

REGIONAL ECONOMIC CONVERGENCE: THE CASE OF LATIN AMERICAN ECONOMIES

Víctor J. Elías*

ABSTRACT

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

SINTESIS

El objetivo de este trabajo es estudiar la convergencia económica regional en Argentina, Brazil y Perú usando la metodología de Barro y Sala-i-Martin. Aún cuando los datos regionales para estos países no son lo suficientemente amplios como para poder aplicar su metodología a cabalidad, constituyen un punto de partida razonable para intentar determinar la existencia o no de una convergencia regional y de sus determinantes en América latina.

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1. INTRODUCTION

Evidences of economic convergence on 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 in the endogenous growth model literature (See: Romer (1994); and Barro and Sala-i-Martin (1991)). Other implications such as the direction of human capital migration have not been studied in detail as yet (See: Lucas (1988)).

Despite many criticisms made on the use of large cross-country and cross-region information to study the convergence phenomena, it seems, however, to provide very interesting insights for the study of the development of a region or country. As once the so called residual marked the beginning of a big empirical and theoretical machinery to study its real size and to provide a theory of technological change, I believe that evidences on convergence could also involve meaningful advances in understanding the economic growth process.

Barro and Sala-i-Martin (1991) provided a very interesting modelling of the convergence behavior —implied by the neoclassical growth model— that is suitable for empirical analysis. They applied what they called the β convergence, making a comparison with the model to study the speed of convergence across regions in the United States and some European countries. This model was developed for the GDP per capita variable¹. However, they placed the emphasis on the results implied by the σ convergence measurement (standard deviation of log of GDP per capita across regions).

* *Estudios de Economía*, publicación del Departamento de Economía de la Facultad de Ciencias Económicas y Administrativas de la Universidad de Chile, vol. 22 N°2, diciembre de 1995.

¹ Another possibility would be to use 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 such as manufacturing and look at Total Factor Productivity instead of GDP per capita (see Hulten and Schwab, 1993).

The β convergence model estimated by Barro and Sala-i-Martin implied a value for β around 2.5 per cent per year. This convergence speed was considered to be very low. They verified this result by including other variables (such as economic structure) and the role of regional labor migration².

The objective of this paper is to study economic regional convergence in Argentina, Brazil, and Peru using the methodology of Barro and Sala-i-Martin. Though the regional data on those countries is not as rich as one may 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.

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 on an annual basis for most of the States since 1960. For this study I will use 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.

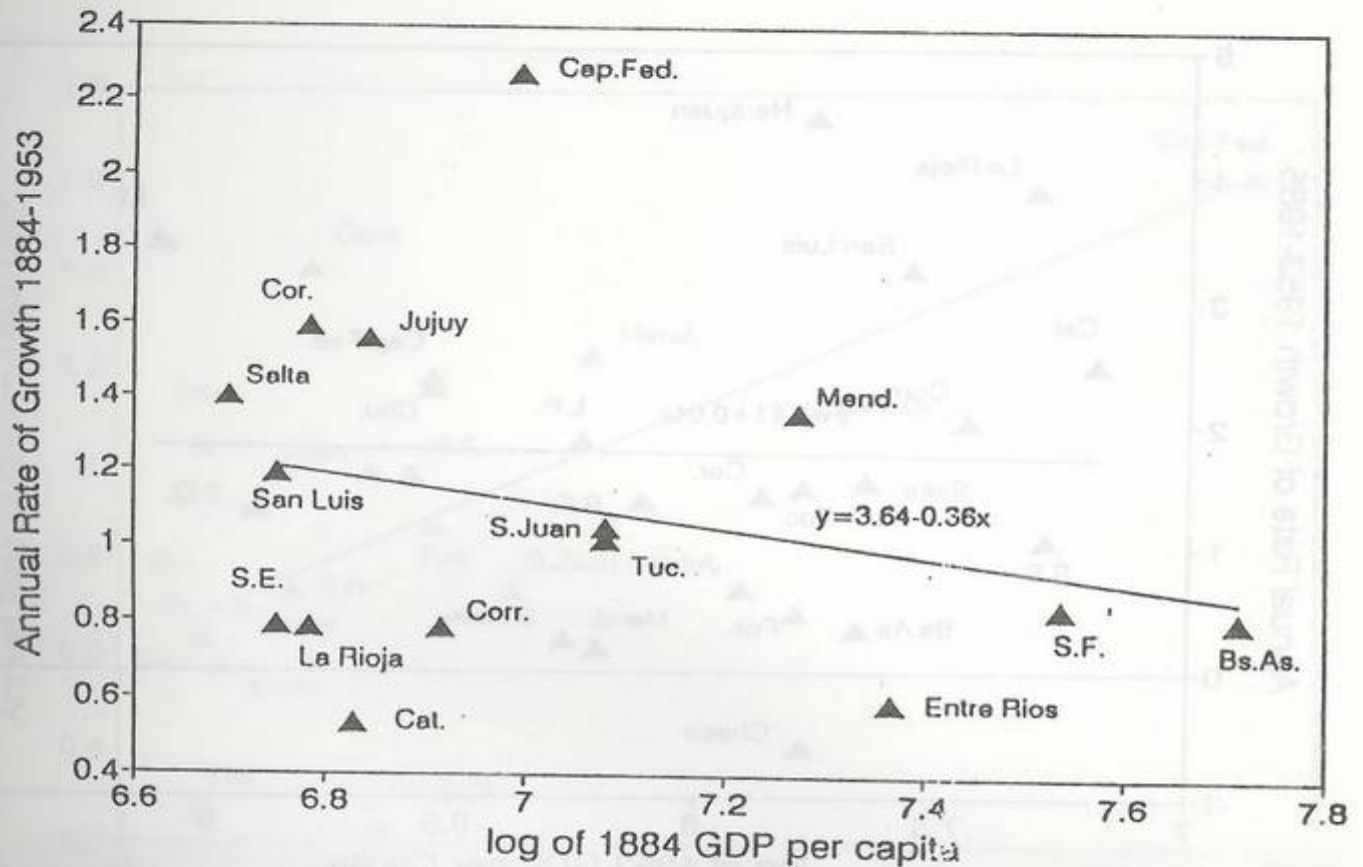
Figure 1 and 2 does not show much convergence in the Argentine case. This could be due to the role of other variables that should be considered in the convergence model. So one could add another variable that could have been working that explains the results presented in both figures. I will consider some indicators 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 Engineers, 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 inhabitants and the proportion of the total population that could write and read. In the case of the economic sector composition I will use the share of agriculture in total GDP in 1884.

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 labor and capital migration elasticities play the role of the parameter β .

