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CONVERGENCE IN HEALTH AMONG THE PROVINCES OF SPAIN
(1975-2000)

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Abstract:

This study measures the process of convergence in health among the provinces and regions of Spain from 1975-2000 so as to analyze the possible influence of the decentralization of healthcare management to the regions in this period. Sigma and beta convergence models, traditionally employed in macroeconomics, have been used, taking Life Expectancy at Birth and Infant Mortality as health indicators. The results reveal that, instead of a convergence in health during the period analyzed, there has been a *change of role*. Thus, certain provinces with initially poor indicators have improved, overtaking those that were originally in a better position. The final result, however, is one of greater dispersion. Finally, it should be mentioned that, among provinces, and depending on the level of responsibility acquired, there may have been a different dynamic evolution, thus forming distinct *stationary states* in health.

Keywords: convergence; health needs, public health

JEL codes: C12; C22; H70; I12; I18

1. BACKGROUND.

In the past two decades, the Spanish society has gone through a profound process of territorial decentralization. On a regional level, 17 Autonomous Communities (AC) have been created, taking on wide responsibilities in the provision and management of public services. In the area of healthcare, this decentralization can be divided into two different periods. The first was undertaken in 1981, starting with the transfer of healthcare responsibilities to the AC of Catalonia and ending with the same transfer of responsibilities to the AC of the Canary Isles. During this period, 7 ACs[1] (PCAC) took over the management of their healthcare systems. The second stage took place in 2002, when the remaining 10 ACs received the control of their respective health services (PCAS).

[1] Catalonia (1981), Andalusia (1984), Basque Country (1988), Valencia (1988), Galicia (1991) Navarre (1991) and Canary Isles (1994).

Each AC is made up of one or more provinces, which are intermediate politico-administrative structures between the regions (ACs) and the local councils. The first 7 ACs to take charge of healthcare cover 25 provinces with a total population of some 25 million inhabitants. The transfer of healthcare to the other 10 ACs in 2002 (PCAS) affected the other 25 provinces, whose overall population is around 15 million inhabitants.

This unique historical process gives us the chance to analyze how, and to what extent, the territorial decentralization of healthcare has affected convergence in health among the Spanish provinces and ACs. To answer this question, we have applied the convergence models known as sigma and beta convergence, which have traditionally been used in macroeconomic analysis (Barro and Salas & Martín, 1991, 1992, 1995). We have also drawn from certain antecedents in health convergence processes, though these have concentrated more on the convergence among nations (Nixon, 1999, 2000).

The advantage of applying convergence models, and not other approximations (Goerlich, 1998), to the area of health, as a measure of imbalance among different geographical regions, resides in the fact that they are relatively easy to calculate, and are both dynamic and stochastic. Another point to bear in mind is that the results have a great potential for interpretation. The article is divided into three sections. Firstly, we describe the convergence methodology used, along with the sources and variables employed. Secondly, we present the results in terms of sigma and beta convergence, as well as of conditional convergence, both for provinces and ACs. The final section deals with the conclusions.

2. METHODOLOGY.

As mentioned previously, the most widely-used economic definitions of convergence are sigma and beta convergence. The idea of sigma (σ) convergence is more intuitive. It occurs when the standard deviation of the study variable decreases significantly over time. Applied to our context, this means that, if there is a drop in the mean of the health differences of the different geographical areas considered, it can be said that there is a reduction in the differences. Therefore, if the typical deviation falls over time, convergence has taken place, and vicerversa[2].

