

Regional Economic Convergence: The cases of Argentina,  
Brazil, and Peru

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1. Introduction

Evidences on economic convergence in the GDP per capita across countries and regions have been used to test the implications of the neoclassical economic growth model, and also to generate part of the ideas incorporated on the endogenous growth model literature (See: Romer, 1994; and Barro and Sala-i-Martin, 1991). Other implications like the direction of human capital migration were not studied in detail yet (See: Lucas, 1988).

Despite of many criticisms made on the use of large cross-countries and cross-regions information to study the convergence phenomena, it looks that provides very interesting insights for the study of the development of a region or country. As once the so called residual put the beginning of a big empirical and theoretical machinery to study the truth of its size and to provide a theory of technological change, I think that evidences on convergence could also push meaningfully advances on the understanding of the economic growth process.

Barro and Sala-i-Martin (1991) provided a very interesting modelling of the convergence behavior implied by the neoclassical

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growth model suitable for empirical analysis. They applied the model to study the convergence speed across regions in United States and some European countries. This model were developed for the GDP per capita variable'. Eventhough they put the emphasis on what they called the  $\beta$  convergence, they made a comparison with the results implied by the  $\sigma$  convergence measurement (standard deviation of log of GDP per capita across regions).

The  $\beta$  convergence model estimated by Barro and Sala-i-Martin implied a value for  $\beta$  of around 2.5 per cent per year. This convergence speed was considered to be very low. They verified this result including other variables (like economic structure) and the role of regional labor migration\*.

The objctive of this paper is to study the economic regional convergence in Argentina, Brazil, and Peru using the methodology of Barro and Sala-i-Martin. Eventhough the regional data on those countries are not as rich as one will need to fully apply their methodology, it provides a reasonable start in the search of the existence or not of regional convergence in Latin America and its determinants.

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1. Other possibility could be to use the Wealth per capita (which could have a different pattern than the GDP per capita distribution, see Rosen, 1992). Also one could analyze only one economic sector like manufacturing, and to look instead of the GDP per capita the Total Factor Productivity (see Hulten and Schwab, 1993).
  2. Blanchard (1991) developed a regional model with labor and capital migration that produced a reduced form similar to the equation of Barro and Sala-i-Martin, in which the labor and capital migration elasticities playing the role of the parameter  $\beta$ .

