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Econometrics of Structural Change

With 6 Figures

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Preface

Econometric models are made up of assumptions which never exactly match reality. Among the most contested ones is the requirement that the coefficients of an econometric model remain stable over time. Recent years have therefore seen numerous attempts to test for it or to model possible structural change when it can no longer be ignored. This collection of papers from Empirical Economics mirrors part of this development.

The point of departure of most studies in this volume is the standard linear regression model

$$y_t = x_t'\beta_t + u_t \quad (t = 1, \ldots, T),$$

where notation is obvious and where the index t emphasises the fact that structural change is mostly discussed and encountered in a time series context. It is much less of a problem for cross section data, although many tests apply there as well.

The null hypothesis of most tests for structural change is that $\beta_t = \beta_0$ for all t, i.e. that the same regression applies to all time periods in the sample and that the disturbances u_t are well behaved. The well known Chow test for instance assumes that there is a single structural shift at a known point in time, i.e. that $\beta_t = \beta_0$ $(t < t^*)$, and $\beta_t = \beta_0 + \Delta\beta$ $(t \geq t^*)$, where t^* is known.

It can easily be generalized to multiple structural shifts, the timing of which must however still be known. Another generalisation, provided by Toyoda and Ohtani in this volume, is to different change points for individual coefficients. Under the usual alternative all coefficients change at once, but here it is shown in a demand for fuel application that change points for individual coefficients might well be different.

Pötzelberger and Polasek consider the standard Chow test from a Bayesian viewpoint. By varying the prior distribution of $\Delta\beta$, they determine whether or not the structural change is robust against the different choices for the prior distribution, the major point being that a structural change can be diagnosed with

much more confidence if it is found substantial irrespective of the prior distribution.

Leybourne and McCabe consider regression coefficients which follow a random walk, i.e. where

$$\beta_t = \beta_{t-1} + v_t \quad (v_t \sim \text{i.i.d. } (0, \sigma_V^2)).$$

Here, the null hypothesis of structural stability is equivalent to $H_0: \sigma_V^2 = 0$. Alternatively, one can dismiss specific alternatives altogether and look for pure significance tests, as is done by King and Edwards. By suitable transformations of recursive (or other LUS) residuals, they reduce the problem to one of testing independently distributed uniform random variables. This is similar to the established CUSUM and CUSUM of squares tests, which likewise do not require any prior knowledge about the type and timing of structural shifts.

Another group of papers in this volume consider standard procedures in non-standard situations. MacKinnon modifies the Chow test such as to become robust to heteroskedasticity among the disturbances u_t of the model, and Ploberger et al. adapt the CUSUM test to dynamic models of the form

$$y_t = \gamma y_{t-1} + x_t'\beta + u_t,$$

which are ruled out in the classical analysis with nonstochastic regressors. The problem is that recursive residuals are then no longer nid $(0, \sigma^2)$ (given nid disturbances), and the standard assessment of their cumulative sums breaks down.

A different but perennial problem in all empirical work is adressed by Lütkepohl and Phillips/McCabe. This is the possible presence of several complications at time. Lütkepohl considers test of causality in vector autoregressions, and shows that the true significance level far exceeds the nominal one when there is structural change in the regression coefficients. This implies that many rejections of non-causality which have been reported in empirical work in recent years may well be due to structural change.

Phillips and McCabe suggest a sequential approach to testing for structural change to take care of such multiple violations of the assumptions of the model. It has become common practice in empirical econometrics (and a good one at that) to test a model for various misspecifications such as omitted variables, autocorrelated or heteroskedastic disturbances, incorrect functional form or structural change at a time. The obvious problem with this approach, which Phillips and McCabe at least partially resolve, is how to control the Type I error probability and how to draw conclusions from the results of the tests.

An annotated bibliography containing about 400 items by Hackl and Westlund of econometric and statistical work on structural change concludes this volume. It is a tribute to the dynamics of this literature that in the few months after the acceptance for publication of this bibliography, dozens of additional papers have appeared which deal with the testing and modelling of structural change. A huge literature, which is not touched upon here, has for instance evolved around the Kalman filter approach to parameter instability. New tests for structural change keep appearing at an increasing rate, and given the multitide of possible models and alternatives, this will continue for quite some time. I should be pleased if readers would judge this volume as a useful contribution to this fascinating field.

Dortmund, April 1989 Walter Krämer

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