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The PPP debate: Price matters!

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Abstract

We implement panel unit root PPP tests that allow for cross-sectional dependence between 15 OECD economies 1973:03–1998:12. The main variation in the results stems from using the CPI or PPI indexes rather than from ignoring or allowing for cross-sectional dependence.

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1. Introduction

Panel unit root procedures have been extensively employed in recent years to investigate long run purchasing power parity (PPP) by testing for a unit root in real exchange rates.¹ For instance, MacDonald (1996), Oh (1996), Wu (1996), and Coakley and Fuertes (1997) find some support for PPP using such tests. However O'Connell (1998) shows that accounting for cross-sectional dependence (CSD) overturns the case for PPP in panels of up to 64 real exchange rates and calls this the overvaluation of PPP. Likewise, recent contributions by Moon and Perron (2004), Harris et al. (2003)

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¹ See Taylor and Taylor (2004) for a recent review of the literature.

and Smith et al. (2004) that allow for CSD also are unable to provide much evidence in favour of PPP in contrast to applications that ignore CSD.

CSD should matter in PPP tests using bilateral exchange rates since these are defined using a common numeraire currency and price index. This paper formally assesses the evidence on PPP for a panel 15 OECD economies 1973:03–1998:12 using two price indexes and two numeraire currencies. We contrast the results from test procedures that ignore and allow for CSD. These are the standard Im et al. (2003) [IPS] test and the novel cross-sectionally augmented IPS or CIPS panel unit root test of Pesaran (2003), respectively.² These tests are chosen for two reasons. On one hand, they incorporate cross-sectional heterogeneity that is likely to be relevant in large panels such as ours. On the other, they have good size and power properties for the panel dimensions employed. Strikingly, it is found that both test procedures yield the same qualitative verdict on PPP for the same panel. Instead, the novel finding is that the main influence on (non) rejection of the unit root null stems from the choice of price index: while the CPI panel mainly rejects PPP, the PPI panel largely supports it.

The paper is organized as follows. Section 2 outlines the two panel unit root tests, Section 3 discusses the data and results while Section 4 concludes.

2. Two panel unit root tests

Define the data generating process for q_{it} , the observation on the i th cross-section unit at time t , as:

$$\Delta q_{it} = \alpha_i + \beta_i q_{i,t-1} + u_{it} \quad i = 1, \dots, N; \quad t = 1, \dots, T \quad (1)$$

where u_{it} is an error term. Allowing for residual serial correlation:

$$u_{it} = \sum_{j=1}^k \rho_{ij} u_{i,t-j} + \eta_{it} \quad (2)$$

CSD can be represented by allowing η_{it} to have a factor structure:

$$\eta_{it} = \gamma_i f_t + \varepsilon_{it} \quad (3)$$

where f_t is an unobserved common factor and ε_{it} is a white noise idiosyncratic error. Under (1) the appropriate null and alternative hypotheses can be defined as:

$$H_0 : \beta_i = 0 \quad \forall i \quad (4)$$

$$H_1 : \beta_i < 0 \quad \forall i = 1, \dots, N_1; \quad \beta_i = 0 \quad \forall i = N_1 + 1, \dots, N \quad (5)$$

where N_1 is non-zero. Pesaran (2003) proposes a novel test of the unit root hypothesis in (4). This is based on the t -ratio, denoted $t_i(N, T)$, of the least squares estimate of β_i in the following cross-sectionally augmented ADF regression for each country:

$$\Delta q_{it} = a_i + b_i q_{i,t-1} + c_i \bar{q}_{t-1} + \sum_{j=0}^p d_{ij} \Delta \bar{q}_{t-j} + \sum_{j=1}^p \delta_{ij} \Delta q_{i,t-j} + e_{it} \quad (6)$$

² The latter is also known as the average cross-sectionally augmented Dickey–Fuller (CADF) test.

Table 1
Panel unit root test results 1973:03–1998:12 (CPI)

Exogenous specification Numeraire	Constant		Constant and linear trend	
	USD	DM	USD	DM
IPS	−0.996	−2.430	1.448	−0.225
CIPS	−1.891	−1.969	−2.419	−2.557
10% Critical values (CIPS)	−2.15	−2.15	−2.66	−2.66

where \bar{q}_t is the cross-sectional mean of q_{it} . Pesaran notes, that under certain assumptions, the cross-sectional averages in (6) are shown to act as proxies for f_i in (3). The appropriate CIPS panel test statistic is a generalisation of the IPS test:

$$CIPS(N, T) = N^{-1} \sum_{i=1}^N t_i(N, T) \quad (7)$$

and the critical values can be found in Pesaran (2003), Table 3a–c.