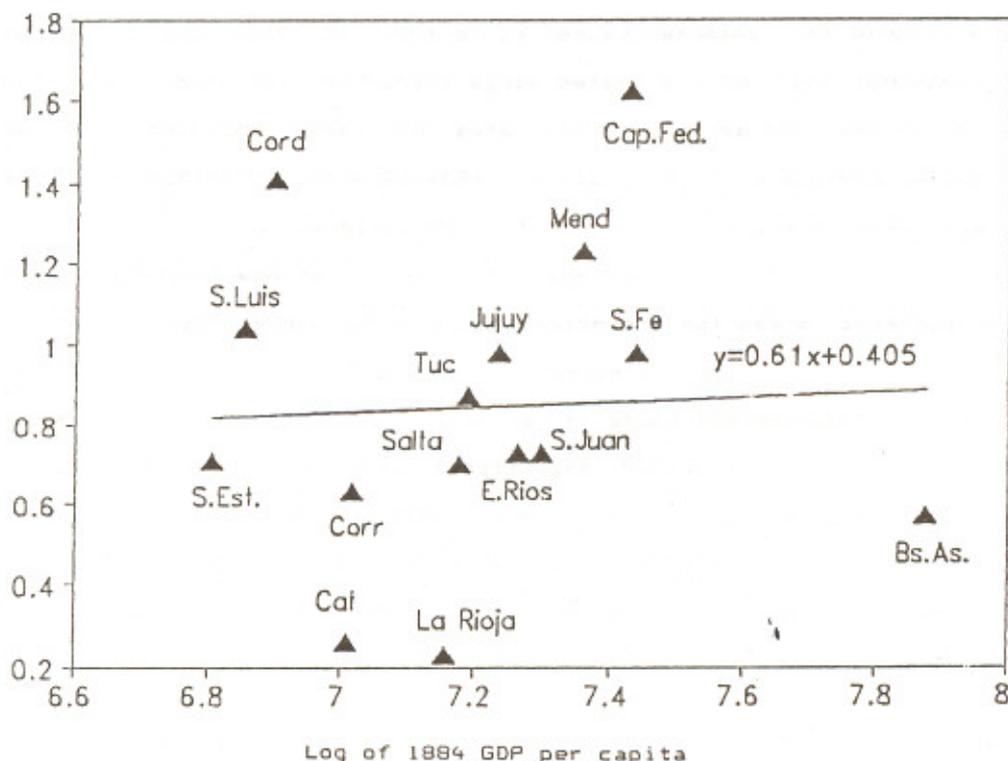
## 2. The data and convergence figures

In the case of Argentina GDP estimates at the State level are available for selected years since 1884 to 1960, and in annual basis for most of the States since 1960. For this study I am going to use the GDP per capita estimates for 1884, 1953, and 1985, so two subperiods will be analyzed: 1884-1953 and 1953-1985. All the estimates were put in terms of 1992 US dollars.

Figures 1 and 2 present a first view of how the convergence hypothesis worked for Argentina in these two subperiods:

Figure 1. Convergence of GDP per capita across Argentina States: 1884 GDP per capita and GDP per capita Growth from 1884 to 1953.

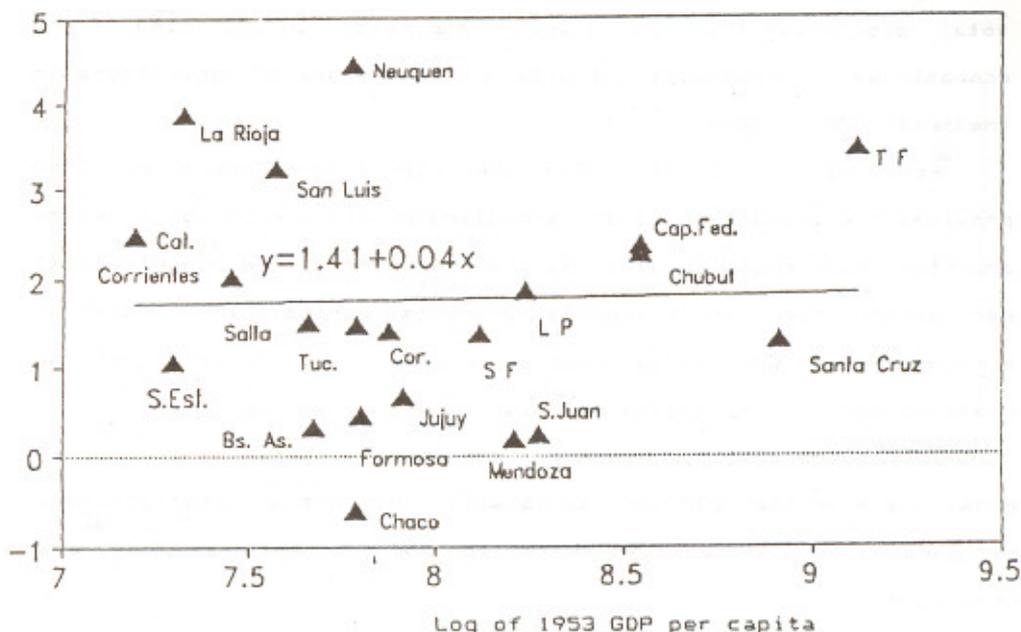
Annual Growth rate 1884-1953



Sources: Consejo Federal de Inversiones, Producto Bruto Geográfico (1970-1985), Buenos Aires, March 1990. M.G. and E.T. Mulhall, Handbook of the River Plate, fifth edition, Buenos Aires and London: M.G. and E.T. Mulhall and Trubner and Co., 1985. Juan V. Sourrouille, Análisis Regional Argentino, unpublished, Buenos Aires. Consejo Federal de Inversiones and Instituto Torcuato Di Tella, Relevamiento de la Estructura Regional de la Economía Argentina, Buenos Aires, 1963.

