Chapter 5
Panel Non-Stationarity Methods in Macro- and Microeconomic Studies

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ABSTRACT

Panel data analysis aims to overcome the weaknesses of its alternatives: country-by-country analysis is usually based on short samples, there is a significant country-specific distortion in the data, and it leads to biased estimates, and the cross-section analysis neglects the time dimension. In last two decades, tests for non-stationary panels sparked a large body of literature both on tests theory and on various empirical studies in multiple areas of micro- and macroeconomic research. The most popular studies include topics such as growth, finance, exchange rates, fiscal matters, and international trade, but also popular are studies in tourism, energy, resource demand and supply, IT and technology spreading, politics, inflation, international trade and current accounts, stock markets, etc.

INTRODUCTION

Data in macroeconomics is often comprised of short series, therefore the usage of tests for non-stationarity can lead to suspicious results. In microeconomics the situation is similar in many cases. The emergence of panel non-stationarity methods in the last decades gives the researcher the opportunity to explore for non-stationarity even shorter series. Panel tests are considered as more powerful than their time series counterparts. Combined with broader accessibility of data, especially from international sources as the World Bank, IMF, UN etc., a big number of studies appears for all types of countries and in various areas. Many countries provide more detailed data on their economies, making panel data studies feasible.

Theory behind the panel tests on non-stationary data has been developed mainly in the 1990s and up to 2008-2009. The first attempts to treat panel data were made parallel to the time series non-stationarity tests, in the late 1980s. Seminal papers by Levin and Lin (1993) and Im, Pesaran and Shin (1995) were

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followed by vast literature on panel unit root tests and panel tests for cointegration. In its majority, panel literature is developed as some generalization of non-stationarity in time series.

However, there are two major problems with panel tests: the cross-sectional dependence and the unexplored small sample properties of the tests. The former problem consists in the fact that the early tests rely on independence in the N-dimension, which is almost never the case with real world data. In approaching this problem, tests are divided in "first generation" and "second generation" types. The latter problem is addressed mainly with bootstrap methods and other simulations.

The use of panel tests has recently become a common practice in economic studies, panel data has turned into a de facto standard in many cases. In the 2000s, the main panel tests on unit roots and cointegration were included in the popular econometric software packages, today they are an integral part of the software, and since then numerous papers using panel data and tests have appeared.

Panel methods have been applied in various macro- and microeconomic studies, to name but a few areas and titles: economic growth, inflation and other general issues; money demand and exchange rates; investment; fiscal policy; energy; environmental issues; trade and integration; development studies; labour studies; various sectoral studies. Most of the popular panel studies appear to be in the field of macroeconomics, however panel methods prove to be especially useful for studying some microeconomic topics as well, notably the market failures areas, and papers on ecology, energy, and resource allocation and use are among the most cited ones with panel methodology.

The rest of this chapter is organized as follows: section 2 presents the most popular tests, section 3 presents some of the popular areas of research, section 4 gives some future research directions, section 5 concludes.

TESTS FOR PANEL NON-STATIONARITY

Panel Unit Root Tests

Pioneering work in panel data on exploiting the information from cross-sectional dimensions in inferring non-stationarity is contributed to Quah (1994), who derives the normality of some cases of unit root regression in panels, demonstrating that coefficient estimators have a mixture of standard normal and Dickey-Fuller-Phillips asymptotics. Also found is that the standard normal distribution is a good approximation of both large N, small T, and large N, large T cases. This initial work is soon followed by a multitude of practical tests.

Levin, Lin and Chu (LLC) Test

Levin et al. (2002) develop a theory and a test (LLC) for panels where weak stationarity is violated by unit roots within each individual time-series. The test is based on the asymptotic theory, therefore it is applicable for relatively large panels. The proposed test statistic is a modified t-statistic, based on the normality of unit root t-statistic for a model with no individual fixed effects and independent and identically distributed disturbances derived by Quah (1994).

The test statistics have limiting normal distributions, but are "super-consistent", they converge faster as the time dimension grows, unlike the case of stationary data.

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