Essays

Manifesto for a growth econometrics

Steven N. Durlauf

Department of Economics, University of Wisconsin at Madison, Madison, WI, USA

While the last three decades have seen remarkable advances in the econometric analysis of many areas of microeconomics and macroeconomics, growth economics has not experienced anything close to such progress. This is so despite the veritable explosion of theoretical and empirical studies of economic growth that has occurred in the last 15 years. A sign of the need for a growth econometrics is made clear when one reflects on how little the empirical and theoretical literatures on economic growth make contact. For example, while spillover effects and attendant nonlinearities continue to be hallmarks of the new endogenous growth theory, empirical practice still largely focuses on linear models whose specification is suggested by the neoclassical exogenous growth model of Solow and whose empirical implementation is often asserted to provide evidence in favor of that model (cf. Barro, 1991). It is no exaggeration to say that the theoretical and empirical growth literatures are evolving with little interaction. It is only through an econometrics that can link theory to data analysis and hypothesis testing that a synergy can be achieved.

Empirical analyses of growth generally follow a common strategy. A cross-section or panel of countries is employed in which per capita output growth rates are assumed to depend over a common time horizon on two sets of variables. One set of variables consists of initial per capita output, savings and population growth rates, variables that are suggested by the Solow growth model. The second set of variables consists of control variables that correspond to whatever additional determinants of growth a researcher wishes to examine. In a survey published last year, Danny Quah and I (Durlauf and Quah, 1999) found that over 90 different additional variables had appeared in the literature as of 1998. The current number is certainly much larger, despite the fact that only about 120 countries are available for analysis in the standard data sets. A result of this paucity of data relative to theories is the vast number of nonoverlapping studies that have appeared.

A number of the problems that plague empirical growth analysis represent variants of traditional problems with the interpretation of econometric models.
For example, there has been remarkably little attention paid to the problem of the endogeneity of the different variables used as regressors in modeling and testing growth theories. It is hard to imagine why savings rates or democracy or the level of trade openness would not be influenced by the same factors that influence growth, including factors which are consigned to the error term in a given growth regression. Yet, those studies which attempt to use instrumental variables to address regressor endogeneity have not been persuasive in that the choices of instruments have not met the necessary exogeneity requirements for instrument validity.

The reason for this failure is that growth theories are fundamentally open-ended, which means that the ‘truth’ of one theory (in the sense that the theory embodies a distinct causal explanation of growth) has no necessary bearing on the truth of another. Hence the accuracy of the statement that trade openness bears a causal relationship to growth says nothing about the accuracy of the statement that distorting government taxes reduce growth or the statement that democratic institutions facilitate growth. This creates serious problems with any application of instrumental variables. Consider the use of an instrument such as country area, which Frankel and Romer (1999) employ to deal with the endogeneity of trade openness in a regression which omits tax rates and democracy, among many other possible growth determinants. Geographic area is plausibly associated with levels of military spending, which in turn is related to democracy and tax levels; hence, area is an invalid instrument even though it is clearly predetermined with respect to growth. Because so many factors plausibly matter for growth, it is problematic to identify instruments that simultaneously are correlated with those growth determinants that are included in a regression and uncorrelated with the model’s residuals. This problem does not possess any econometric solution per se. Rather, it requires broad consideration of what theories in economics, sociology and other social sciences have to say about the determinants of possible instruments in order to make a persuasive case for instrument validity. Put differently, econometricians need to reeducate the applied community as to what is really necessary for instrumental variables techniques to be appropriate.

Model openness is associated with another serious issue in empirical growth, one that is more amenable to formal analysis – the choice of variables for a particular growth model. Given the vast number of proposed growth determinants, there is a great need for procedures that can assess the sensitivity of coefficient estimates and standard errors to choices of covariates. An initial effort along these lines is due to Levine and Renelt (1992), using Leamer’s (1978, 1983) ideas concerning extreme bounds analysis. However, this approach does not seem persuasive as a way of adjudicating competing growth theories. The problem is that the operational lack of robustness will be associated with collinearity of a given growth determinant with other possible determinants. Such collinearity should be expected for important sources of growth; hence
robustness can be a very misleading way to evaluate the economic significance of a variable. (And to be fair, Leamer’s writings make clear how multicollinearity is a problem of data and cannot be used to conclude that certain regressors in fact are not causally related to growth.) A more promising approach to present- ing evidence on growth determinants is based on Bayesian model averaging. This method may be interpreted as an attempt to ‘uncondition’ the dependence of the parameter estimate for a given variable on the model in which it was estimated. Doppelhofer (1999) and Fernandez et al. (1999) are very interesting efforts in this regard.