FIGURE 1

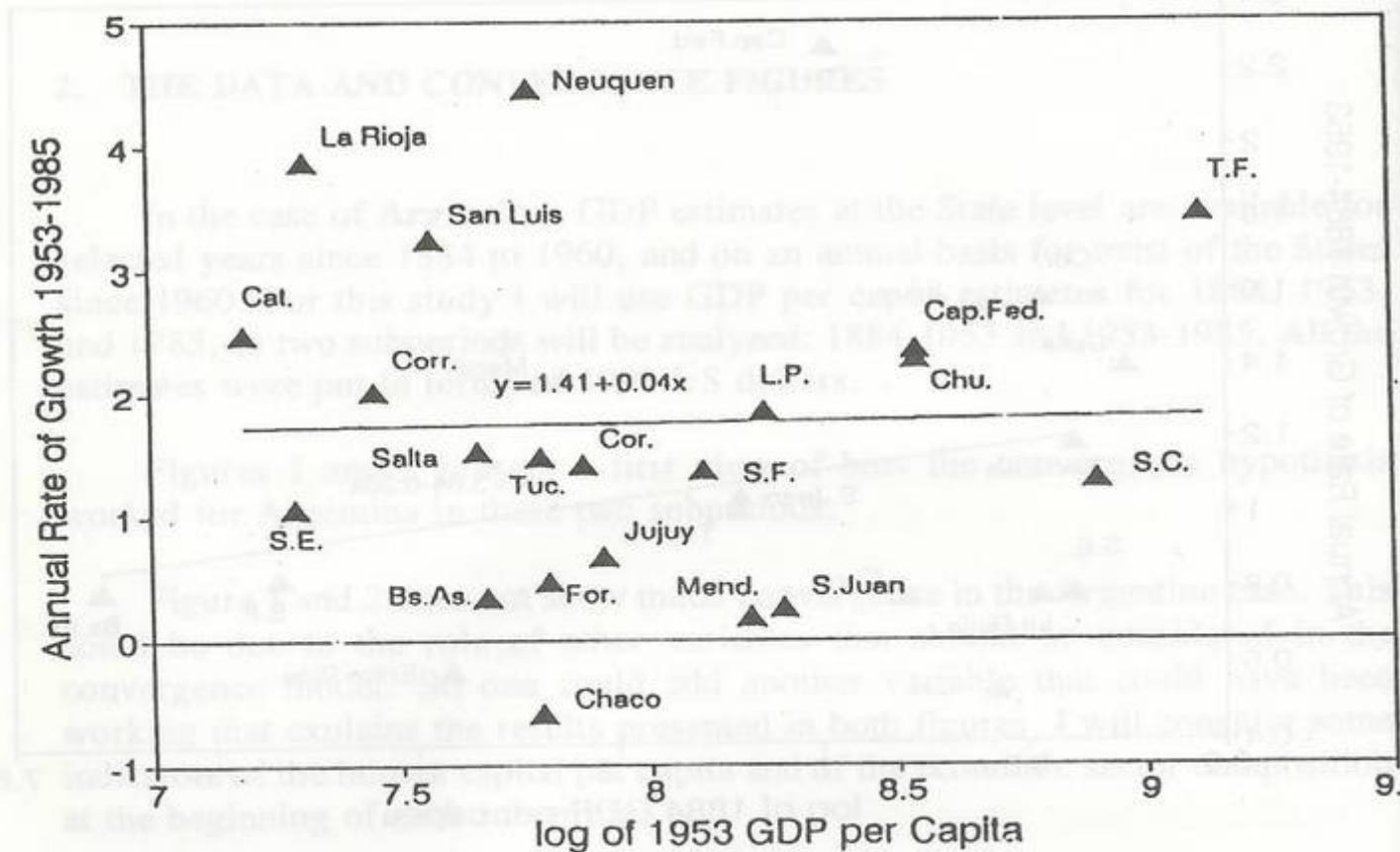
CONVERGENCE OF GDP PER CAPITA ACROSS ARGENTINA STATES: 1884 GDP PER CAPITA AND GDP PER CAPITA GROWTH FROM 1884 TO 1953



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., 1885. 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

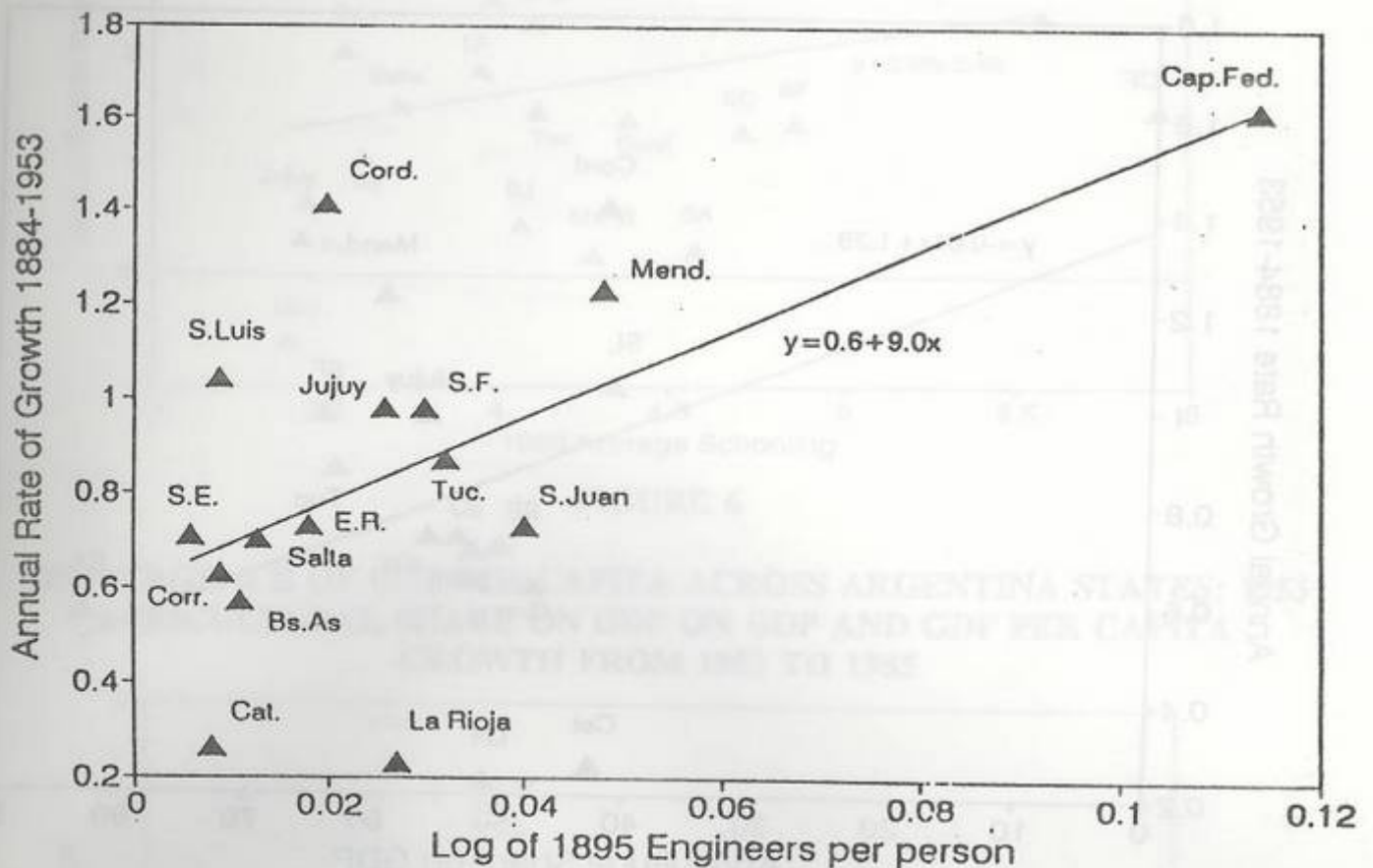
CONVERGENCE OF GDP PER CAPITA ACROSS ARGENTINA STATES: 1995
 GDP PER CAPITA AND GDP PER CAPITA GROWTH FORM 1953 TO 1985