Figure 2. Convergence of GDP per capita across Argentina States: 1995 GDP per capita and GDP per capita Growth form 1953 to 1985.

Annual Growth rate 1953-1985.



Sources: Ibidem Figure 1.

Figure 1 and 2 does not show much convergence in the Argentine case. This could be due to the role of other variables that should be considered in the convergence model. So one could add another variable that could have been working that explain the results presented in both figures. I will consider some indicator of the human capital per capita and of the economic sector composition at the beginning of each subperiod.

For the period 1884-1953 the Population Census of 1895 provides the number of Engineerings, which divided by the total

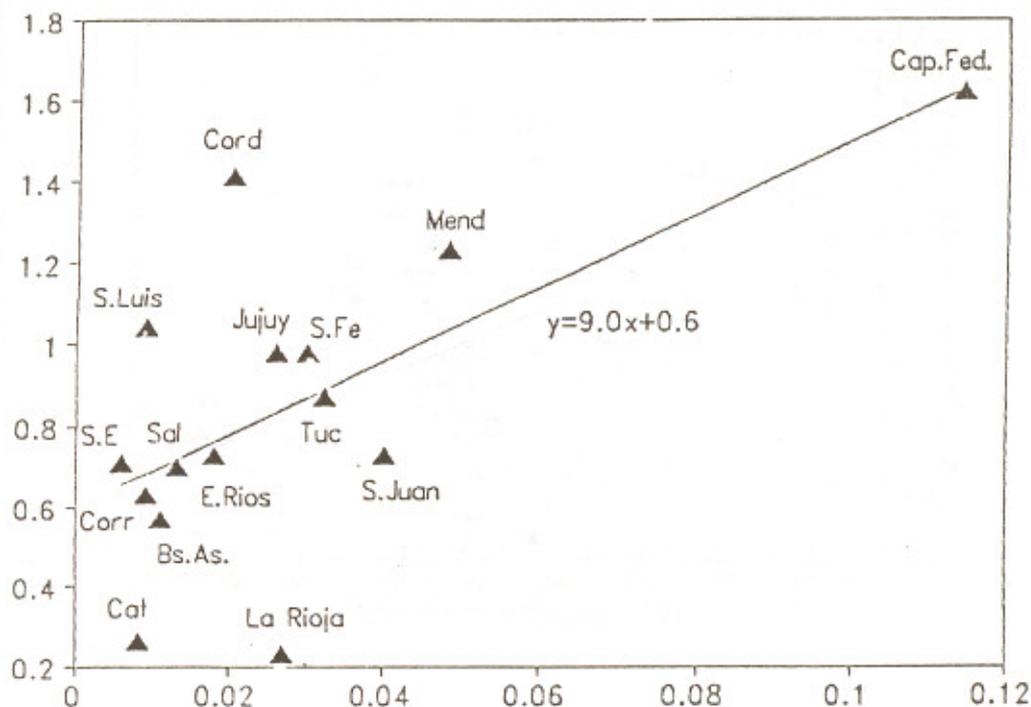
population could be considered as a proxy of human capital per capita. Other indicators that could be used are the total number of professionals per person and the proportion of persons in the total population that could write and read. In the case of the economic sector composition I will use the share of agriculture in the total GDP in 1884.

For the period 1953-1985 the Population Census of 1960 provides the average level of schooling of the population 14 years and older that could be used as the indicator of the human capital per person for the beginning of this period. The share of agriculture on GDP could also be used as an indicator of the economic sector composition for year 1953.

In Figures 3 through 6 the relationships between the annual growth rate of the GDP per capita with the initial human capital per person and agriculture share on GDP for both periods are presented.

