SOUSA GALITO, Maria (2000). Portugal in the EU: the Perspective of Convergence – Parte I.C. *CI-CPRI*, Tese, Nº3, Setembro, pp. 13-18.

CI-CPRI

Portugal in the EU: the Perspective of Convergence

<u>Tese de Mestrado</u>

Âmbitos (2000):

Economia
Estudos Europeus

2.2.1.2 σ-Convergence

Hénin and Le Pen (1995), instead of basing its study over dispersion's coefficients evolution, they would rather use a test of dispersion's reduction, based on the following formula:

$$\ln(y_{in}) - \ln(y_{i0}) = a - b.\ln(y_{i0}) + \varepsilon_{in} \qquad \text{(B.2)}$$

Existing convergence when -b is negative and $(1-b)^2 / R^2 < 1$, just by using a t-student's test.

Consequently, comparing both methods, according to Hénin & Le Pen, in $\ln(y_{in}) - \ln(y_{i0}) = a - b.\ln(y_{i0}) + \varepsilon_{in}$, there will be β-convergence if -b is negative and σ-Convergence if the variance of yit is decreasing with time.

The calculations of the σ-convergence test are simpler and get better dispersion calculations isolating regions for countries. It's a test that considers the impact of the shocks, which can be said an advantage as well as a disadvantage, since perceives short-term shocks leading to some long-term links. Of this easy influence speaks Neven and Gouyette, as well of the β-convergence's only concern for catching up for long-term regular growth.

If in the β-convergence a measurement error may bias the regression coefficients in such a way that convergence seems possible when shouldn't, the σ-convergence is free from the measurement error problem, for this kind of error can't affect measures of dispersion.

2.2.1.3 Link Between β-convergence and σ-convergence

β-Convergence relevant question: How has been the mobility of revenue within the same distribution?

σ-Convergence determinant question: how has been the evolution of the distribution of revenue over time?

So, for the β-convergence test the main questions are: how rapidly does the large countries revert to mediocrity? Or the inverse question: how long does a small poor country take to become rich? How to augment competitiveness in the poor countries of a rich regional block like the European so that the whole may be stronger in the world-markets against the competition of countries like the USA and Japan?

The σ-convergence is used when want to know if the differences between poor and rich countries have diminished over time. So let's compare analytically.

Considering the β-convergence holding for a group of countries i, where i=1...K, then:

$$\log(y_{in}) = \alpha + (1-\beta)\log(y_{i,n-1}) + \varepsilon_{in} \tag{B.3}$$

Where 0<β<1. If β<1 there aren't achievements more quickly than usual by missing some of the usual stages nor driving past the point that the country wanted to stop or turn where poor countries are continuously expected to get ahead of rich countries at future dates. So, β>0 is in favour of β-convergence because $\log(y_{in})$ and $\log(y_{in} / y_{i,n-1})$ aren't direct but inversely related with each other. Note that $\log(y_{in} / y_{i,n-1})$ is the annual rate growth.

As said before, higher the β, stronger the convergence on the poor country. Since v_{in} has mean zero and the same variance, σ_v^2, for all countries, as well as it is independent across countries and through time.

Realizing the cross-sectional dispersion of revenue with ϖ_n as the sample mean of $\log(y_{in})$, the formula for the variance is:

$$\sigma_n^2 = \frac{1}{k}\sum_{i=1}^{k}\left[\log(y_{in}) - \varpi_n\right]^2 \tag{B.4}$$

If k is large, then the sample variance is close to the population variance. From (B.4) to get the evolution of the variance throughout time, we make:

$$\sigma_n^2 \cong (1-\beta)^2\sigma_{n-1}^2 + \sigma_v^2 \quad , \text{ stable for } 0<\beta<1 \tag{B.5}$$

If we verify β<0, there's no β-convergence and the cross-sectional variance augment with time. So, there's no σ-convergence, this because β-convergence is a necessary condition for the existence of σ-convergence. The steady-state value for the variance is:

$$(\sigma^2)^{\#} = \frac{\sigma_v^2}{1-(1-\beta)^2} \tag{B.6}$$

The steady-state dispersion is positive even if β is positive as long as $\sigma_v^2 > 0$, but diminishes with β and augments with the variance of the disturbance term.