In terms of income, beta (β) convergence occurs when the least developed countries or regions tend to grow more quickly than their developed counterparts (Boyle, G.E. and T.G. McCarthy, 1997). In health terms, this convergence will come about when those regions with initially lower health levels improve their situation with regard to the rest. The convergence implies the presence of an inverse correlation between the initial level of health and the rate of growth. We should, therefore, be able to verify the following identity:

$$\left(\frac{1}{T}\right)\left(s_{i,t} - s_{i,t+T}\right) = a + bs_{i,t} + \varepsilon_{i,t} \qquad (1)$$

[2] To detect when the differences are significant, the Leven test (F test) has been carried out. This consists of comparing the following nil and alternative hypotheses: ($H_o : \sigma 2_t = \sigma 2_{t+1}$; $H_1 : \sigma 2_t \neq \sigma 2_{t+1}$). For a certain confidence level (0.05), through comparing the variance coefficient, the F test gives us a measurement of statistical significance.

Where *T* is the total period of the study; *s* is the value that represents the state of health *s* in each region *i;* $s_{i,t}$ is the initial state of health; $s_{i,t+T}$ is the final state of health; *a* and *b* are the population parameters to be estimated; and $\varepsilon_{i,t}$ is the level of perturbation.

A negative or significant value for $\hat{b}$ implies the presence of β convergence, and vice versa. Furthermore, a logarithmic transformation of the independent variable will turn its estimator into a measure of the speed of convergence, regardless of the scale. The determination coefficient value (R^2) will be a measurement of the goodness-of-fit[3].

The evolution of the literature on convergence illustrates a particular case, with important implications. There may exist different stationary states caused by structural differences among different geographical areas that cause distinct convergence horizons. To detect their presence, a concept known as conditioned beta convergence has been developed. In this concept, convergence is controlled in terms of a structural characteristic that distinguishes between each of the areas.

The following econometric model is used (Sala i Martín, 1996):

$$\left(\frac{1}{T}\right)\ln\left(\frac{s_{i,t}}{s_{i,t+T}}\right) = a - \left(\frac{1-e^{-\beta T}}{T}\right)\ln(s_{i,t}) + \Phi Z_{i,t} + \varepsilon_{i,t} \qquad (2)$$

Where $Z_{i,t}$ is a vector of variables that includes the stationary state of each area and Φ is the associated parameter to be estimated. What we ultimately wish to know is, by including it in the model, to what extent it improves the explanatory capacity of said model.

In traditional macroeconomic analysis, the vector $Z_{i,t}$ usually contains regional data (on investment, added value, building of capital, etc.). In our case, it has been constructed as a bivariant categorical variable that adopts a value of 0 for the PCAS and of 1 for the PCAC. Adopting only two values for $Z_{i,t}$ is justified in that the management capability stemming from the transfer of responsibilities is the same for all those ACs that have taken them on. The non-transfer of such responsibilities is, likewise, both equal and nil for those ACs that still depended on the centrally-based management of their healthcare. As with the absolute model, a negative estimation of *b* will imply the presence of conditioned convergence.

The unique historical process of healthcare decentralization in Spain allows us to test whether there exists a different *stationary state* of health and health convergence among the ACs that took over the management of health during the first stage (PCAC) and those that were not given such competences until January 2002 (PCAS).

[3] The model to be estimated follows the classical non-linear specification (Sala i Martín,1996), which is:

$$\left(\frac{1}{T}\right)\ln\left(\frac{s_{i,t+T}}{s_{i,t}}\right) = a - \left(\frac{1-e^{-\beta T}}{T}\right)\ln(s_{i,t}) + \varepsilon_{i,t}$$

where β is the rate of convergence, which can also be obtained by means of the transformation

$$-\beta = (1/T)[\ln(1-Tb)]$$

We have used two variables that are representative of the state of health on a regional level: Life Expectancy at Birth (LEB) and Infant Mortality (IM). Both factors have been widely used in other studies comparing countries or regions. Our source has been the mortality tables published periodically by the National Statistics Institute (INE). For each of the variables, the data compiled corresponds to the following years: 1) IM by provinces, measured as the number of cases per 1,000 inhabitants, from 1975 to 2001 - a total amount of 1,404 observations; 2) LEB by provinces, measured as the probable number of years of life expectancy at birth, during the years 1969, 1981, 1985, 1990 and 1995 - 250 observations. Furthermore, for the regional analysis[4], we have taken into account the mortality tables by ACs, both for IM (1975-2001 - 459 observations) and for LEB (1970, 1975, 1980, 1985, 1990, 1995 and 1998 - 119 observations).