Figure 3. Convergence of GDP per capita across Argentina States: 1895 number of engineering per person and GDP per capita Growth from 1884 to 1953.

Annual Growth rate 1884-1953

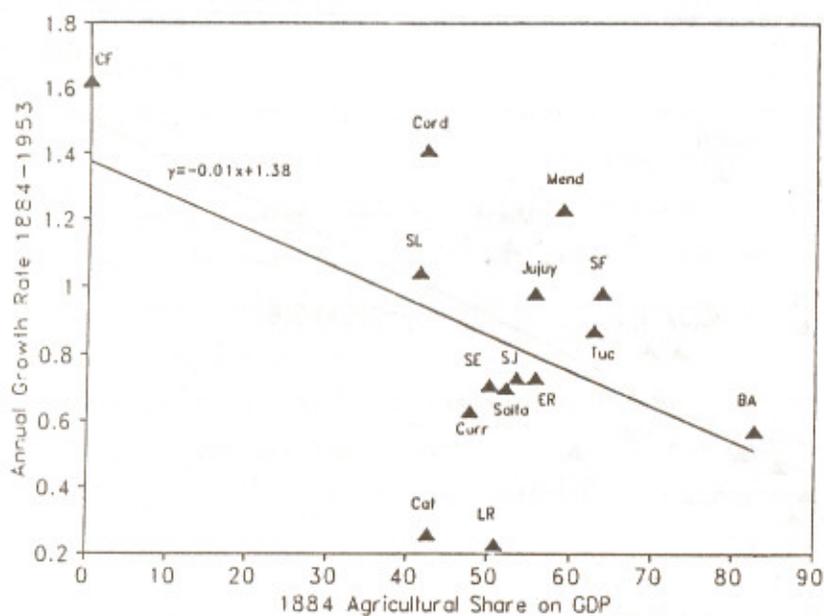


Log of 1895 Engineerings per person.

Sources: Ibidem Figure 1 and Population Census of 1895, Dirección Nacional de Estadísticas y Censos, Buenos Aires.

Figure 4. Convergence of GDP per capita across Argentina States:  
1884 agricultural share on GDP and GDP per capita Growth  
from 1884 to 1953.

Annual Growth rate 1884-1953



Sources: Ibidem Figure 1.

Figure 5. Convergence of GDP per capita across Argentina States: 1960 average schooling in the labor force and GDP per Capita Growth from 1953 to 1985.

