Growth, cycles and convergence in US regional time series: a personal point of view

Miguel Jerez*
José Casals**
Sonia Sotoca***

Universidad Complutense de Madrid
Departamento de Fundamentos del Análisis Económico II
Campus de Somosaguas, 28223 Madrid (Spain)

* Corresponding autor. Tel. (+34) 91 394 23 61, Fax. (+34) 91 394 25 91, E-mail: mjerez@ccee.ucm.es
** E-mail: jcasalsc@cajamadrid.es
*** E-mail: sotoca@ccee.ucm.es

This note summarizes both, our personal views on the paper discussed and some interesting points raised by the attendants to the First IIF Workshop on Nonlinearities, Business Cycles and Forecasting. We will assume the risk of quoting other people remarks and, therefore, will be responsible for any inaccuracy.

Synopsis

In our opinion, this paper contributes to the literature on growth econometrics with three main theoretical ideas:

1. Growth and convergence should be measured in terms of the unobserved components (UC) of the relevant time series.
2. It is important to separate the long-run growth path of the time series from the individual transitional dynamics. To this end, the authors propose an extension to the family of UC models capturing these 'convergence components.'
3. The empirical literature about growth relies excessively in the mechanical application of cointegration/unit root tests. Even when applied correctly, these tests are of limited value, and often inconclusive, in comparison to a model describing the data features that are being researched.

These ideas are applied to an analysis of the annual time series of real per capita income in the eight US census regions, from 1950 to 1999. The study concludes that the two richer regions, New England and Mid East, are diverging from the rest as well from each other, while the remaining regions show absolute convergence over the last fifty years. Within-the-sample smoothed estimates for the convergence components describe how this convergence/divergence occurred in the past, while out-of-the-sample extrapolations provide a 'forecaster perspective' about how convergence may evolve in the future.

Importance of the results

We are comfortable with the ideas summarized above. Perhaps oversimplifying, the first two points suggest that empirical analysis of growth should be done in terms of UCs measuring concepts such as "trend" or "deviations from long term equilibria". As smoothed estimates of these components are not contaminated by irrelevant fluctuations, they should be clearer and simpler than alternative measures.

On the other hand, the practical importance of these notions is not clearly highlighted by the empirical study. Note for example that Figures 1 and 4 in the paper discussed are very similar, so the profile of the original time series is very close to that of the unobserved trend estimate. Also, deviations from the cointegration relationship are similar to the convergence components plotted by Harvey and Carvalho in Figure 6 (this similarity was evident from graphical material displayed in the Workshop, but not included in the paper). Then, one may think that the empirical analysis in this case could have been done using simpler techniques, probably arriving to the same conclusions. In a more complex situation, perhaps when working with seasonal data, the advantages of the UC approach would have been more evident.

Estimation issues

The paper generically describes the estimation method employed as 'maximum likelihood'. We asked for further clarification because, given the number of time series involved and the UC model structures, some models have about one hundred unknown parameters, to be obtained from a sample of 400 data points. The stability of a standard likelihood algorithm looked dubious in this context, furthermore when some models combine parameters of very different order of magnitude, typically ranging from 10^{-1} and 10^{-7}. Professor Harvey provided an interesting explanation to this remark.

The key idea is that component estimates derived from a fixed-interval smoother (FIS) are not affected by arbitrary values in the error covariances. This well-known property can be exploited to estimate large-scale UC models in two ways:

Assume first, that all the unknown parameters are error covariances, initialised to arbitrary values. In this situation FIS residuals may be used to obtain estimates of their covariances and estimation, therefore, does not require to iterate.

Assume now that the state equation contains unknown parameters. In this situation one may iterate between two stages consisting of: a) estimating the state parameters conditional to error covariances, and b) estimating the error covariances conditional to state parameters.

Estimation of large-scale UC model looks feasible, given a efficient implementation of these strategies that we summarize here due to their potential technical interest.