The regression models have been solved using non-linear LSMs. In the case of conditional convergence, the significance of the difference in behavior between both territorial groups has been measured using the Chow test[5].

3. RESULTS.

Below, we analyze the results of β convergence, σ convergence, and conditional convergence, both by provinces and by ACs.

3.1. β Convergence

Table 1 shows the results of the provincial β convergence model in Spain, both as regards LEB and IM. As can be observed, the rate of convergence is low. In the case of LEB, the estimated parameter is negative and significant, with a good fit (R^2 of 46.07% and low error), and an estimated rate of convergence of 1.5% per year. In the case of IM, the results are similar, the estimated $\hat{b}$ being negative and significant (the general fit is 20.85%), the the convergence rate for the period is 2.99% per year, which implies a 50% reduction of the differences over 24 years.

Table 1. Provincial Beta Convergence in Health (1970-2001)

	b (s.e.)	p-value	R2 (s.e.)	Sample years	Convergence rate (β)
LEB (1969-1995)	-0.019 (0.004)	0.000	0.4607 (0.0003)	27	-1.50%
IM (1975-2001)	-0.046 (0.013)	0.001	0,2085 (0.01826)	27	-2.99%

[4] In all cases, the Autonomous Cities of Ceuta and Melilla have been omitted.

[5] This test enables us to check the hypothesis of structural change between two sub-samples, and is defined as:

$$F = \frac{SCR_T - (SCR_1 + SCR_2)}{SCR_1 + SCR_2}\frac{m}{n}; \qquad F \sim F_{n,m}$$

Where SCR is the sum of the squares of the total residuals (T) or of each of the two sub-samples (1 & 2); m is the sum of the degrees of freedom of the sub-samples' regressions and n is the difference between the degrees of freedom of the full regression. The Chow test follows an $F_{n,m}$ and the nil hypothesis consists of the absence of structural change.