A final area in which the growth literature is flawed concerns the modeling of parameter heterogeneity. Studies such as Durlauf and Johnson (1995) and Canova (1999) have illustrated, albeit in very different ways, that the constant coefficient linear model assumptions made in standard growth analyses are not supported by the data. This should hardly be a surprise; there is nothing in growth theory which would lead one to think that the marginal effect of a change in high school enrollment percentages on the per capita growth of the United States should be the same as the effect on a country in sub-Saharan Africa. It is of course the case that one can make an argument for parameter heterogeneity for virtually any observational data set. Yet in the case of cross-country growth, this concern seems particularly salient, as any parsimonious regression will necessarily leave out many factors that would from the perspective of economic theory be likely to affect the parameters of the included variables. In fact, I would go so far as to argue that the relationship between a set of controls and a particular country’s growth rate will generally depend on its state of development, which means that the parameters of growth equations should be treated as functions rather than as constants. Methods developed by Hastie and Tibshirani (1993) and Fan and Zhang (1999) for modeling varying coefficients contain the basis for the development of a richer and more theoretically satisfactory approach to growth regression modeling. Finally, with respect to the identification of data patterns in the presence of heterogeneity, Quah’s (1996, 1997) work on the estimation of the evolution of cross-section distributions is very important.

At a minimum, empirical growth needs far greater considerations of the limits to formal statistical work. Given the large number of plausible competing theories and the likelihood of substantial parameter heterogeneity across countries, there are clear limits to what econometric analyses can do. By implication, historical studies are of special importance in growth analysis; the tendency of economists to treat statistical studies as automatically more informative than narrative studies has no justification in general and is clearly pernicious in contexts such as growth where the data are so poor. While econometrics can help to deal with issues of model selection and parameter heterogeneity, formal advances will not be sufficient, I suspect, to permit very firm inferences concerning many of the assertions currently made about growth. It would be interesting to see if ideas in Phillips and Ploberger (1999) could be used to establish limits
on what may be learned from statistical analyses of growth in the presence of some of the issues I have raised.

In addition, it is important to develop measures for the local goodness of fit of models. It seems sensible that different growth theories will fit different sets of countries relatively well. Empirical growth studies virtually always assume that one theory is equally valid for all countries, whereas it is far more natural to think that a given theory will explain the growth experience of each country more or less well depending on the country’s individual characteristics. Durlauf and Johnson (1995) find that the explanatory power of the Solow growth model varies across countries with different initial incomes and literacy rates. Multivariate analogs of the local correlation coefficient due to Bjerve and Doksum (1993) could have an important role to play in formalizing this idea. One can also imagine that various classification algorithms have a role to play in this regard — see Gordon (1999) for a wealth of possibilities. Of course, the choice of particular classification schemes will need to be guided by economic theory.

A key contribution that econometrics can make is to clarify how empirical workers should elucidate data patterns and draw inferences concerning growth. One aspect of this potential contribution is the continuing development of model robustness and averaging techniques in the spirit of Leamer. Another is the development of varying coefficient methods that allow the growth process to depend on a country’s state of development. Yet another is the development of goodness of fit measures which allow one to tell how well a model fits various subsets of the data. Many of these desiderata have antecedents in the statistics and econometrics literatures, (certainly a number of my suggestions amount to a call for using various types of semi- and nonparametric methods and/or classification and clustering algorithms) but have yet to be developed for and applied to the growth context. At a minimum, econometrics has a crucial role to play in correcting the overclaiming and unjustified assertions that have become so commonplace in the growth literature. This literature leads one to recall Ludwig Wittgenstein’s dictum:

What can be said at all can be said clearly, and what we cannot talk about we must pass over in silence.

(Tractatus Logico-Philosophicus)

By providing appropriate tools, econometric theory can expand the domain of what empirical workers can in fact say clearly even for a subject as complicated as economic growth.

Acknowledgements

I thank Andros Kourtellos, Bruce Hansen and Ken West for helpful comments.
References