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Evidence on the Purchasing Power Parity in Panel of Cities

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Abstract

We provide evidence on the PPP hypothesis using a sample of fifty Spanish cities for a long time period through the application of panel data unit root tests. Although results suggest non-rejection of the PPP, short-run deviations –as measured by half-lives– indicate that real factors might be causing a slow rate of convergence to a common price index, even in highly integrated economies.

Keywords: Convergence in prices, cities, PPP, half-life, panel data unit root tests

JEL codes: F31, F37, F41

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1. Introduction

The Purchasing Power Parity (PPP) hypothesis has raised a lot of interest in both theoretical and applied economic analysis. Some theoretical models on international economics have been developed assuming some kind of PPP hypothesis –strong or weak version– although it is in the empirical arena that testing the PPP hypothesis has become very popular. Froot and Rogoff (1995) review the literature and distinguish up to three different stages on the empirical PPP hypothesis testing: (i) old tests in which the PPP holds under the null hypothesis, (ii) unit root tests, in which under the null hypothesis it is assumed a permanent deviation from the PPP and (iii) cointegration tests, in which deviations from the PPP are analysed using a linear combination of prices. Note that the second and third stages involve the analysis of the stochastic properties of time series of prices. Actually, most of the recent evidence to the PPP hypothesis has been obtained applying the fruitful frameworks of the unit root, stationarity and cointegration techniques. Some of the outstanding contributions to this field are Frankel (1986), Meese and Rogoff (1988), Corbae and Ouliaris (1991), Lothian and Taylor (1996), and Montañés and Clemente (1999). The main limitation of these analyses comes from the lack of power shown by the unit root and cointegration tests. Some practitioners have advocated for the use of longer time series as a way to solve this shortcoming, but this gives rise to another problem, *i.e.* the fact that long time series encompass periods in which nominal exchange rates regimes shifted from floating to fixed and back again.

The univariate analysis of the PPP has found a natural extension into the panel data framework. The idea behind the use of these tools is that the combination of the cross-section and time series information increases the power of the statistical inference which, in turn, allows practitioners to deal with time series corresponding to an homogeneous exchange rate regime. Some of the relevant papers that address the PPP testing in a panel data framework are Abuaf and Jorion (1990), Oh (1996), Papell (1997), Culver and Papell (1999), O'Connell

(1997), Papell and Theodoridis (1998) and Fleissig and Strauss 2000), to mention few. All of them point to the analysis of the PPP at an international level –samples of G7, industrialised OECD countries and European countries.

The study of the PPP hypothesis has not only been restricted to international economics. Recently, the PPP literature has experienced the rising of a broad number of empirical works aimed to testing for the PPP at an intranational level. In fact, there is wide consensus in that the PPP hypothesis should be most easily satisfied at an intranational level than when it is analysed at an international level. Among the reasons for that are the higher markets integration, the absence of trade barriers –such as tariffs and quotas– and the absence of exchange rate volatility. Although there are transportation costs that prevent arbitrage, they are presumably smaller within than between countries. Finally, price indices within a country are expected to be more homogeneous than price indices between countries since, first, they are collected by the same statistical institution and, second, the basket of goods is more homogeneous.

Most of the empirical evidence on intranational PPP has focused on the U.S. and Canadian cities –see Parsley and Wei (1996), Jenkins (1997), Culver and Papell (1999), Levin, Lin and Chu (2002), Cecchetti, Mark and Sonora (2002), and Chen and Devereux (2003). In contrast to this evidence for the North-American cities, there are less empirical studies that address the PPP hypothesis testing on other geographical areas. Exceptions are, for instance, Nenna (2001) and Esaka (2003) for twenty one Italian and for the major Japanese cities respectively, concluding in favour of the PPP hypothesis, though noting the high persistence of the deviations. It should be stressed that price convergence across economies has recently become a crucial issue for the implementation of the EU common currency area. In this regard, the aim of this paper is to extend the empirical evidence on the PPP hypothesis to a sample of fifty Spanish cities. The long time period covered by the monthly time series –from 1939:7 to 1992:12– allows us to apply some of the panel data unit root tests that have been recently proposed in the literature. Our results supports the PPP hypothesis among the Spanish cities, though in some cases deviations are highly persistent, even lasting more than ten years.

The outline of the paper is as follows. Section 2 briefly presents the PPP hypothesis and describes the panel data unit root statistics used to test it. Section 3 reports results for the sample of Spanish cities while Section 4 discusses the persistence of shocks affecting city prices. Finally, Section 5 concludes.

