Change–point detection in panel data

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We consider N panels and each panel is based on T observations. We are interested to test if the means of the panels change at an unknown time against the alternative that the means remain the same during the observation period. We provide tests which are derived from a likelihood argument and they are based on the adaptation of the CUSUM method to panel data. Asymptotic distributions are derived under the no change null hypothesis and the consistency of the tests are proven under the alternative. The asymptotic results are shown to work in case of small and moderate sample sizes via Monte Carlo simulations.

One of the tools to analyse large, high dimensional data sets is the panel data model. The focus of our paper is to test for possible changes in the location (mean) parameter of panel data. We study the setup with N panels and with T observations in each panels and define our model as

$$X_{i,j} = \mu_i + \delta_i I\{j > k_0\} + e_{i,j}, \;\; 1 \le i \le N, 1 \le j \le T, \tag{1}$$

where $Ee_{i,j} = 0$ for all i and j. According to (1) μ_i changes to $\mu_i + \delta_i$ in case of panel i at time k_0. The parameter k_0, the time of change, is unknown. Both T and N are assumed to be large. In this paper we wish to test that the location parameter μ_i will not change during the observation period, i.e.,

$$H_0 : \;\; \delta_i = 0 \;\; \text{for all } 1 \le i \le N.$$

Change point detection in panel data can be viewed as a structural stability problem in high dimensional time series.