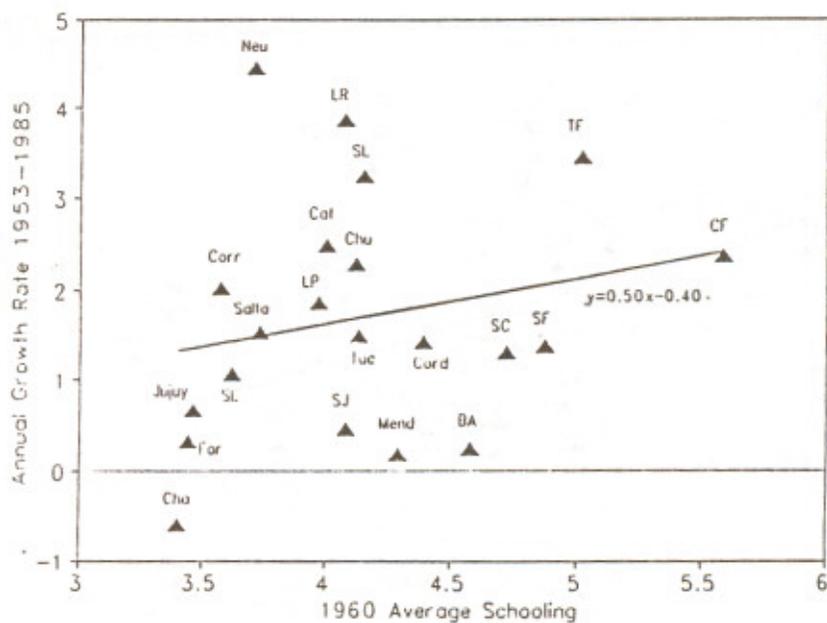
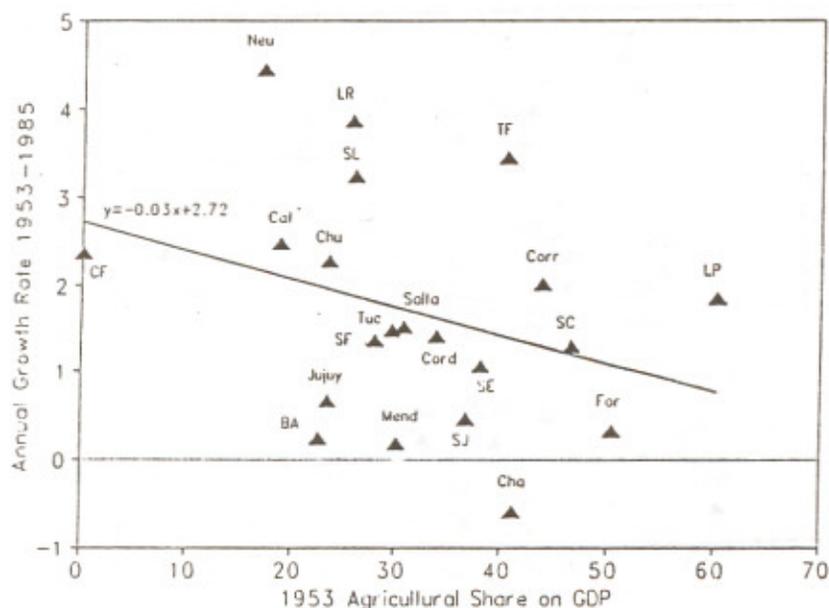


Figure 6. Convergence of GDP per capita across Argentina States: 1953 agricultural share on GDP on GDP and GDP per capita Growth from 1953 to 1985.

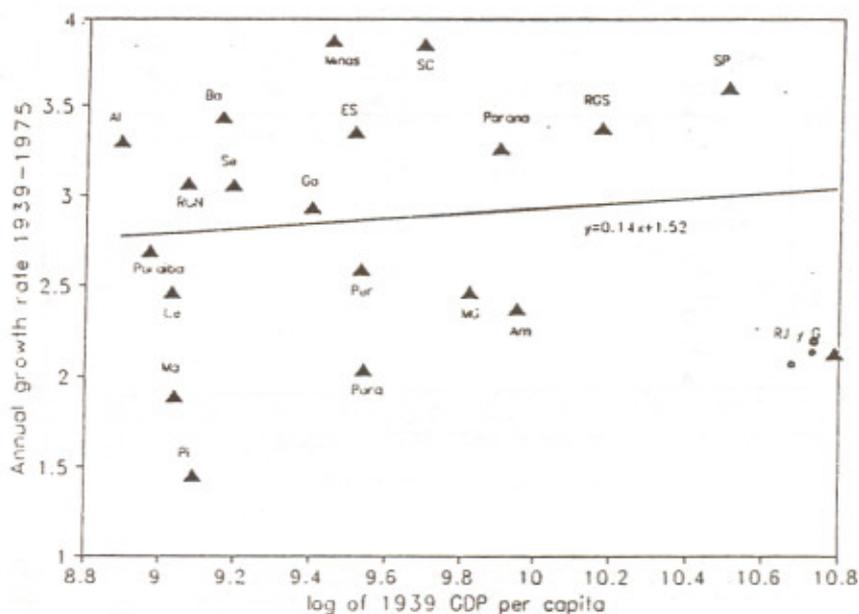
Annual Growth rate 1953-1985.



In the case of Brazil the periods 1939-1975 and 1939-1980 will be analyzed. In this period there were some changes in the definition of some States like the cases of the Federal District (moved from Rio de Janeiro to Brasilia) and the two Matto Grosso. Figure 7 present the convergence evidences for the period 1939-1975 and Figure 8 the ones for the period 1939-1980.

