On testing for cross sectional correlations in panels: with various time series dimensions (T) and cross sectional dimensions (N)

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Abstract

The past decade has witnessed a rapid development in models with cross sectional correlations. Apart from the traditional approach in spatial statistics, which uses the so-called spatial weights matrix (see, for instance, Kelejian and Prucha, 1999), a number of approaches are suggested in the literature of panel data econometrics. Notable examples include (a) Economic distance (Conley, 1999), (b) Factor model (Bai, 2003), and (c) Using proxies (Pesaran, 2006). Re-visiting the Lagrange Multiplier (LM) test for error components first suggested in Breusch and Pagan (1980) (see also the extensions in Honda, 1985, Pesaran, 2004 and Hsiao, Pesaran and Pick, 2007), we interpret this LM test as a test for cross sectional correlation and derive its asymptotic distribution under the following cases: (1) both time series dimension (T) and cross sectional dimension (N) go to ∞ (*jointly*), (2) $T \to \infty$ while N is fixed, and (3) $N \to \infty$ while T is fixed. Case (1) is in contrast with that in Honda (1985) or Quah (1994) who consider $T = \rho N$ while $N \to \infty$ (the *diagonal path* limit named by Phillips and Moon, 1999). The results under Cases (2) and (3), to the best of our knowledge, are new. Interestingly, while the distributions under (1) and (2) are normal, that under (3) is not. The critical values under (3) can be easily approximated by Monte Carlo simulations though. Finite $(2 + \delta)th$ ($\delta > 0$) moments are required for independently but non-identically distributed (i.n.i.d) data, while only finite $2nd$ moments are required for i.i.d data. A Monte Carlo experiment is performed and it aims to throw light on the choice of critical values suggested in the three cases, given a T and an N. We close the paper with a discussion on the diagnostic testing, after the cross sectional correlation is taken out with one of the four approaches.

Key Words: Cross sectional correlation; Cross sectional dimension; Diagonal path limit; Joint limit; Sequential limit; Time series dimension

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