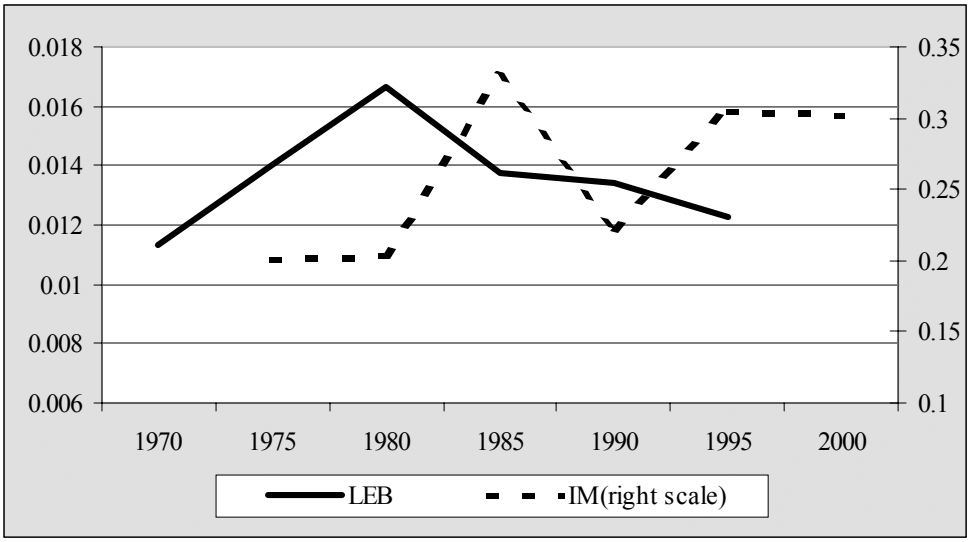
3.2. σ Convergence

The typical deviation of LEB[6] among provinces (Table 2) rose from 1.13% in 1969 (approx. 0.81 years of mean dispersion) to 1.27% in 1995 (approx. 0.99 years). The F statistic, which measures the significance of the differences, shows that the change over the period is not significant; in other words, they can be assumed to be the same. However, in the case of IM, there is an increase in the divergence from 20.2% in 1975 to 49.0% in 2001. In this case, the divergence is completely significant[7]. Graph 1 shows the annual evolution of the mean differences. The growth in territorial imbalances among provinces has grown since 1970, both in LEB and in IM. In short, the hypothesis of interprovincial sigma convergence cannot be accepted.

Table 2. Sigma Convergence in Health

	σ	
	Initial	Final
LEB (1969-1995)	0.0113 (0.81 yrs.)	0.0127 (0.99 yrs.)
IM (1975-2001)	0.202 (4.18 deaths/'000 inhab.)	0.490 (1.43 deaths/'000 inhab.)

Graph 1. Sigma Convergence in Health



By combining these results with the previous analysis of beta convergence, we can conclude that, during the period analyzed, a situation the literature calls *change of role* has occurred; that is, certain provinces that, initially, were worse off as regards LEB or IM are improving, slowly overtaking others that were, originally, in a better position. The final result, however, is one of greater dispersion.

[6] In reference to the natural logarithm of the LEB.

[7] The results of Levene's F test, at 0.05 significance, have been as follows: for LEB, a test value of 0.84 and a p-value of 0.28, and for IM, 0.16 and 0.000, respectively. Therefore, in the case of LEB, the nil hypothesis of equality of variances is not rejected, the opposite being true for IM. At the same time, we can consider that the differences between the variances are significant.

3.3. Conditional Convergence

The fact that, for quite a long period of time, there were certain ACs with health management responsibilities and others without; that is, two groups of provinces (PCAC and PCAS), means that we are able to test the convergence hypothesis in a situation that is one of natural experiment. This test has involved an analysis of conditional convergence. Table 3 shows us the main results for the period chosen (1980-2000). In it, we can see the estimated parameters, with the standard errors in brackets, except for the determination coefficient, which gives the value of the F test in brackets.

There is an increase in the determination coefficient both for LEB and for IM[8]. In the case of LEB, two aspects turn out to be significant: including the variable that discriminates in terms of the level of responsibilities, and the value of the Chow test[9]. Therefore, in the LEB analysis, the nil hypothesis of absence of structural change is rejected (both sub-samples are different), with a probability of almost 90%. This implies that, perhaps, a separate analysis of each of the sub-groups should be made.

Table 3. Conditioned Beta Convergence, by Provinces (1980-2000)