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., 1885. 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 3

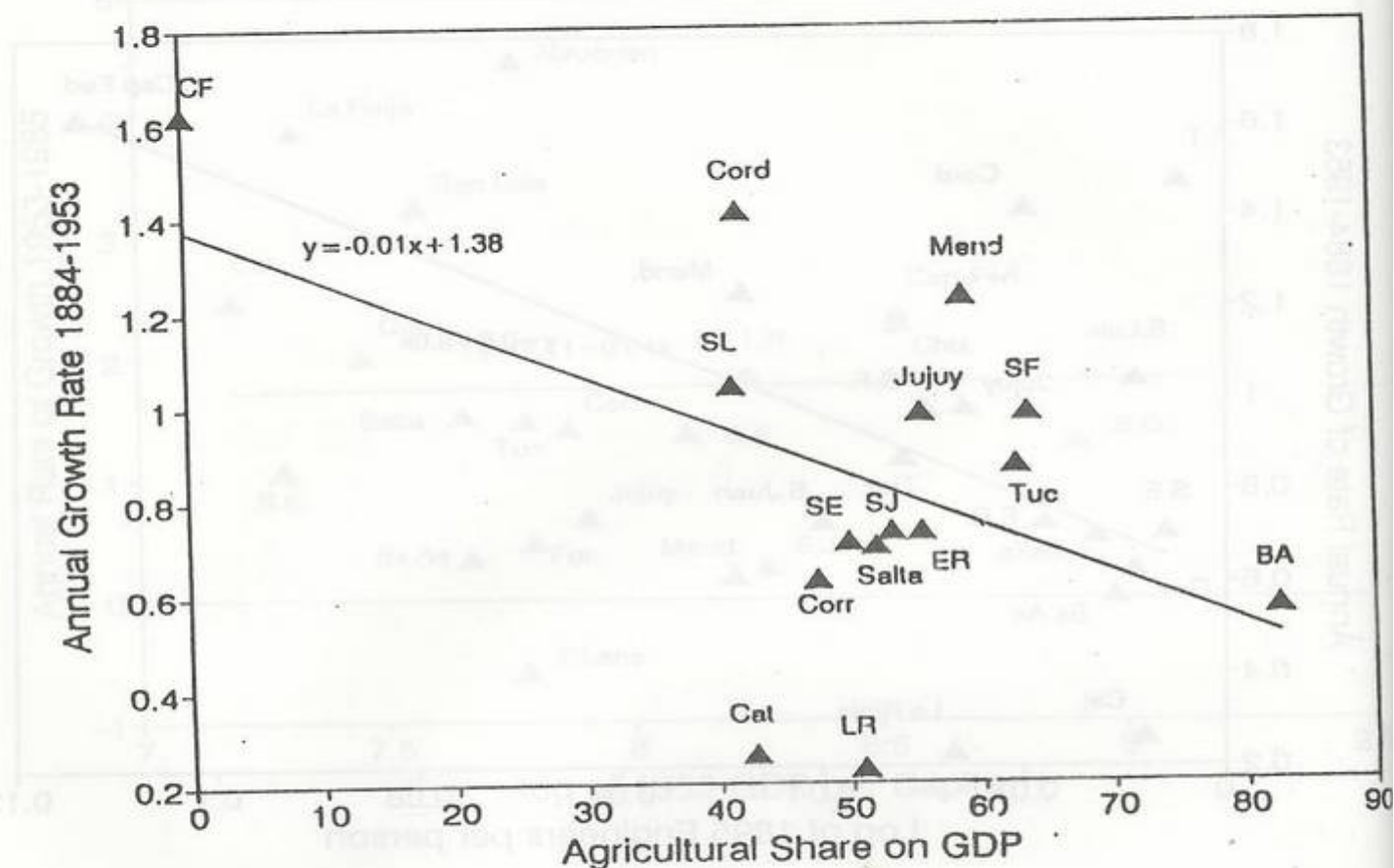
CONVERGENCE OF GDP PER CAPITA ACROSS ARGENTINA STATES: 1895
 NUMBER OF ENGINEERINGS PER PERSON AND GDP PER CAPITA
 GROWTH FROM 1884 TO 1953



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., 1885. 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. 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



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., 1885. 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 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