Continuing with (B.5):

$$\sigma_n^2 = (\sigma^2)^{\#} + (1-\beta)^2\left[\sigma_{n-1}^2 - (\sigma^2)^{\#}\right] \tag{B.7}$$

When β>0, σ^2 reaches monotically its steady-state value $(\sigma^2)^{\#}$. From this we understand that the β-convergence is a necessary condition for the existence of σ-convergence. Yet, σ_v^2 also may augment or diminish towards the steady state accordingly to the value of σ^2, if higher or lower the steady state. And we must not forget that σ may augment even if β>0. From this we understand that β-convergence, even if necessary, isn't a sufficient condition for the σ-convergence.

2.1.1.4 Both β and σ convergence Methods Raise Critics

We understand that β-convergence doesn't necessarily imply σ-convergence, especially if there are uncertain shocks that keep constant or increase the distribution of dispersion.

If the hierarchy of the GDP per capita is inverted, we can find a contradiction between the σ-convergence and the β-convergence tests. When the process of convergence is troubled by stochastic shocks, the β-convergence test will follow the σ-convergence test if the amplitude of those same shocks will increase sufficiently.

The β-convergence and σ-convergence don't have in consideration the particularities of each region they rather consider each one as any other observation in the interval. But if we're studying the Portuguese path in the European Union it isn't indifferent seen it as one of the first six countries that signed the Rome's Treaty in 56 when the country only entered in 86.

These tests tend to econometrically reject the null hypothesis when there are different steady states for the determinant variables, especially if economies begin with very close values to the steady-state level and tend to significant product per capita. So, to check a possible nominal convergence of Portugal in the EU, we have to realise the Portuguese evolution in the past few years, implying a middle-run analysis (not a short-term one) but that doesn't take in account (infinite) long run.

2.2.2 Different Test Procedures

2.2.2.1 Convergence in Panel

These tests of convergence develop the exactitude of estimators and determine the dynamic of series, all this because of the manipulation of panel data, not always easy for more that its results seem very efficient. Chamberlain (1984) works teach us how to use panel data in his paper. Islam (1995) realizes how panel data are able to discover the problems of neglected variables in individual effects.

The two formulas (B.1) and (B.2) are usually used on tests of transversal cut but can also be used with panel data for convergence in panel. This paper will do that exactly with the (B.2) some time afterwards.

But there are other possibilities. For example, since individual effects under a context of GDP per capita are seen as a result from the existing technology, they may be formalized according to Canova and Marcet (1995) in the following way:

$$y_{i,n} - y_{i,n-1} = c_i - \beta . y_{i,n-1} + \varepsilon_{i,n} \qquad \text{(B.8)}$$

So, individual effects of incomes per capita are correlated between countries. c_i (Fixed effects) allow the introduction of different stationary states. Each series must converge towards its different steady state that may be estimated by $\hat{c}_i / \hat{\beta}$.

Alain Pirotte (1999) presents a general dynamic error component model with the time dimension fixed. The long-run impact can be reached from an estimation of a static relation whereas the real model is a dynamic one, if coefficients are homogenous among individual units.

For tests on unit roots in panel, we may follow Beine, Docquier & Hecq (1998). To study these non-stationary trends, they base themselves in the:

$$\Delta(y_{i,n} - y_{t,n-1}) = c_i - \beta . (y_{i,n-1} - y_{t,n-1}) + \sum_{t=1}^{\eta_i} \Delta(y_{i,n-t} - y_{n-t}) + \varepsilon_{in} \qquad \text{(B.9)}$$

The formula allows us to conclude that series tend to return to average, where y_n represent the transversal average of series. It is an interesting test because uses the accurate statistics to each non-stationary series and allows testing:

- If β>0 and $\beta_i = \beta$ for ∀I and $c_i = c_t$ for $i \neq t$, there is convergence absolute;
- If β>0 and $\beta_i = \beta$ for ∀I and $c_i \neq c_t$ for $i \neq t$, there is conditional convergence;
- If $\beta_i \neq \beta$ for $i \neq t$, so that convergence speed different from one series to the other;

With stationary series the average and variance of differences are constant, which means that the series converge at a constant, not that they converge.