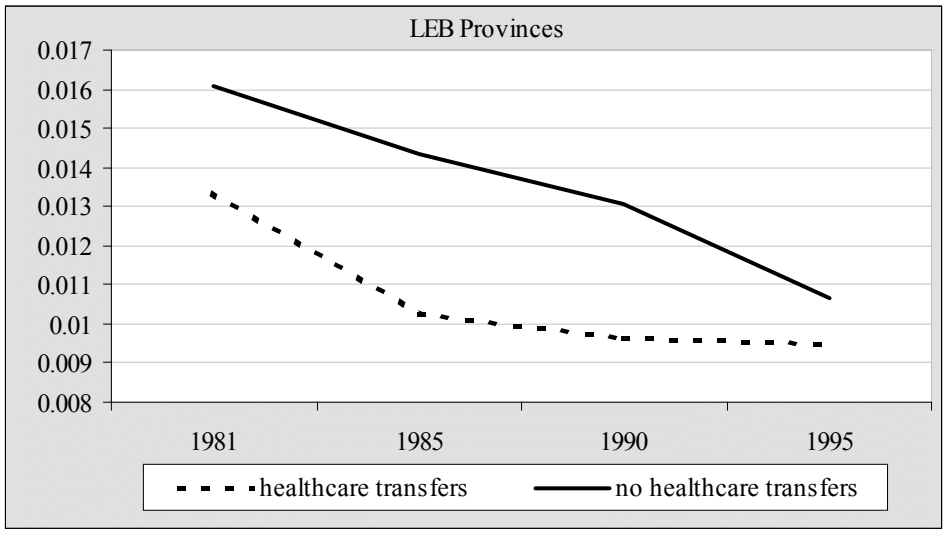
	LEB (1981-1995)		IM (1980-2001)	
	unconditioned (s.e.)	conditioned (s.e.)	unconditioned (s.e.)	conditioned (s.e.)
B	-0.033	-0.041	-0.049	-0.050
	(.005)	(.005)	(.015)	(.015)
Φ		-0.0005		0.0010
		(.000)		(0.006)
R^2	46.07%	54,60%	17.04%	21.58%
	(.001)	(.001)	(.022)	(.022)
Chow Test	4.33 (p-value: .018)		1.95 (p-value: .1537)	

In the case of IM, though the data point in the same direction, they are not so conclusive. Therefore, some of them, including the Chow test, are not significant[10]. Hence, for IM, we accept the nil hypothesis of absence of structural change; in other words, both sub-samples can be taken from the same sample.

If we differentiate between both groups (those initially with healthcare responsibilities and those without), the results of the sigma convergence show that, in the case of IM, there are no differences in behavior between the PCAS and the PCAC. However, in the case of LEB, the rate of sigma convergence of the PCAS is greater. While the PCAS have fallen from 1.60% in 1981 to 1.07% in 1995 (significant difference), in the same period the PCAC have only dropped from 1.34% to 0.95%, respectively (non-significant difference).

Graph 1. Sigma Convergence in LEB by provinces, in terms of level of responsibilities

[8] Though greater in the former, increasing from 46.7% to 54.6%.
[9] The test for LEB gives a value of 4.33 against a threshold of 3.19 to 0.005 of confidence, which implies that there may be a structural change in the models; i.e. the PCAC and PCAS behave differently.
[10] Being close to 85% of confidence.



Applying Levene's test of the difference of variances of both samples reveals that the reduction in the differences among the PCAS is significant, while that of the PCAC is not[11].

In conclusion, the results of the conditional convergence indicate that there are no evident differences in convergence behavior between both groups, and that the differences only drop significantly in the case of LEB for the PCAS.

3.4. Analysis by ACs

Although the limited number of ACs prevents us from obtaining robust conclusions from the results of the statistical models, it is still of interest to record them. At least, to interpret them in the light of the fact that they confirm or refute the results of the analysis by provinces.

Table 4. Beta by ACs (1980-1998)

	LEB	IM
parameter	-0.013 (0.011) p-value 0.250	-0.0470 ((.0384) p-value 0.24
R2	0.0847 (.00046)	0.0908 (0.0202)