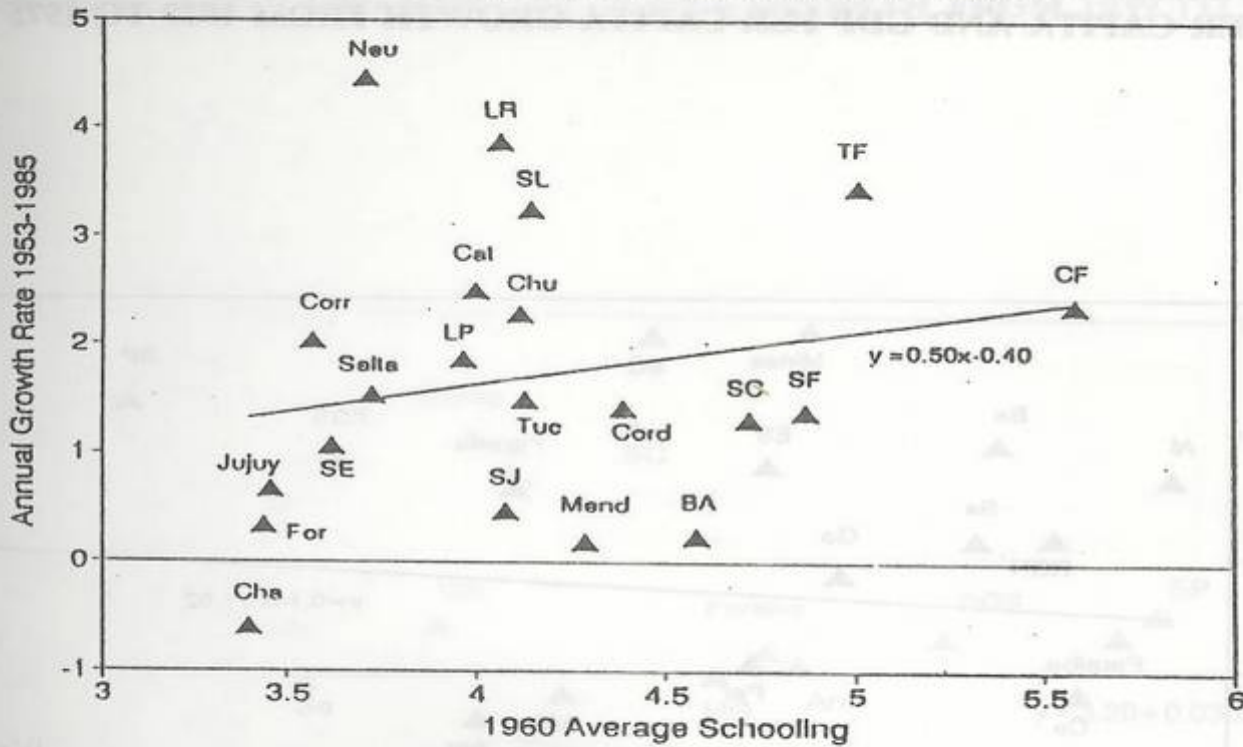


FIGURE 6

CONVERGENCE OF GDP PER CAPITA ACROSS ARGENTINA STATES: 1953
AGRICULTURAL SHARE ON GDP ON GDP AND GDP PER CAPITA
GROWTH FROM 1953 TO 1985

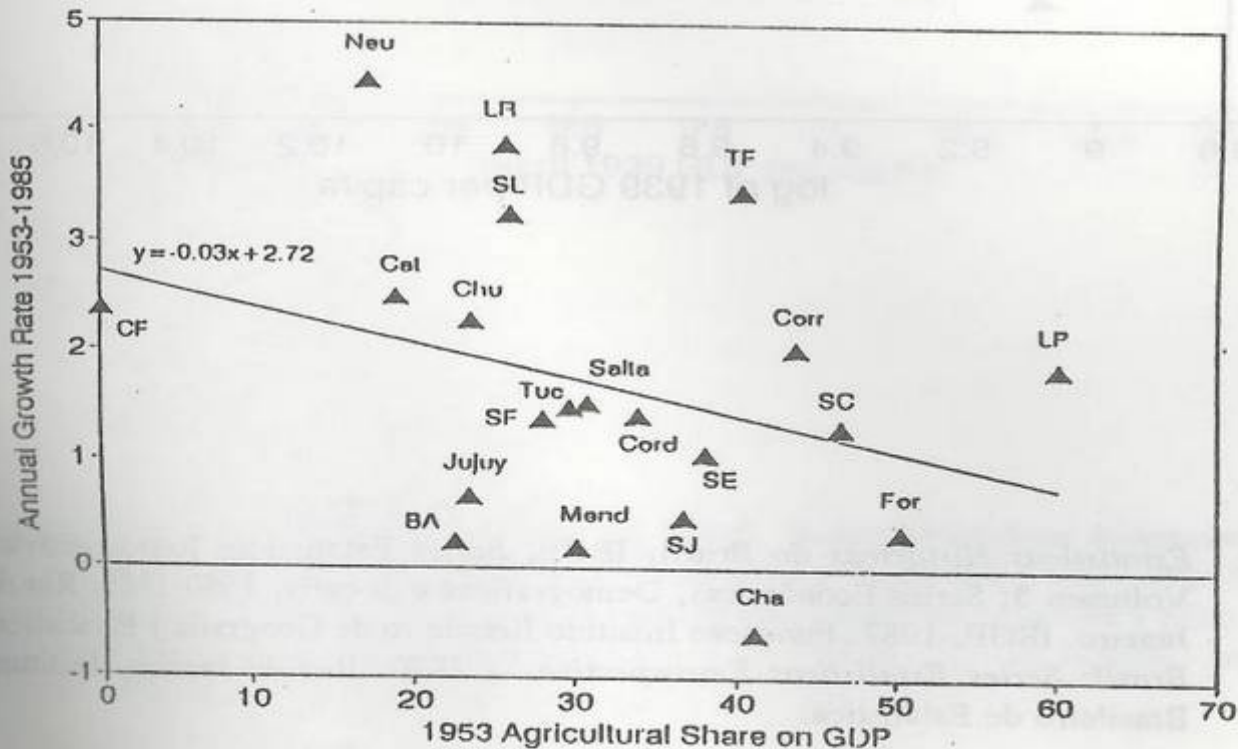
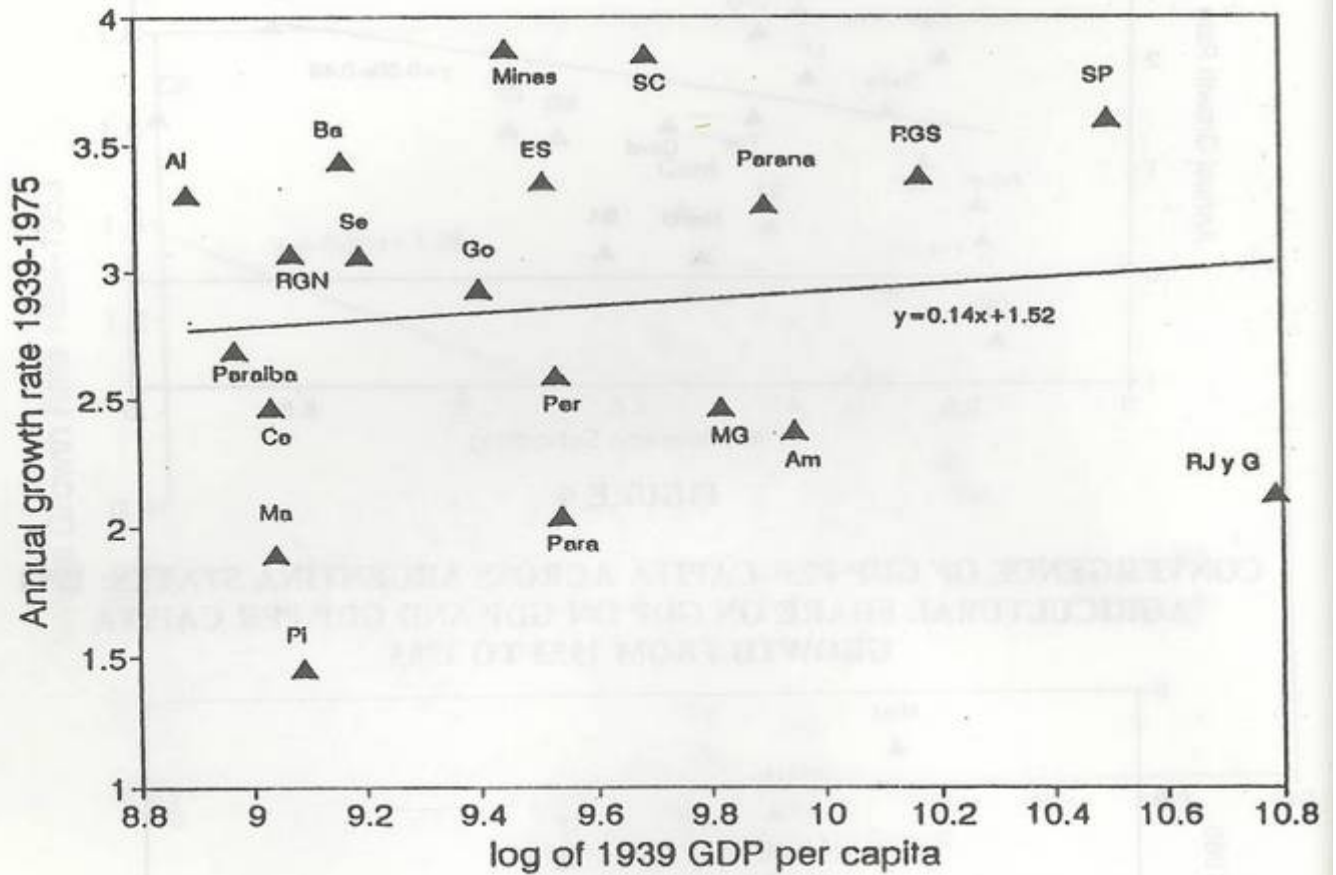