The popular IPS t -bar panel unit root test is based on the t -ratio, denoted t_{iT} , of the least squares estimate of b_i in (6) without the cross-sectional average terms. The relevant standardised test statistic is:

$$IPS(N, T) = \frac{\sqrt{N} \left\{ tbar_{NT} - \frac{1}{N} \sum_{i=1}^N E[t_{iT} | \beta_i = 0] \right\}}{\sqrt{\frac{1}{N} \sum_{i=1}^N Var[t_{iT} | \beta_i = 0]}} \xrightarrow{T, N} N(0, 1) \quad (8)$$

where $tbar_{NT} = N^{-1} \sum_{i=1}^N t_{iT}$. In contrast to the CIPS test, this procedure assumes that the individual time series are cross-sectionally independently distributed.

3. Data and results

Monthly bilateral exchange rates are downloaded from Datastream for 15 OECD countries with the US Dollar (USD) and Deutschmark (DM) as the numeraire currency and the Consumer Price Index (CPI) and Producer Price Index (PPI) indexes as proxies for prices. The CPI and PPI panels—while similar—do not comprise of the same countries due to data availability (see Appendix A). The monthly dataset spans 1973:03–1998:12 which yields just over 300 observations. As a preliminary step, conventional ADF tests are applied to each individual real exchange rate series, using the modified Akaike information criterion (MAIC) to select the appropriate lag length. These results overwhelmingly fail to reject the unit root null with only a handful of rejections in over 180 tests.³

Tables 1 and 2 present the CIPS and IPS test results for the CPI and PPI panels, respectively, again employing the MAIC to select the lag lengths.

On the plausible assumption that test procedures that allow for CSD are more relevant, Table 1 indicates rejection of PPP for the CPI panel while PPP is supported for the PPI panel in Table 2. The

³ Results available from the authors on request.

Table 2

Panel unit root test results 1973:03–1998:12 (PPI)

Exogenous specification Numeraire	Constant		Constant and linear trend	
	USD	DM	USD	DM
IPS	–1.946	–3.289	–0.184	–2.986
CIPS	–2.742	–2.624	–3.212	–3.129
10% Critical values (CIPS)	–2.15	–2.15	–2.66	–2.66

finding is in line with [Froot and Rogoff \(1995\)](#) who argue that PPI panels produce more support for PPP since this index contains a higher proportion of tradable goods. There is no overall support for [O’Connell’s \(1998\)](#) overvaluation case. In [Table 1](#) the CIPS results overturn the IPS support for PPP in one case (DM-constant) but the CIPS statistic in [Table 2](#) reverses the IPS PPP rejection in another case (USD-constant and linear trend).

These striking results show that the overwhelming influence on (non) rejection of the null stems not from allowing for CSD but from the choice of the price index. One is far likelier to get rejections using PPI data as opposed to CPI data and this applies irrespective of whether one employs the CIPS or IPS tests or the US dollar or DM as numeraire currency.⁴ Hence, price matters for PPP!

4. Conclusions

This paper investigates the PPP hypothesis by comparing the results of [Pesaran’s \(2003\)](#) new CIPS panel unit root test that allows for CSD with those from the IPS test that ignores it. Employing a panel of 15 OECD exchange rates it is found that the overwhelming influence on (non) rejection of the unit root null is the choice of price index and not CSD. Two important conclusions can therefore be drawn. First, rejection of the unit root or non-PPP null in panel tests is heavily conditioned on the price index series used in constructing the real exchange rate series. Second, both the CIPS and IPS tests yield qualitatively similar results for the same price index panels, suggesting that the CSD problem may not be the key to the PPP puzzle after all.

Appendix A. Sample countries

A.1. CPI Panel

Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, and the United States.

A.2. PPI Panel

Austria, Canada, Denmark, Finland, Germany, Greece, Ireland, Japan, Mexico, Netherlands, South Korea, Spain, Sweden, Switzerland, United Kingdom, and the United States.

⁴ See [Papell and Theodoridis \(2001\)](#) on the numeraire currency issue.

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