Panel unit root tests of purchasing power parity between Japanese cities, 1960–1998: disaggregated price data

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Abstract

This paper makes use of new panel unit root tests of Im et al. [Testing for unit roots in heterogeneous panels, Working paper, Department of Applied Economics, University of Cambridge, 1997], and Maddala and Wu [Oxford Bull. Econ. Stat. 61 (1999) 631] to examine whether long-run purchasing power parity (PPP) holds between major Japanese cities. By using a panel of 13 disaggregated consumer price indices from seven cities in Japan over the period 1960–1998, we are able to reject the null hypothesis that the relative price of goods between Japanese cities is non-stationary at the 5 percent level for all eight tradable goods and in two of the five non-tradable goods. Hence, we conclude that long-run PPP holds between major Japanese cities and PPP holds more for tradable goods than for non-tradable goods.
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1. Introduction

Over the past decade, a considerable number of empirical studies have analyzed purchasing power parity (PPP) and the law of one price (LOOP) (see Froot and Rogoff, 1995; Rogoff, 1996 for a comprehensive survey). Many studies have tested the hypothesis

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that real exchange rate is stationary by using the unit root tests in order to examine whether long-run PPP holds across industrialized countries for the post Bretton-Woods period. However, these studies fail to reject the null hypothesis of the unit root by using industrialized countries data.

Conventional unit root tests examine the unit root null based on a univariate approach. However, it is well known that these tests have low power when the root is close to one. Moreover, Shiller and Perron (1985) point out that the augmented Dickey–Fuller (ADF) test has low power with short time spans. More recently, the panel unit root tests developed by Levin and Lin (1993), Im et al. (1997) and Maddala and Wu (1999) have more power than univariate time series tests. Levin and Lin (1993) demonstrate that implementing a unit root test on a pooled cross-section data set, rather than performing separate unit root tests for each individual series, can provide dramatic improvement in statistical power.

To increase the power of univariate ADF regressions, the Levin and Lin (1993) procedure imposes identical first-order autoregressive coeffcients on all series in the panel, whereas Im et al. (1997) and Maddala and Wu (1999) allow for different first-order autoregressive coefficients in the estimation procedure. Im et al. (1997) propose a panel unit root test based on the mean group approach and show that their t-bar statistic achieves more accurate size and high power relative to the Levin and Lin (LL) test by allowing for a greater degree of heterogeneity across individuals.

Maddala and Wu (1999) propose the use of Fisher (1932) test which is based on combining the P-values of the unit root test statistics in each cross-sectional unit. Maddala and Wu (1999) show that the Fisher test achieves more accurate size and high power relative to the LL test. The advantage of this test is that it can use different lag lengths in the individual ADF regressions, although the IPS test must use the same lag lengths in all the individual ADF regressions.[1] Moreover, the Fisher test does not require a balanced panel as in the case of the IPS test.

Panel unit root tests have been used in the PPP literature when the failure to reject the null hypothesis is attributed to the lack of power intrinsic in univariate unit root tests. For example, by using the LL test, Wu (1996) and Papell (1997) can reject the unit root null of real exchange rates. The IPS test have been applied by Coakley and Fuertes (1997) and Canzoneri et al. (1999) to test real exchange rate stationary. Wu and Chen (1999) use the IPS test and the Fisher test to examine real exchange rate stationary for Pacific Basin countries.

In this paper, we examine whether long-run PPP holds between major Japanese cities by using a panel of 13 disaggregated consumer price indices from seven cities in Japan over the period 1960–1998. The contribution of this paper is two-fold. First, by using disaggregated price between cities in the same country,[2] we can directly analyze the relationship between the deviations from PPP and type of goods. Froot and Rogoff (1995)

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[1] Therefore, in practice, the Fisher test can decrease the bias which is caused by the lag selection (Banerjee, 1999). The Fisher test is non-parametric, on the other hand, Im, Pesaran and Shin (IPS) test is parametric.

[2] For analyses of PPP by using disaggregated price data, see Engel and Rogers (1996), Parsley and Wei (1996), Jenkins (1997), Takagi and Yoshida (1999) and Esaka (2000). Esaka (2000) first tests the hypothesis that the relative price of goods between major Japanese cities is stationary by using the univariate unit root test and then makes use of a logit model to statistically identify the determinants of PPP between Japanese cities by using the results of the unit root test.