FIGURE 7

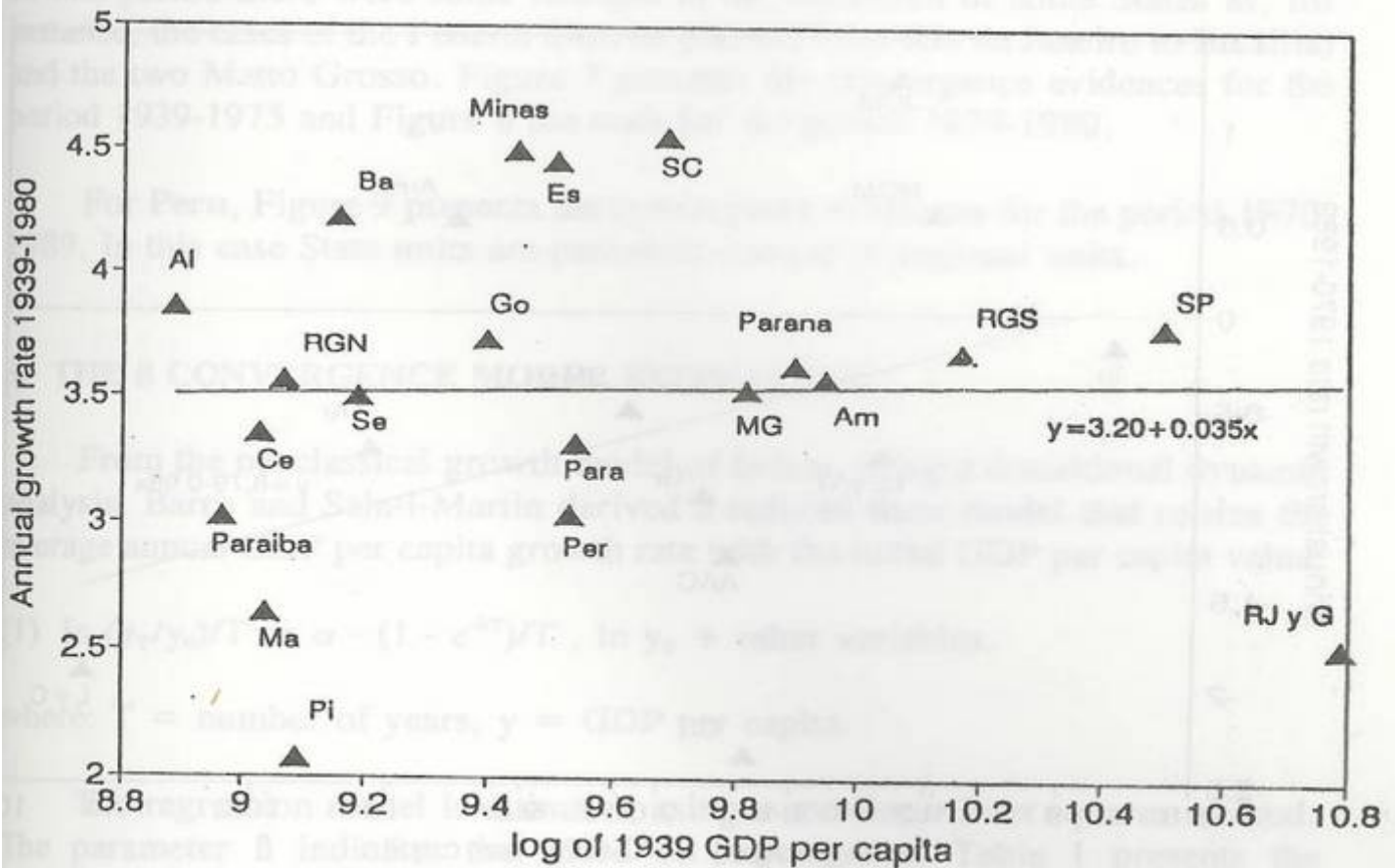
CONVERGENCE OF GDP PER CAPITA ACROSS BRAZIL STATES: 1939
 GDP PER CAPITA AND GDP PER CAPITA GROWTH FROM 1939 TO 1975