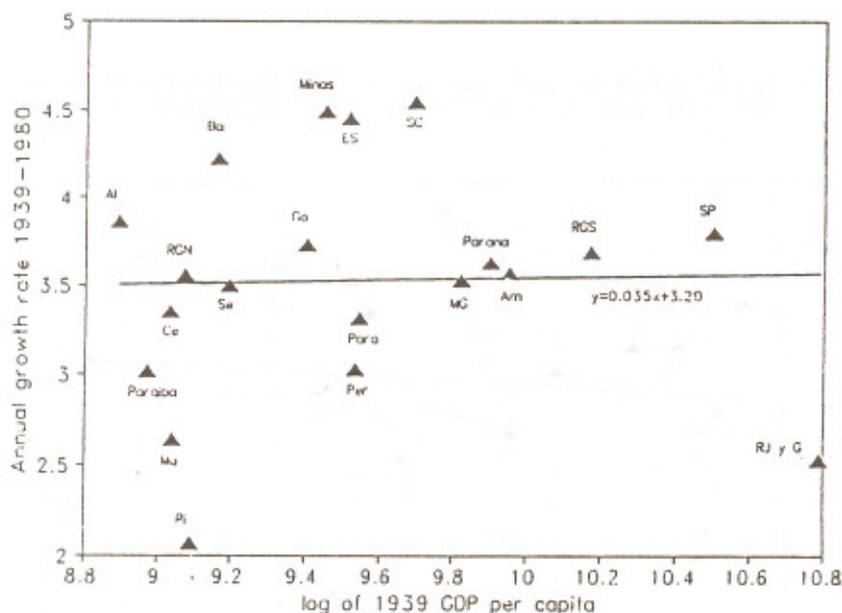
For Peru, Figure 9 presents the convergence evidences for the period 1970-1989. In this case States units are presented instead of regions units.

Figure 7. Convergence of GDP per capita across Brazil States: 1939 GDP per capita and GDP per capita growth from 1939 to 1975.



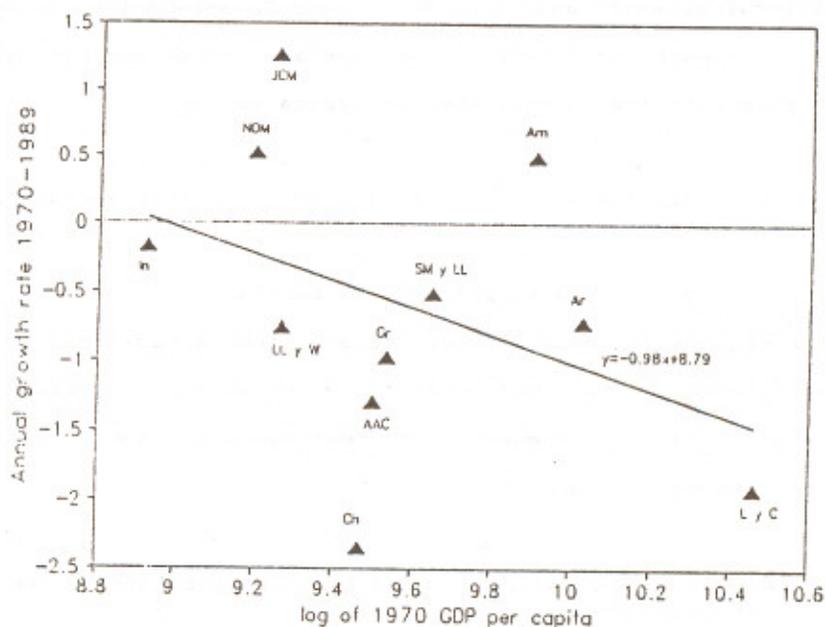
Sources: Estadísticas Históricas do Brasil, IBGE, Séries Estadísticas Retrospectivas; Volumen 3: Séries Económicas, Demográficas e Sociais, 1550-1985. Rio de Janeiro. IBGE, 1987. Fundação Instituto Brasileiro de Geografia y Estadística: Brasil: Séries Estadísticas Retrospectivas - 1970. Rio de Janeiro, Instituto Brasileiro de Estadística.

