable	Factor 1	Factor 2
MORINF	–0.866	0.109
SAN	–0.685	–7.856E-02
PRIM	0.821	–0.517
SEC	0.893	–2.129E-02
ESPV	0.942	0.625
DEP	–0.685	3.868E-02

We have obtained the weight of each variable from Factor 1. -2.051 for MORINF, -1.621 for SAN, 1.944 for PRIM, 2.116 for SEC, 2.233 for ESPV and -1.621 for DEP.

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TABLE A.5
EXPLAINING THE GROWTH PROCESS IN LATIN AMERICA:
ALL THE COUNTRIES

Dependent variable: GDP per head growth
Method: GLS (Cross Section Weights)

Exogenous	**(1a)**	**(2a)**	**(3a)**	**(4a)**	**(5a)**	**(6a)**
Constant	0.009 (1.348)	0.014 (1.831)	0.027 (1.127)	0.107 (5.806)	0.146 (4.929)	0.133 (7.222)
Initial GDP per head	–0.0007 (–0.336)	–0.003 (–1.252)	–0.021 (–3.594)	–0.029 (–5.763)	–0.039 (–4.829)	–0.035 (–6.949)
Investment rate		0.025 (3.143)	0.046 (2.909)	0.059 (2.680)	0.068 (3.699)	0.067 (–2.906)
Active Population growth		0.018 (1.719)	0.0048 (0.270)	0.020 (1.420)	0.023 (1.398)	0.022 (1.632)
Primary Enrolment			–0.008 (–1.242)			
Secondary Enrolment			–0.009 (–1.314)			
Infant Mortality rate			0.008 (1.801)			
Inhabitants per Doctor			–0.0008 (–2.402)			
Life Expectancy			0.085 (3.112)			
Dependency rate			0.004 (0.717)			
Human Capital Index				0.003 (2.718)	0.004 (3.200)	0.004 (2.996)
Degree of Openness					–0.009 (–3.024)	
Public Expenditure rate						–0.033 (–2.819)
DUM	–0.011 (–10.856)	–0.011 (–9.992)	–0.012 (–11.026)	–0.014 (–10.302)	–0.014 (–10.658)	–0.014 (–8.920)
Weighted Statistics	N.º Obs=175 R–sq.=0.369 D–W=1.955 F=52.038	N.º Obs=175 R–sq.=0.397 D–W=1.939 F=29.653	N.º Obs=91 R–sq.=0.545 D–W=1.697 F=11.784	N.º Obs=65 R–sq.=0.728 D–W=1.602 F=35.375	N.º Obs=65 R–sq.=0.684 D–W=1.669 F=24.131	N.º Obs=65 R–sq.=0.765 D–W=1.594 F=35.724

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TABLE A.6
EXPLAINING THE GROWTH PROCESS IN LATIN AMERICA:
ALL THE COUNTRIES

Dependent variable: GDP per head growth
Method: GLS (Cross Section Weights) **Fixed Effects**

Exogenous	**(1b)**	**(2b)**	**(3b)**	**(4b)**	**(5b)**	**(6b)**
Initial GDP per head	–0.008 (–2.576)	–0.007 (–2.597)	–0.085 (–8.242)	–0.086 (–9.437)	–0.086 (–9.903)	–0.100 (–9.838)
Investment rate		0.034 (2.438)	0.069 (3.383)	0.090 (3.560)	0.093 (3.826)	0.010 (3.372)
Active Population growth		0.017 (1.737)	–0.013 (–0.684)	0.030 (1.508)	0.031 (1.601)	0.031 (1.108)
Primary Enrolment			–0.006 (–1.143)			
Secondary Enrolment			0.009 (1.355)			
Infant Mortality rate			0.0006 (–0.096)			
Inhabitants per Doctor			–0.0003 (–8.764)			
Life Expectancy			–0.038 (–0.950)			
Dependency rate			–0.006 (–1.294)			
Human Capital Index				0.007 (8.951)	0.006 (8.523)	0.008 (5.871)
Degree of Openness					–0.008 (–1.413)	
Public Expenditure rate						–0.031 (–0.965)
DUM	–0.010 (–10.486)	–0.010 (–9.317)	–0.009 (–7.792)	–0.012 (–9.679)	–0.013 (–9.545)	–0.012 (–7.063)
Weighted Statistics	N.º Obs=175 R–sq.=0.433 D–W=2.213 F=152.11	N.º Obs=175 R–sq.=0.456 D–W=2.218 F=55.710	N.º Obs=91 R–sq.=0.793 D–W=2.246 F=41.471	N.º Obs=65 R–sq.=0.991 D–W=2.34 F=190.308	N.º Obs=65 R–sq.=0.990 D–W=2.376 F=213.556	N.º Obs=65 R–sq.=0.928 D–W=2.479 F=170.70

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TABLE A.7
UNCONDITIONAL CONVERGENCE
BETWEEN THE RICHEST COUNTRIES
Dependent variable: GDP per head growth
Method: (A) GLS (Cross Section Weights); **(B) Fixed Effects**

Exogenous	**(A) GLS**	**(B) Fixed Effects**
Constant	0.053 (3.637)	
Initial GDP per head	–0.012 (–2.975)	–0.010 (–2.626)
DUM	–0.009 (–4.874)	–0.009 (–5.199)
Weighted Statistics	N.º Obs=60 R-sq.=0.441 D-W=1.884 F=207.90	N.º Obs=60 R-sq.=0.449 D-W=2.024 F=55.203

TABLE A.8
UNCONDITIONAL CONVERGENCE
BETWEEN THE POOREST COUNTRIES
Dependent variable: GDP per head growth
Method: (A) GLS (Cross Section Weights); **(B) Fixed Effects**