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

FIGURE 8

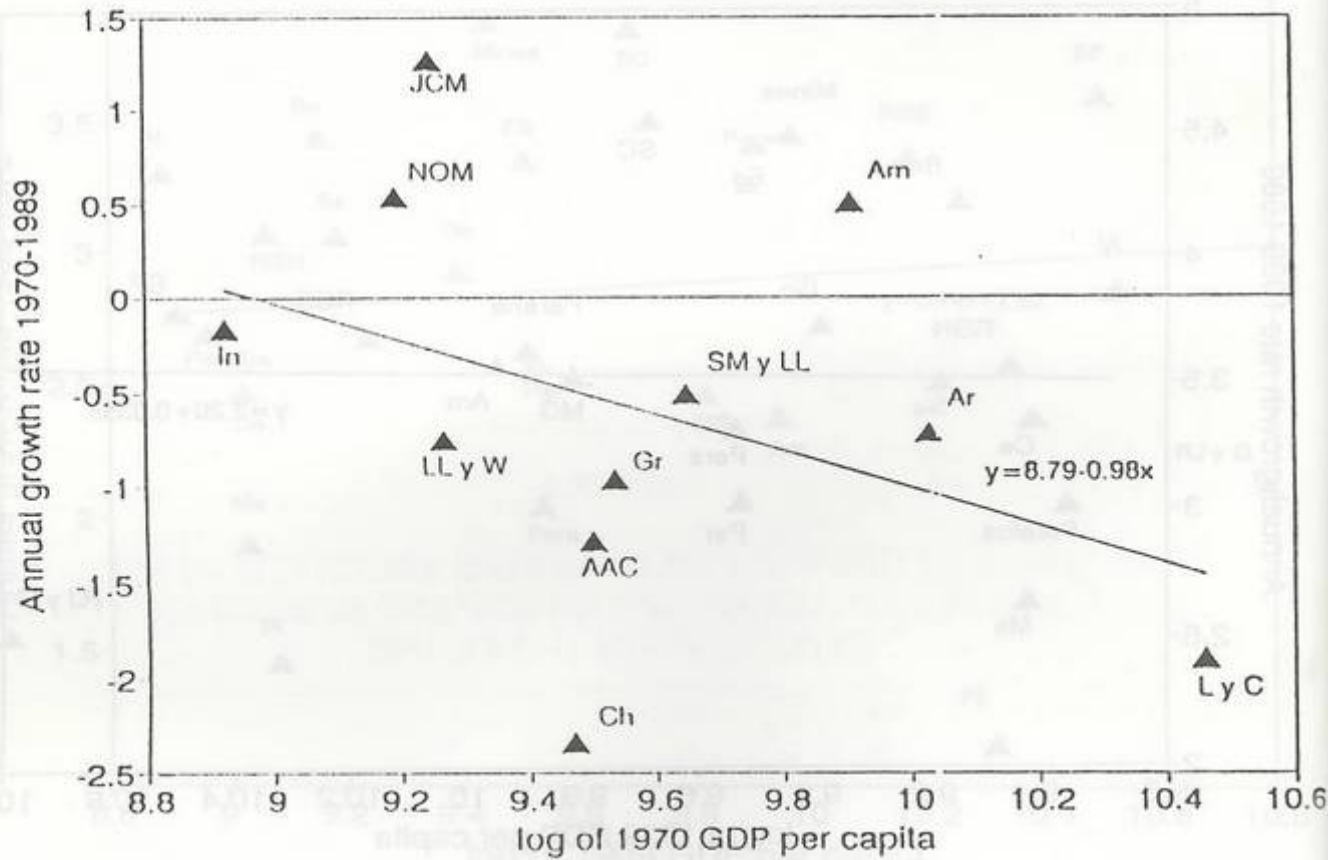
**CONVERGENCE OF GDP PER CAPITA ACROSS BRAZIL STATES: 1939
GDP PER CAPITA AND GDP PER CAPITA GROWTH FROM 1939 TO 1980**



Sources: *Estatísticas Históricas do Brasil*, IBGE, Series Estatísticas Retrospectivas; volume 3: Series Económicas, Demográficas e Sociais, 1550-1985. Rio de Janeiro, IBGE, 1987. Fundação Instituto Brasileiro de Geografia y Estatística: *Brasil: Series Estatísticas 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 and Graciela Fernandez Baca, *Perú en Números 1991*, Anuario Estadístico, Cuantos SA, Lima 1991.

For the period 1953-1985, the 1960 Population Census 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 inhabitant for the beginning of this period. The share of agriculture in 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 inhabitant and agriculture share in GDP for both periods are presented.

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 as, for instance, the cases of the Federal District (moved from Rio de Janeiro to Brasilia) and the two Matto Grosso. Figure 7 presents 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 State units are presented instead of regional units.

3. THE β 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 β indicates the speed of convergence. Table 1 presents the estimates of the regression model for the case of Argentina.

In Table 2 the regression 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 different convergence patterns may be noticed between these two groups of States).

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 seemed to be relevant to explain the low convergence, and the agricultural share variable had the opposite effect to that which was expected.

TABLE 1

**REGRESSION ESTIMATES OF THE β CONVERGENCE MODEL:
THE CASE OF ARGENTINA**

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

Note: t-test values within parenthesis.

TABLE 2

**REGRESSION ESTIMATES OF THE β CONVERGENCE MODEL:
THE CASES OF BRAZIL AND PERU**

Variables	Brazil		Peru	
	Constant	4.039	(0.991)	.048
β	.461	(0.000)	6.237	(0.000)
Dummy	-.559	(-1.344)		
R ²	.193		.022	
n	20		12	

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

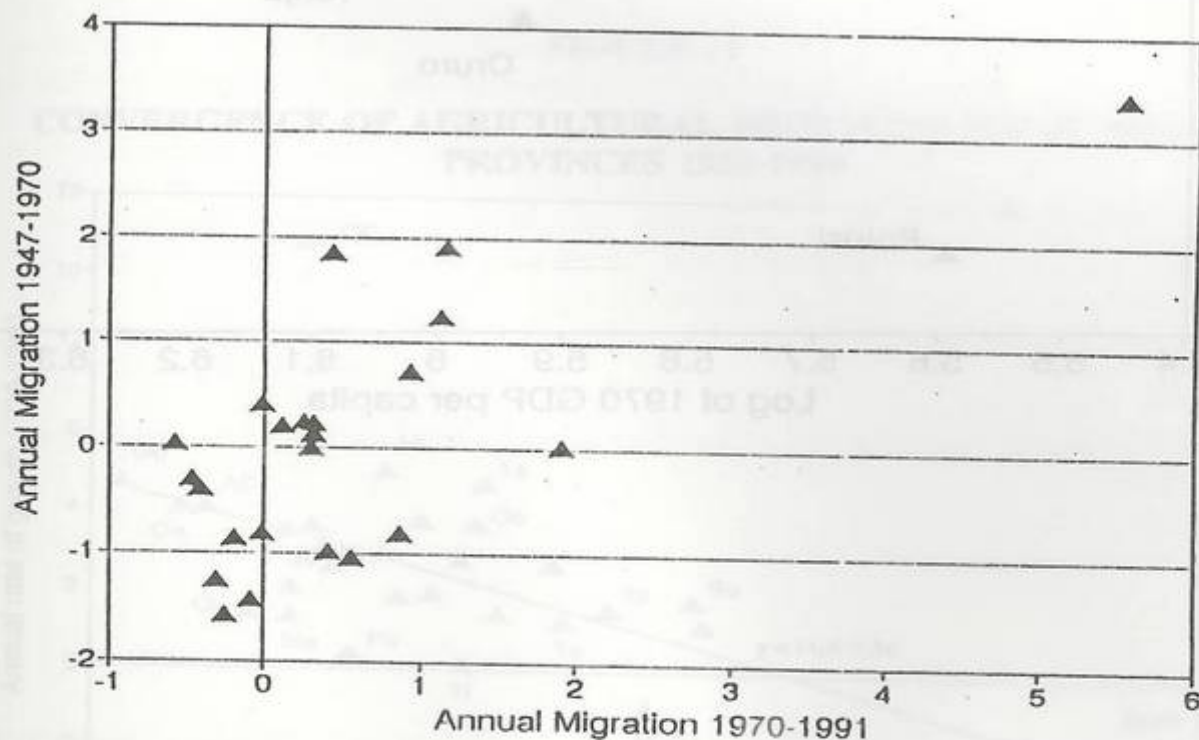
4. MIGRATION PERSISTENCE

The regional migration of labor and capital inputs competes with the convergence theory as an explanation of the behavior of the GDP per capita growth rate across regions. Some evidence in favor of the convergence theory at work is 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 migration in the next period).