Figure B. Convergence of GDP per capita across Brazil States: 1939 GDP per capita and GDP per capita growth from 1939 to 1980.



Sources: Estadísticas Históricas do Brasil, IBGE, Séries Estadísticas Retrospectivas; volume 3: Séries Económicas, Demográficas e Sociais, 1550-1985. Rio de Janeiro, IBGE, 1987. Fundação Instituto Brasileiro de Geografia y Estatística: Brasil: Séries Estadísticas Retrospectivas - 1970. Rio de Janeiro, Instituto Brasileiro de Estatística.

Figure 9. Convergence of GDP per capita across Peru Regions: 1970 GDP per capita and GDP per capita Growth from 1970 to 1989.



Sources: Richard Webb y Graciela Fernandez Baca, Perú en Números 1991, Anuario Estadístico, Cuantos SA, Lima 1991.

### 3. The $\beta$ Convergence Model Estimation

From the neoclassical growth model of Solow, using a transitional dynamic analysis, Barro and Sala-i-Martin derived a reduced form model that relates the average annual GDP per capita growth rate with the initial GDP per capita value:

$$(1) \ln(y_t/y_0)/T = \alpha - (1 - e^{-\beta T})/T \cdot \ln y_0 + \text{other variables.}$$

where: T = number of years, y = GDP per capita.

The regression model is estimated using a non-linear least squares method. The parameter  $\beta$  indicates the speed of convergence. Table 1 presents the estimates of the regression model for the case of Argentina.

Table 1. Regression estimates of the  $\beta$  convergence model: The case of Argentina.

Variables.	Periods	
	1884-1953	1953-1985
<u>Regression 1</u>		
Constant	.056 (2.042)	.113 (.773)
$\beta$	.008 (1.181)	.042 (.454)
Human capital	.008 (4.109)	.030 (1.372)
R <sup>2</sup>	.609	.095
n	15	21
<u>Regression 2</u>		
Constant	1.183 (3.293)	2.459 (2.864)
$\beta$	0.0002(0.890)	- 0.0001(-0.642)
Agricultural share	- 0.013 (-2.143)	- 0.034 (-1.539)
R <sup>2</sup>	.277	.127
n	15	21

Note: t-test values within parenthesis.

In Table 2 the regressions results for Brazil and Peru are presented. In the case of Brazil a dummy variable is used to discriminate between the North and Northeast States from the other regions (in Figures 8 and 9 could be noticed different convergence pattern between these two groups of States).

Table 2. Regression estimates of the  $\beta$  convergence model: The cases of Brazil and Peru.

Variables	Brazil	Peru
Constant	4.039 (0.991)	.048 (.013)
$\beta$	.461 (0.000)	6.237 (0.000)
Dummy	- .559 (-1.344)	
R <sup>2</sup>	.193	.022
n	20	12

In all the cases estimated the convergence were either very low or non-existent. In the case of Argentina (first subperiod) the Human Capital variable looked to be relevant to explain the low convergency, and the agricultural share variable worked in contrary to what was expected.

These preliminary results indicates teh need to increase the sample size and to explore the relevance of other variables that could play an important role in the convergence phenomena.