Using panel data also imply disadvantages. The hypothesis of convergence absolute towards the transversal average may lead us in mistake if series diverge, because the results of the tests can show absolute divergence when may not be the case.

2.2.2.2 Testing Convergence of the Distribution of Series Over Time

Quah also proposed a method to study convergence under an other perspective, the one that follows the distribution of series over time, analysing it at two defined points: in the beginning and in the end, or estimating the future limit of that distribution (ergotic distribution).

Having this in mind, the analysis may lead:

- To a multimodal distribution; in this case groups of series converge towards different levels; curiously, if this dispersion diminishes between series of the same group, is maintained or enlarged between groups;
- To a diminishing dispersion under a tied distribution; in this case dispersion tends to one same level.

This test has advantages since allows an long term analysis through the estimation of the limit of the distribution of series; doesn't impose, among the relations of series, an initial strict structure, realizing at the same time the specific behaviours inside the distribution (the possible existence of groups of convergence). But being my objective to find if there is convergence of series between groups of countries, more than to detect groups of convergence, perhaps this isn't the best of methods.

2.2.2.3 Testing Convergence in Chronological Series

Process of convergence as a linear process

Investing in a long-term analysis, the question is situated some where between a convergence in probability and an expected convergence. Since this work will give much importance to the countries' GNP per capita, it's interesting to know that their cointegration may situate them in a stationary state. Parameters are fixed in time.

As seen before, will search for cointegration among non-stationary series. Though, once found, more will be needed; despite necessary isn't a sufficient condition.

According to Bernard & Durlauf, testing convergence means expect an equilibrium between series where there must be verified a b=1, different from saying that they tend to converge.

Two non-stationary series, y_n and $y_n^{\#}$, can be cointegrated if there's a stationary relation between them, in such a way that:

$$y_n^{\#} = \alpha + \beta . y_n + \varepsilon_n \qquad \text{(B.10)}$$

To avoid some of the problems that rise from this constraint, Fuss (1988) extends the results' interpretation according to the next subdivision:

- α>0 and β<1 series converge; y_n reaches $y_n^{\#}$ when both series grow
- α>0 and β>1 series diverge; y_n is over $y_n^{\#}$
- α=0 and β=1 series converged or converged at a constant (a)
- α<0 and β<1 series diverge $y_n^{\#}$ under y_n
- α<0 and β>1 series converge $y_n^{\#}$ reaches when both series grow

<u>Process of convergence tending to evolution</u>

Considering the possibility that some of the variables may change when series are facing a process of convergence, several authors propose a way to resolve econometrically the problem. I'll deal here with two versions.

Gundlach (1993) presents a very simple method that, because of its simplicity, has the disadvantage of only being possible the variation of one parameter and the advantage of preserving the cointegration characteristics under a basic analyse context.

The method departs from a linear cointegration model in such a way that:

$$\frac{y_n}{y_n^{\#}} = \alpha + \beta y_n^{\#} + \varepsilon_n \qquad \text{(B.11)}$$

Where the elasticity of y_n over $y_n^{\#}$ tends to 1 when y_n tends to $y_n^{\#}$. If β=0 the series converge. With β>0 y_n tends to $y_n^{\#}$ at a constant value.

Fuss (1998) proposes a study focused on recursive cointegration. Her method seems able to realize if there are changing variables as time passes or ruptures in the evolution of series. The idea is to use convergence tests in several sub-intervals of the same size. If tests of convergence are based in cointegration relations between series, two situations are considered: the one in which the parameters value of the relation between series may change over time and the one in which the variance of the relation between series tends to a constant transforming that relation in a cointegration process.

This has as big advantages the consideration of all different types of convergence in a long-term study, not forgetting the non-stationary of series. But since the optimum is enemy of the good, the method becomes two heavy and difficult to work with, not always its results are clear and the interpretation of the all thing has some limitations.