Figure 10 presents the migration behavior for Argentina 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 β convergence model discussed above.

FIGURE 10

MIGRATION PERSISTENCE IN ARGENTINA. ANNUAL MIGRATION RATE ACROSS STATES. PERIODS 1947-1970 AND 1970-1991



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

APPENDIX

ADDITIONAL EVIDENCE IN OTHER LATINAMERICAN COUNTRIES:
BOLIVIA, CHILE AND MEXICO

FIGURE 11

CONVERGENCE OF GDP PER CAPITA ACROSS BOLIVIA STATES: 1970
GDP PER CAPITA AND GDP PER CAPITA GROWTH FROM 1970 TO 1991

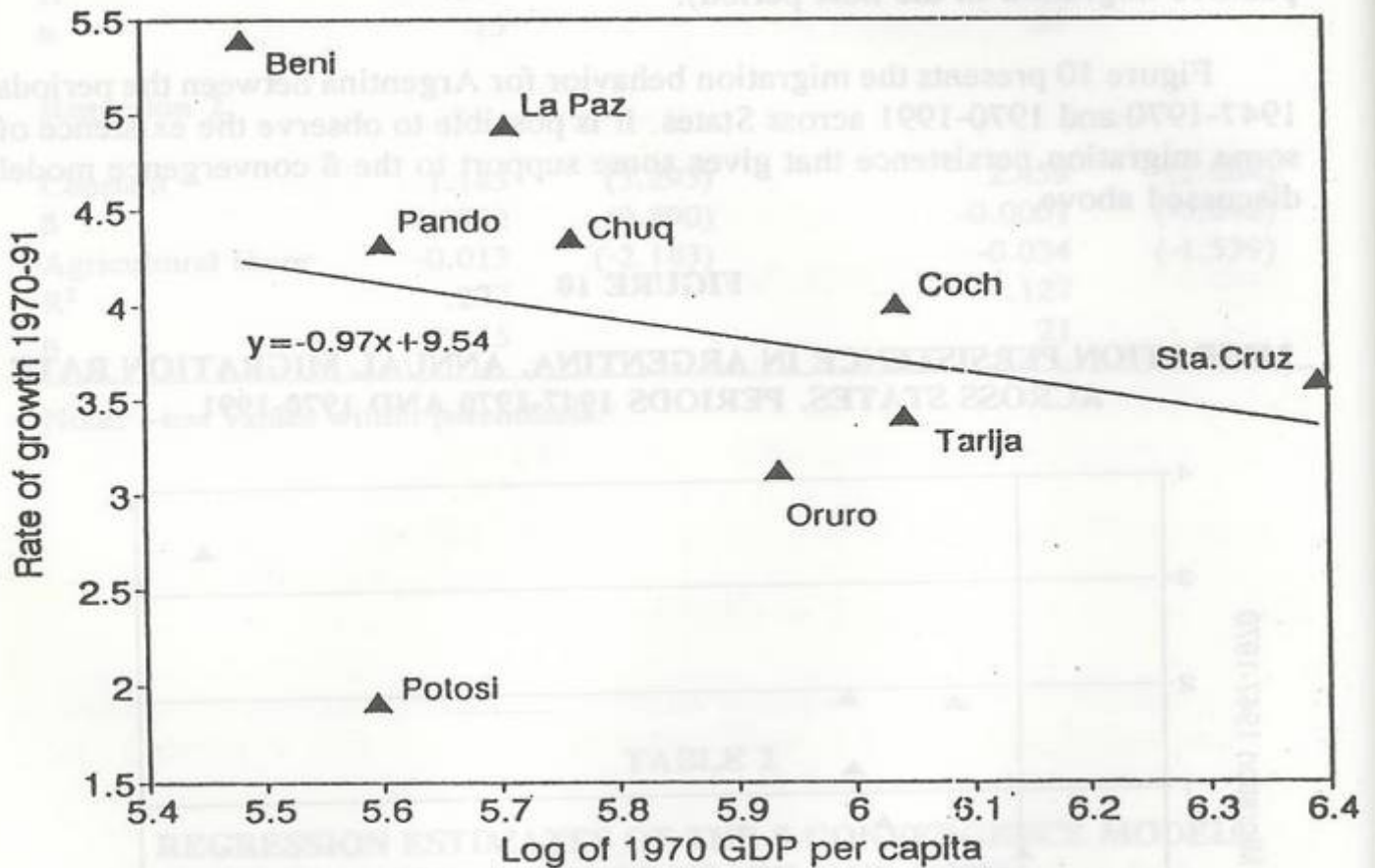


FIGURE 12

CONVERGENCE OF GDP PER CAPITA ACROSS CHILE REGIONS 1960-1970

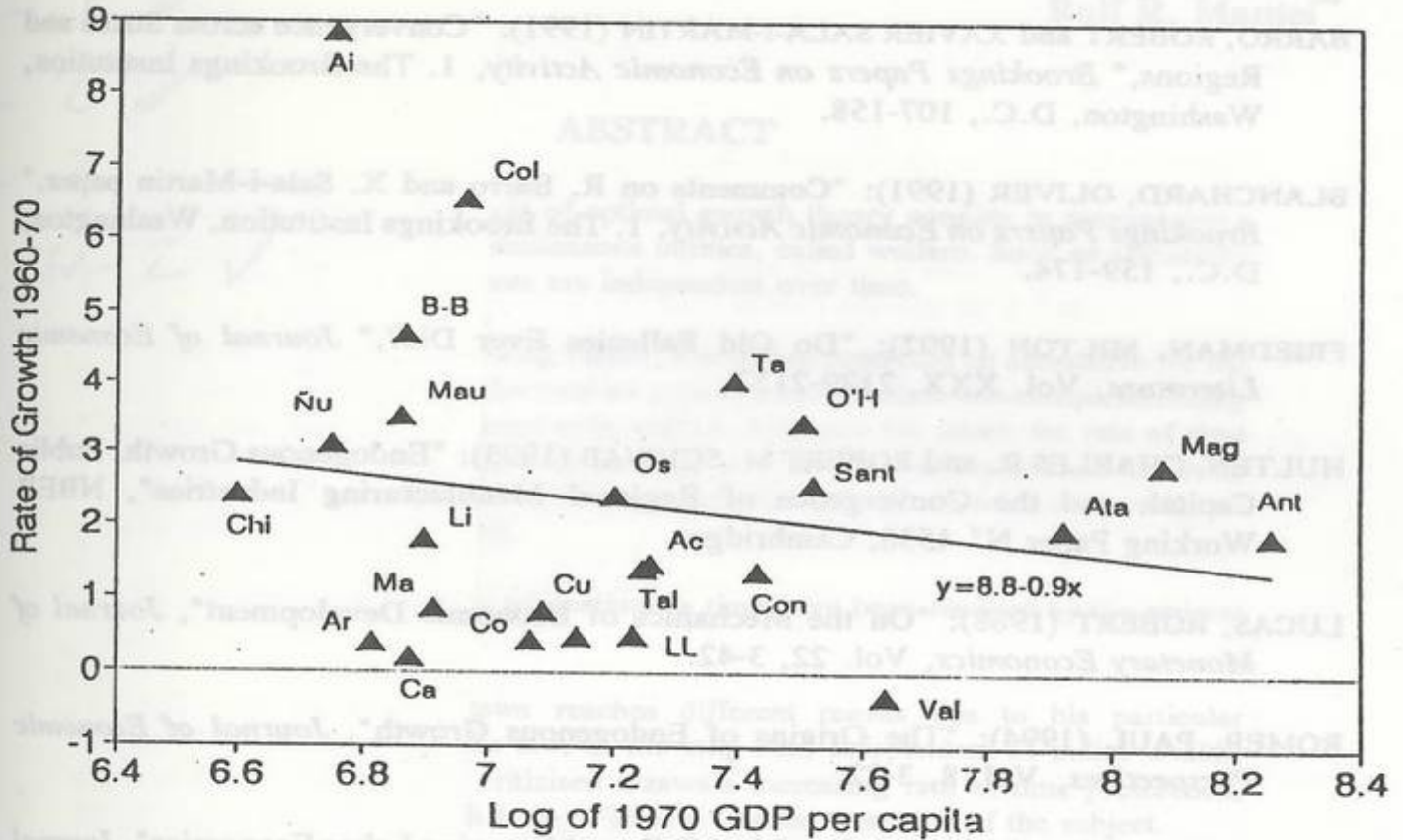
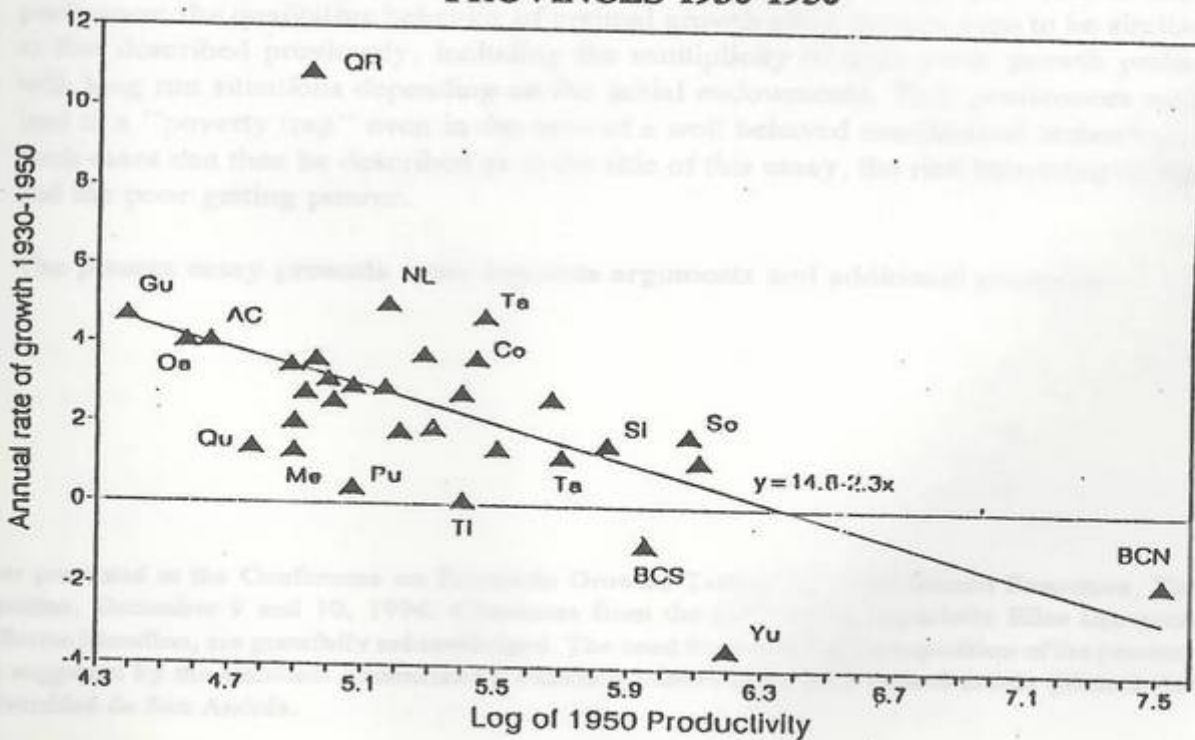


FIGURE 13

CONVERGENCE OF AGRICULTURAL PRODUCTIVITY IN MEXICO PROVINCES 1930-1950



REFERENCES

- BARRO, ROBERT and XAVIER SALA-I-MARTIN (1991): "Convergence across States and Regions," *Brookings Papers on Economic Activity*, 1. The Brookings Institution, Washington, D.C., 107-158.
- BLANCHARD, OLIVER (1991): "Comments on R. Barro and X. Sala-i-Martin paper," *Brookings Papers on Economic Activity*, 1. The Brookings Institution, Washington, D.C., 159-174.
- FRIEDMAN, MILTON (1992): "Do Old Fallacies Ever Die?," *Journal of Economic Literature*, Vol. XXX, 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, Cambridge.
- LUCAS, ROBERT (1988): "On the Mechanics of Economic Development", *Journal of Monetary Economics*, Vol. 22, 3-42.
- ROMER, PAUL (1994): "The Origins of Endogenous Growth", *Journal of Economic Perspectives*, Vol. 8, 3-22.
- ROSEN, SHERWIN (1992): "Distinguished Fellow: Mincering Labor Economics", *Journal of Economic Perspectives*, Vol. 6, 157-170.
- SOLOW, ROBERT (1994): "Perspectives on Growth Theory", *Journal of Economic Perspectives*, Vol. 8, 45-54.

