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Some empirics on economic growth under heterogeneous technology

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Abstract

A new econometric approach to testing for economic growth convergence is overviewed. The method is applicable to panel data, involves a simple regression based one-sided *t*-test, and can be used to form a clustering algorithm to assess the existence of growth convergence clubs. The approach allows for heterogeneous technology, utilizes some new asymptotic theory for nonlinear dynamic factor models, and is easy to implement. Some background growth theory is given which shows the form of augmented Solow regression (ASR) equations in the presence of heterogeneous technology and explains sources of potential misspecification that can arise in conventional formulations of ASR equations that are used to analyze growth convergence and growth determinants. A short empirical application is given illustrating some aspects of the methodology involving technological heterogeneity and learning in growth patterns for selected groups of countries.

JEL classification: 040; C32; C33

Keywords: Convergence parameter; Conditional convergence; Determinants of growth; Economic growth; Growth convergence; Heterogeneity; Learning; Neoclassical economics; Speed of learning; Transition curve; Transitional divergence

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1. Introduction

An important task in the economic growth literature is to explain the substantial heterogeneity in income performance across countries. A number of studies have attempted to model this heterogeneity empirically, running cross section, time series and panel regressions with various data sets over the past two decades. Most of these studies assume homogeneity in technological progress, which is convenient in economic growth theory models but seems unrealistic in the context of many empirical applications. For examples, see Barro and Sala-i-Martin (1992), Mankiw et al. (1992) among many others. Much of this theoretical and empirical literature has been expertly overviewed in Durlauf et al. (2005) and will not be reviewed here. The purpose of the present paper is to examine the impact of heterogeneity in technical progress on growth and econometric tests of convergence, transition and the determinants of growth.

Under a Cobb–Douglas production function, the per capita real income y_{it} for country i at time t can be decomposed so that

$$\log y_{it} = \log \tilde{y}_{it} + \log A_{it},$$

involving technology, A_{it}, and effective per capita real income, $\tilde{y}_{it}$, which is a function of real effective capital, $\tilde{k}_{it}$. When technology is homogenous across countries, so that $\log A_{it} = \log A_{jt}$ for $i \neq j$, the cross sectional income differential is explained only by differences in relative real effective income. Homogenous technology across countries is, of course, a rather strong and unrealistic assumption and it is of interest to relax the condition in models that are explicitly designed for empirical use.

Once the condition is relaxed, the possibility of heterogeneous technology in growth raises some immediate issues. One issue concerns the validity of conventional growth convergence tests and another relates to the appropriate formulation of the cross sectional regression equations that are conventionally used to investigate growth determinants – the so-called 'augmented Solow regressions' (ASRs). Phillips and Sul (2006a) address the first issue, showing that, under technological heterogeneity, neither standard panel unit root tests (using relative log income differentials) nor conventional ASRs are appropriate vehicles for testing for growth convergence. Another paper (Phillips and Sul, 2006b) deals with the second issue, showing that commonly used formulations of ASR equations are misspecified and inappropriate for exploring growth determinants.

The present paper overviews some of the results in the aforementioned papers and provides some new empirical illustrations involving technological heterogeneity and learning. The plan of the paper is as follows. The next section explains the sources of misspecification in conventional augmented Solow regression and the consequent difficulties in using these regressions to test growth convergence and find growth determinants. Section 3 outlines a new empirical approach to studying growth convergence with heterogeneous technology and discusses a new clustering algorithm which can be applied to find growth convergence clubs. Section 4 illustrates a new empirical analysis of growth determinants, exploring the relationship between learning and the adoption of advanced technology. Section 5 concludes.

2. Homogeneous vs. heterogenous technology

The production function in the neoclassical theory of growth with labor augmented technological progress can be written as