
Bootstrap LM-lag test for spatial dependence in panel data models

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Abstract. This paper applies bootstrap methods to LM-lag test for spatial dependence in panel data models, and LM-lag test is asymptotic pivotal. The consistencies of LM tests and their bootstrap versions are proved, and then the asymptotic refinements of bootstrap LM tests are obtained. It shows that the first order asymptotic distribution of LM-lag test converges as $O((NT)^{-1})$, and the convergence rate of bootstrap LM-lag test is $O((NT)^{-2})$. The error made by the bootstrap LM-lag test approximation to the asymptotic distribution is $O((NT)^{-3/2})$. Compared to asymptotic distribution of LM-lag test, bootstrap LM-lag test gets asymptotic refinements.

1. Introduction

The bootstrap is a method for estimating the distribution of an estimator or test statistic by resampling one's data or a model estimated from the data (Horowitz, 2001). So far, bootstrap is widely applied in cross sectional data, time series and panel data. Many scholars investigate the performance of bootstrap methods in terms of simulation analysis, and few provide the corresponding mathematical proof.

In the classical econometrics, the performance of bootstrap methods is derived based on Edgeworth expansion by Beran (1988), Hall (1992), Horowitz (2001), Hall and Horowitz (1996), Cameron and Trivedi (2005), Godfrey (2009). Recently, bootstrap is extensively focused on its applications in spatial econometrics. Lin et al. (2011) investigate the performance of bootstrap Moran's I test for spatial dependence in cross sectional data, and find that bootstrap Moran's test for spatial dependence is superior to asymptotic Moran's I test in terms of mathematical derivation and Monte Carlo experiments.

Tests for spatial dependence are one of the important essentials in spatial econometric analysis. Both Moran's I and LM tests are usually applied for spatial dependence in cross sectional data and panel data. Many Monte Carlo experiments show that LM tests for spatial dependence have good finite sample properties when the disturbances are normal, however when the disturbances are not normal or with heteroskedasticity, LM tests can have large size distortion and lower power (Anselin et al. (1996), Yang (2015)). So far there are three important and closely associated studies in mathematical derivation. Long et al. (2012) use Edgeworth expansion to prove the validity of bootstrap Moran's I tests for spatial dependence in cross sectional data. Jin and Lee (2015) prove the existence of the Edgeworth expansions for LQ forms with the normal disturbances, and establish an asymptotic expansion of LQ forms based on martingales with no normal disturbances. Yang (2015) find that in finite samples, the LM test referring to asymptotic critical values may suffer from the problems of size distortion and low power, which become worse with a denser spatial weight matrix, and introduces residual-based bootstrap methods to refine asymptotically approximations to the finite sample critical values of the LM statistics. In a word, Edgeworth expansion proposed by Hall (1992) is still the most feasible method that mathematically derives the validity of bootstrap methods. However, all above studies are focused on tests for spatial dependence in cross sectional data. This paper will firstly extend bootstrap LM tests for spatial dependence from cross sectional

Bootstrap For Panel Data Models

Irina Murtazashvili



Bootstrap For Panel Data Models :

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