Exogenous	**(A) GLS**	**(B) Fixed Effects**
Constant	0.011 (1.359)	
Initial GDP per head	–0.0014 (–0.584)	–0.008 (–1.390)
DUM	–0.012 (–10.434)	–0.011 (–9.356)
Weighted Statistics	N.º Obs=105 R-sq.=0.404 D-W=2.050 F=36.297	N.º Obs=105 R-sq.=0.421 D-W=2.296 F=87.872

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TABLE A.9
EXPLAINING THE GROWTH PROCESS IN LATIN AMERICA: THE RICHEST COUNTRIES
Dependent variable: GDP per head growth
Method: (A) GLS (Cross Section Weights); **(B) Fixed Effects**

Exogenous	(1A)	(1B)	(2A)	(2B)	(3A)	(3B)	(4A)	(4B)
Constant	0.048 (3.400)		0.306 (5.304)		0.257 (3.350)		0.287 (4.255)	
Initial GDP per head	–0.013 (–3.147)	–0.011 (–2.982)	–0.086 (–5.151)	–0.118 (–7.652)	–0.071 (–3.207)	–0.120 (–3.811)	–0.080 (–4.175)	–0.074 (–6.167)
Investment rate	0.0005	0.0006	0.0012	0.001	0.0010	0.0009	0.001	0.0002
	(2.681)	(2.283)	(3.943)	(3.852)	(3.441)	(3.234)	(1.968)	(1.657)
Active Population growth	0.009 (0.371)	0.010 (0.413)	–0.117 (–0.842)	–0.101 (–1.451)	–0.122 (–0.996)	–0.103 (–1.663)	–0.121 (–0.781)	–0.155 (–3.026)
Human Capital Index			0.009 (2.139)	0.009 (2.432)	0.006 (1.602)	0.009 (1.984)	0.009 (2.069)	0.004 (1.650)
Degree of Openness					–0.0001 (–1.173)	–1.65E-05 (–0.053)		
Public Expenditure rate							0.0002 (0.481)	0.0025 (7.481)
DUM	–0.008 (–4.512)	–0.008 (–4.645)	–0.007 (–2.708)	–0.006 (–2.305)	–0.007 (–2.517)	–0.006 (–1.967)	–0.008 (–2.286)	–0.010 (–9.845)
Weighted Statistics	N.º Obs=60 R-sq.=0.506 D-W=2.028 F=16.097	N.º Obs=60 R-sq.=0.486 D-W=2.012 F=7.201	N.º Obs=24 R-sq.=0.734 D-W=1.664 F=13.741	N.º Obs=24 R-sq.=0.788 D-W=2.152 F=9.573	N.º Obs=24 R-sq.=0.733 D-W=1.744 F=11.531	N.º Obs=24 R-sq.=0.762 D-W=2.210 F=7.717	N.º Obs=37 R-sq.=0.726 D-W=1.751 F=11.187	N.º Obs=24 R-sq.=0.994 D-W=2.294 F=33.324

TABLE A.10
EXPLAINING THE GROWTH PROCESS IN LATIN AMERICA: THE POOREST COUNTRIES
Dependent variable: GDP per head growth
Method: (A) GLS (Cross Section Weights), **(B) Fixed Effects**

Exogenous	(1A)	(1B)	(2A)	(2B)	(3A)	(3B)	(4A)	(4B)
Constant	0.013 (1.430)		0.081 (2.908)		0.096 (2.816)		0.094 (3.314)	
Initial GDP per head	–0.002 (–0.882)	–0.005 (–1.049)	–0.020 (–2.669)	–0.066 (–8.349)	–0.024 (–2.582)	–0.066 (–5.164)	–0.022 (–2.902)	–0.073 (–5.633)
Investment rate	0.0001 (1.605)	0.0003 (1.923)	0.0002 (0.728)	0.0008 (4.124)	0.0002 (0.845)	0.0009 (2.916)	0.0003 (0.946)	0.0009 (2.514)
Active Population growth	0.025 (1.949)	0.023 (2.004)	0.032 (1.782)	0.047 (3.692)	0.032 (1.840)	0.046 (2.238)	0.033 (1.817)	0.045 (1.612)
Human Capital Index			0.003 (1.845)	0.006 (7.149)	0.004 (2.230)	0.005 (6.293)	0.004 (1.953)	0.007 (4.320)
Degree of Openness					–2.35E-05 (–0.648)	–8.80E-05 (–1.147)		
Public Expenditure rate							–0.0004 (–2.703)	–0.0003 (–1.279)
DUM	–0.013 (–9.181)	–0.011 (–7.863)	–0.017 (–7.346)	–0.015 (–12.103)	–0.017 (–8.606)	–0.015 (–10.539)	–0.016 (–5.895)	–0.014 (–6.422)
Weighted Statistics	N.º Obs=105 R-sq.=0.393 D-W=1.973 F=17.875	N.º Obs=105 R-sq.=0.432 D-W=2.283 F=6.662	N.º Obs=37 R-sq.=0.705 D-W=1.878 F=18.263	N.º Obs=37 R-sq.=0.959 D-W=2.521 F=56.45	N.º Obs=37 R-sq.=0.707 D-W=1.870 F=15.480	N.º Obs=37 R-sq.=0.982 D-W=2.566 F=130.63	N.º Obs=37 R-sq.=0.763 D-W=1.826 F=20.361	N.º Obs=37 R-sq.=0.995 D-W=2.293 F=32.332

GRAPH A.1
CONVERGENGE σ IN THE RICHEST SUB-SAMPLE: 1950-2000

GRAPH A.2
CONVERGENGE σ IN THE POOREST SUB-SAMPLE: 1950-2000

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