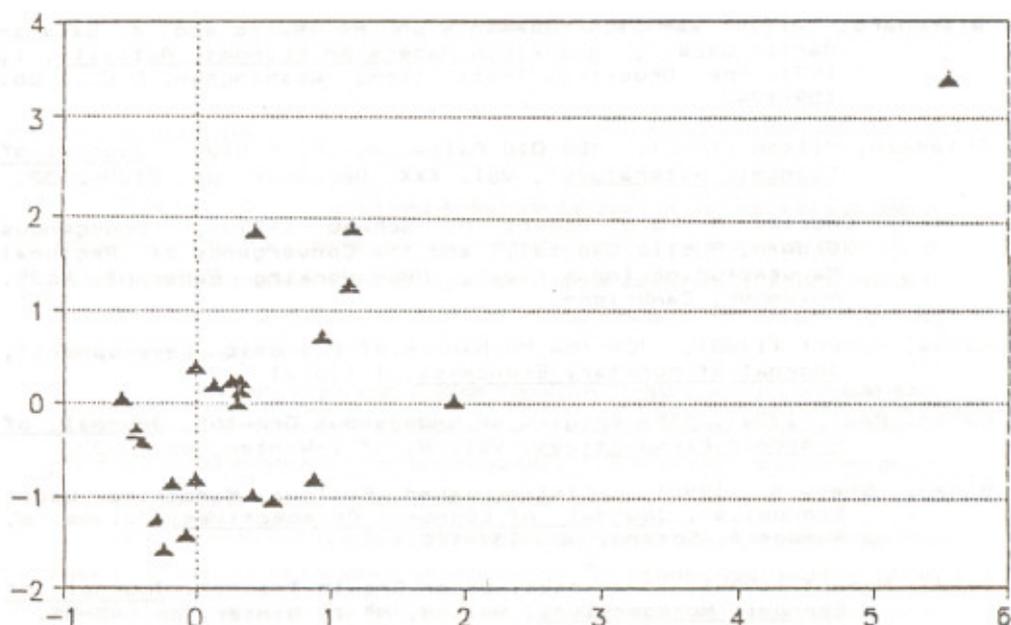
#### 4. Migration Persistence

The regional migration of labor and capital inputs competes with the convergence theory as explanation of the behavior of the GDP per capita growth rate across regions. Some evidences in favor of the working of the convergence theory are the migration behavior between different periods. The migration persistence across regions gives some support to the convergence theory (regions that have positive net migration for the first period continue to have positive net positive migration in the next period).

Figure 10 present for Argentina the migration behavior between the periods 1947-1970 and 1970-1991 across States. It is possible to observe the existence of some migration persistence that gives some support to the  $\beta$  convergence model discussed above.

Figure 10. Migration Persistence in Argentina. Annual migration rate across States. Periods 1947-1970 and 1970-1991.

Annual migration rate 1947-1970.



Annual migration rate 1970-1991

Sources: Population Censuses of 1947, 1970, and 1991. Instituto Nacional de Estadísticas y Censos, Buenos Aires.

## 5. References

- Barro, Robert and Xavier Sala-i-Martin (1991), "Convergence across States and Regions", Brookings Papers on Economic Activity, 1, 1991. The Brookings Institution, Washington, D.C., pp. 107-158.
- Blanchard, Oliver (1991), "Comments on R. Barro and X. Sala-i-Martin paper", Brookings Papers on Economic Activity, 1, 1991. The Brookings Institution, Washington, D.C., pp. 159-174.
- Friedman, Milton (1992), "Do Old Fallacies Ever Die?", Journal of Economic Literature, Vol. XXX, December, pp. 2129-2132.
- Hulten, Charles R. and Robert M. Schwab (1993), "Endogenous Growth, Public Capital, and the Convergence of Regional Manufacturing Industries", NBER Working Paper N° 4538, November, Cambridge.
- Lucas, Robert (1988), "On the Mechanics of Economic Development", Journal of Monetary Economics, 1 (July)
- Romer, Paul (1994), "The Origins of Endogenous Growth", Journal of Economic Perspectives, Vol. 8, N° 1-Winter, pp. 3-22.
- Rosen, Sherwin (1992), "Distinguished Fellow: Mincering Labor Economics", Journal of Economic Perspectives, Volume 6, Number 2, Spring, pp. 157-170.
- Solow, Robert (1994), "Perspectives on Growth Theory", Journal of Economic Perspectives, Vol. 8, N° 1, Winter, pp. 45-54.