On the profile of the convergence components

A lively debate was held about the profile of the convergence components shown in Figure 6. During his exposition, Professor Harvey noted that the intuition of *a convergence process that is taking place* fits nicely with the shape of these components, as they show curved trajectories that are approaching each other. From this point of view, finding deviations from a common trend that are stationary, would mean that *convergence is not taking place, but already occurred in the past*. We think that this distinction between "convergence in progress" and "convergence achieved" is an important idea that redefines how to look at results often found in the empirical literature.

In an interesting remark, Dr. Agustin Maravall pointed out that the estimate for the parameter in model (31), $\hat{\phi} = .889$, means that the convergence components are stationary, while their profile in Figure 6 suggests that they are nonstationary. Professor Harvey answered that this may happen in a stochastic process that is stationary but highly persistent, if its initial conditions deviate substantially from the stationary solution.

Both points of view have merit. Given that: a) the timeframe involved is fifty years and b) the six convergence components look nonstationary, no matter their initial distance to equilibrium, we have some doubts about Professor Harvey's interpretation.

Note that the smooth trend model used throughout the paper implies that the variables are I(2). Also, Expression (29) implies that there is a single trend driving all the time series, so both unit root components are common. We wonder if a model assuming only one common unit root would be adequate for these series. The remaining nonstationary component would then describe a nonstationary path towards equilibrium.

A model for nonstationary convergence

The temptation to try such a model was too strong for us to resist. Thus, we downloaded (www.economagic.com) the time series of personal income per capita series in the Southeast (SE) and Southwest (SW) census regions, from 1950 to 2003, and multiplied them by the corresponding indexes of consumer purchasing power in average US cities. The resulting variables are then roughly comparable with two of the time series analysed in the paper. After a standard analysis, we found the following model to be statistically adequate:

$$\begin{bmatrix} 1-\underset{(.13)}{.37}B & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \nabla & 0 \\ 0 & \nabla^2 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \ln SE_t \times 100 \\ \ln SW_t \times 100 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1-\underset{(.13)}{.64}B-\underset{(.13)}{.27}B^2 \end{bmatrix} \begin{bmatrix} \hat{a}_t^{SE} \\ \hat{a}_t^{SW} \end{bmatrix} \quad (1)$$

$$\hat{\Sigma}_a = \begin{bmatrix} 1.71 & -.52 \\ = & 3.72 \end{bmatrix}; \; Q(10) = \begin{bmatrix} 6.04 & 6.00 \\ 9.43 & 3.72 \end{bmatrix}$$

where B denotes the backshift operator, such that for any sequence w_t: $B^{\pm k} w_t = w_{t \mp k}$; ~~and~~ $\nabla \equiv 1-B$; the figures in parentheses are the standard errors of the estimates and Q(10) is the matrix of Box-Ljung statistics computed with ten lags of the residual auto and cross-correlation functions. Using the method described in Casals et al. (2002) we obtained the FIS estimate of the convergence path, that is shown in Figure 1.

[Insert Figure 1]

This component is the sum of smoothed estimates for the stationary AR(1) and nonstationary random-walk components, driving the approximation of the SE series to the SW series. As this UC tends to zero it can be concluded that both series converge.

We do not claim that this model is superior in any way to those described in the paper. It simply shows the other side of the coin. The convergence components in the paper are derived from a stationary process, and show a possibly nonstationary behaviour at the beginning of the sample (i.e., where convergence is taking place). The comparable component obtained in this example results from a nonstationary process, but shows stability at the end of the sample (i.e., where convergence already occurred).

We wonder if accurately modelling time series such as these, that in given time frame show ongoing convergence and perhaps achieved convergence, would require something such a changing-regime model or a time-varying parameter specification. Anyway, this is point is left here as an open question of potential interest for further research.

Concluding remarks

In summary, this paper makes a significant contribution to the literature on growth econometrics by introducing UC techniques in this area. We found especially appealing the notion of components able to describe the convergence path of different time series, from a given initial situation to a long-term equilibrium. For the reasons described above, this interesting idea deserves more study.

References

Casals, J., Jerez, M. & Sotoca, S. (2002). An Exact Multivariate Model-based Structural Decomposition, *Journal of the American Statistical Association*, 97, 458, 553-564.

Figure 1: SE-specific unobserved components.