



# Time series test of nonlinear convergence and transitional dynamics

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## Abstract

This paper revisits the income convergence hypothesis by using the nonlinear unit root test of Kapetanios et al. [Kapetanios, G., Shin, Y. and A. Snell, 2003. Testing for a unit root in the nonlinear STAR framework. *Journal of Econometrics* 112, 359–379.]. Out of the 12 OECD income gaps in which nonlinearity has been detected, two cases of long-run converging and four cases of catching up are found.

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## 1. Introduction

The income convergence hypothesis postulates that the growth rates of poor and rich countries will converge in the long run. Bernard and Durlauf (1995) use a time series approach to test the income convergence hypothesis. However, Oxley and Greasley (1995) argue that the rejection of convergence by the time series test should not be necessarily taken as evidence of divergence, because countries may still be in the transitional process of convergence. They refine the concept of convergence into long-run converging and catching up. Long-run converging refers to the attainment of long-run steady-state equilibrium in the output differential between two contrasting countries. From definition 2 in Bernard and Durlauf (1996), country  $i$  and  $j$  converge if  $\lim E(y_{i,t+k} - y_{j,t+k} | I_t) = 0$  as  $k$  goes to infinity, where  $y_i$  is the log real GDP per capita in country  $i$ ,  $I_t$  is the information set available at period  $t$ . In contrast, catching up refers to the situation in which the narrowing of the output gap

between the two countries is observed over time but the convergence process has yet to be completed. Datta (2003) and Bentzen (2005) re-examine the convergence debate by relaxing the assumption of structural stability (Chong, 2001). Datta (2003) argues that income disparities among countries are most likely attributable to catching up rather than divergence. He points out that nonlinearity may affect the power of the time series based test, which is under the linear and time-invariant assumptions. To explore the nonlinearity issue, this paper tests if incomes are converging in a nonlinear manner by using the test of Kapetanios et al. (2003).

## 2. Nonlinear test of income convergence

Let  $Y_{OECD,t}$  and  $Y_{US,t}$  be the real per capital gross domestic products of the individual OECD country and the United States respectively. Consider the model

$$\Delta z_t = \mu + \rho z_{t-1} + \alpha t + \sum_{k=1}^n \delta_k \Delta z_{t-k} + \varepsilon_t, \quad (1)$$

where  $z_t = \log Y_{OECD,t} - \log Y_{US,t}$ ,  $\mu$  is the mean of  $z_t$  and  $\varepsilon_t$  refers to the error term. Comparing to the test of Bernard and Durlauf (1995), the above specification of the income convergence test

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