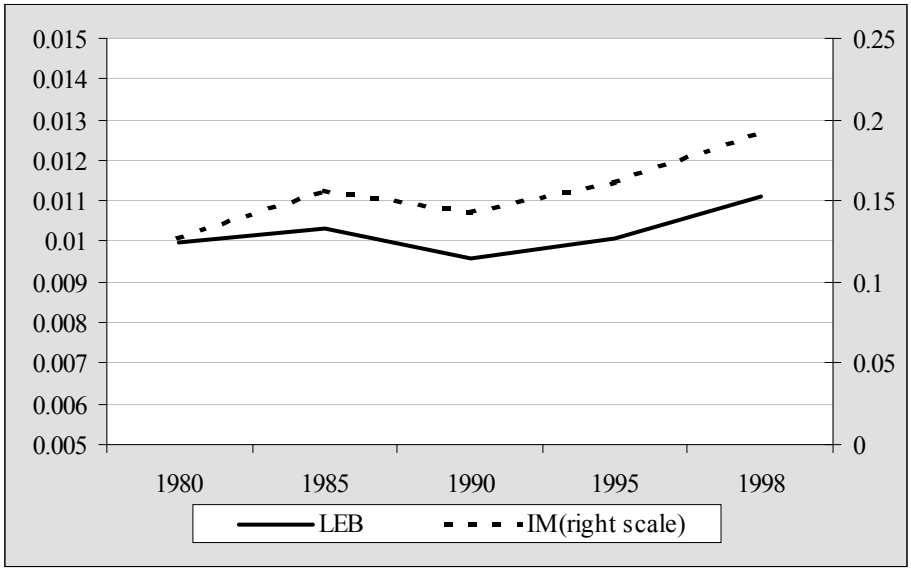
The results (Table 4) show a bad fit of the model in general, both in the non-significance of the parameters and in that they explain very little (9% in the best of the models). Therefore, we must reject the hypothesis of beta convergence by ACs.

In the case of sigma convergence, the results are somewhat more explicit. There is a clear trend toward divergence among the Spanish ACs, both in terms of LEB and of IM. In this case, the Levene test is non-significant for LEB, but is significant for IM[12].

[11] In both cases, with a significance level of 5%, the results obtained have been: F=2.24 (above the treshold of 2.01) for the PCAS, and a p-value of 0.029; for the PCAC, 1.96 (below the threshold of 2.01) and a p-value of 0.056.

[12] The specific results have been: for LEB, the F value is 0.80, against a threshold of 0.42 to 0.05 (p-value of 0.33); for IM, an F value of 0.09, against the same threshold (p-value of 0.000).

Graph 2. Sigma Convergence by ACs



On another note, the sigma convergence graph shows a high degree of correlation between both series, as well as a constant growth in the divergence among ACs from 1990 onwards.

4. CONCLUSIONS.

During the period analyzed, we are unable to confirm the hypothesis that there has been an absolute convergence in health among the Spanish provinces, measured both in terms of LEB and of IM. Thus, the sigma convergence shows that there is either a divergence (IM), or the situation at the end of the period is practically the same as at the start (LEB).

There has been a *change of role*, by which certain provinces that presented poorer levels of LEB or IM have improved, overtaking other provinces, whose initial situation was better, though the final result is one of greater dispersion.

In turn, the conditional analysis of convergence reveals that, in the case of LEB, the behavior of the two groups (PCAC and PCAS) should be analyzed separately. In this study, it has, generally, been detected that the behavior of both groups is either analogous (in the case of IM) or, on the contrary, there is a greater final convergence among the PCAS than at the beginning. In other words, the trend in LEB convergence that can be seen as from 1980 can be mainly attributed to the PCAS.

Finally, the results by ACs, though not particularly robust, given that the degrees of freedom are limited, serve to ratify the aforementioned conclusions. That is, there is no convergence during the long period under study. In this case, an analysis regarding the level of responsibilities has not been carried, due to the loss of degrees of freedom.

In conclusion, the process of transferring healthcare responsibilities to the ACs does not seem to affect convergence in health, which has been measured using two traditional indicators: LEB and IM. Furthermore, the effect could even be negative, thus reducing the rate of convergence, as in the case detected of LEB by provinces.

This result, of course, should be interpreted with great caution, given the many variables that can influence and explain the evolution of health indicators, taken both at a provincial and a regional level. In this sense, the convergence analysis should be carried out using other health indicators that would allow us to confirm or refute the results obtained in this study.

In a National Health System such as that existing in Spain, which is universal and has strong rules of equality, the decentralization of healthcare responsibilities should be compatible with progressive reductions in the health imbalances among regions. However, the results obtained do not seem to point in this direction.

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