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**1. Description**

This repository contains the Matlab code for performing the slope homogeneity tests in panel data models, including the Swamy’s test by Swamy (1970) and the Delta tests by Pesaran and Yamagata (2008).

**2. Citation**

This code is provided as supplementary material for our paper:

Haghnejad, A., Samadi, S., Nasrollahi, K., Azarbayjani, K., & Kazemi, I. (2020). Market power and efficiency in the Iranian banking industry. *Emerging Markets Finance and Trade*, 56(13), 3217-3234.

Please cite this paper if you are using the codes in your research.

**3. Slope homogeneity tests**

The procedure for testing slope homogeneity in the panels is based on the following model:

where is the cross‐sectional dimension, is the time dimension, is the dependent variable, is a vector of regressors, and and are intercept and a vector of unknown slope coefficients, respectively, which are allowed to vary across individuals.

The usual procedure for testing slope homogeneity is the standard *F* test. Considering Equation (1), it tests the null hypothesis of slope homogeneity - , for all - against the alternative hypothesis of slope heterogeneity ‐ , for a non‐zero fraction of pair‐wise slopes for . This test is appropriate in the context of panel data models with strictly exogenous regressors, homoscedastic error variances, and being small relative to (Pesaran and Yamagata, 2008).

By relaxing the homoscedasticity assumption in the standard *F* test, Swamy (1970) develops a slope homogeneity test based on the dispersion of individual slope estimates from an appropriate pooled estimator. The Swamy’s test statistic is given by

where , is the OLS estimate of slope coefficients for unit where is an identity matrix of order and is a vector of ones, and is the estimate of error variance, , which can be written as follows:

where , and is the weighted fixed effects (WFE) estimator of slope coefficients, as given by

Under the null hypothesis of slope homogeneity, in the case where is fixed and , the statistic is asymptotically distributed as with degrees of freedom.

As pointed out by Pesaran and Yamagata (2008), like the standard *F* test, the Swamy’s test is applicable for panels where is small relative to . To address this problem, they propose a standardized version of the Swamy’s test that is appropriate for panels where could be large relative to . The test statistic proposed, denoted by , is based on a modified version of the Swamy’s statistic as

where the error variances for the individual units are estimated using the standard fixed effects (FE) estimator (), rather than the OLS estimator (), namely

and instead of , is applied which is the WFE estimator computed using (instead of ), namely

Then the standardized dispersion statistic is developed as

Under the normally distributed errors, Pesaran and Yamagata (2008) improve the small sample properties of the statistic by considering the following mean and variance bias adjusted version of ,

where and . Monte Carlo experiments carried out in Pesaran and Yamagata (2008) show that in the case of models with strictly exogenous covariates and non‐normally distributed errors, the statistic is asymptotically distributed as when and such that When the errors are normally distributed, the statistic is shown to be distributed as if and without any restrictions on the relative expansion rates of and

**References**

Haghnejad, A., Samadi, S., Nasrollahi, K., Azarbayjani, K., & Kazemi, I. (2020). Market power and efficiency in the Iranian banking industry. *Emerging Markets Finance and Trade*, 56(13), 3217-3234.

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, 142(1), 50-93.

Swamy, P. A. (1970). Efficient inference in a random coefficient regression model. *Econometrica: Journal of the Econometric Society,* 38*(*2*)*, 311-323.