2. The PPP hypothesis testing

Let $p_{i,t}$ denotes the log of price level of the economy i , $p_{j,t}$ the log of price level of economy j , and $tc_{ij,t}$ the log of nominal exchange rate that relates the currencies of both economies, $i, j = 1, \dots, N$, $i \neq j$. The PPP hypothesis establishes the equalization of price levels for both economies once they have been expressed in the same currency. Deviations between prices might exist, though they should be temporary if the PPP is satisfied. This implies that the log of the real exchange rate:

$$q_{i,t} = p_{i,t} - p_{j,t} - tc_{ij,t}, \quad (1)$$

is a stationary stochastic process. Therefore, the PPP can be tested assessing the order of integration of $q_{i,t}$, which can be performed using unit root tests. Thus, non-rejection of the unit root is interpreted as evidence against the PPP.

Among the most relevant arguments to explain the evidence against the PPP are the existence of trade barriers –such as tariffs or quotas– and bureaucratic barriers, the cost of collecting information, the different nature of goods –tradeable and non-tradeable–, differences in productivity, firms exercising local monopoly through differential pricing policies, transportation costs, sticky nominal price level adjustment arising from imperfect markets where price changes are costly, and the fact that nominal exchange rates do not adjust to relative-price shocks –see Cecchetti, Mark and Sonora (2002). All these factors might prevent arbitrage that would fully remove price differentials.

Notice that when working with price levels of economies that share a common currency, the effect of the nominal exchange rate in (1) disappears. Thus, the real exchange rate is given by:

$$q_{i,t} \neq p_{i,t} \neq p_{j,t}. \quad (2)$$

Moreover, when they belong to the same country there are not a direct border effect since there are no tariffs or quotas that restrict the arbitrage. Although the literature has suggested some indirect border effects, as for instance those caused by different systems of taxation, the evidence for U.S. cities points to a minimal influence when explaining the deviations from PPP –Parsley and Wei (1996) and Jenkins (1997). We expect this effect to be even more negligible for the Spanish case provided the prevalence of a centralized taxation system. In all, conducting the analysis within a country, as in this paper, increases the probability of finding evidence in favour of the PPP –we get rid of the nominal exchange rate fluctuations and formal border effects–, though it is still possible to find permanent price deviations if factors that hinder the arbitrage exist within a country.

In order to test the PPP hypothesis amongst the sample of Spanish cities, we apply the panel data unit root based tests in Maddala and Wu (1999) –hereafter MW–, Levin, Lin and Chu (2002) –LLC– and Im, Pesaran and Shin (2003) –IPS–, provided that they accommodate panel data sets with moderate number of individuals (N) and large number of time periods (T). All these tests specify the null hypothesis of unit root, but Levin, Lin and Chu (2002) restrict the model under the alternative hypothesis to be a stationary autoregressive process with a common autoregressive parameter for all the individuals, whereas Maddala and Wu (1999) and Im, Pesaran and Shin (2003) allow for heterogeneity in the autoregressive parameters under the alternative hypothesis. Levin, Lin and Chu (2002) propose to test the null hypothesis of $H_0: \delta = 0$ against the alternative hypothesis of $H_1: \delta < 0$ using:

$$q_{i,t} = \alpha_i + d_{mt} + \varepsilon_{i,t} \quad (3)$$

where d_{mt} denotes the deterministic components and $\varepsilon_{i,t}$ is assumed to be independently distributed across i and t , $i = 1, \dots, N$, $t = 1, \dots, T$. The normalised bias and the pseudo t -ratio that corresponds with the pooled OLS estimation of δ in (3),

once they have been properly normalised, converge to a standard Normal limit distribution as $N \rightarrow \infty$, $T \rightarrow \infty$ in a way that $\sqrt{N}/T \rightarrow 0$.

The test in Im, Pesaran and Shin (2003) is based on the estimation of (3) but replacing δ with δ_i . The null hypothesis is given by $H_0: \delta_i = 0, \forall i$, whereas the alternative hypothesis $H_1: \delta_i < 0$ for $i = 1, \dots, N_1$; $\delta_i = 0$ for $i = N_1+1, \dots, N$. Therefore, the null is rejected if there is a subset N_1 of stationary individuals. The first test that they propose is the standardised group-mean Lagrange Multiplier (LM) bar test statistic:

$$\bar{LM} = \frac{\sqrt{N} \left[\overline{LM} - N^{-1} \sum_{i=1}^N E(LM_i) \right]}{\sqrt{N^{-1} \sum_{i=1}^N Var(LM_i)}}, \quad (3)$$

with $\overline{LM} = N^{-1} \sum_{i=1}^N LM_i$, where LM_i denotes the individual LM test for testing $\delta_i = 0$ in (3), and $E(LM_i)$ and $Var(LM_i)$ are obtained by Monte Carlo simulation. The second test is a standardised group-mean t bar test statistic, $\bar{t}$, with an expression similar to (3) but replacing $\overline{LM}$ and LM_i by $\bar{t}$ and t_i , respectively. We define $\bar{t} = N^{-1} \sum_{i=1}^N t_i$, where t_i denotes the individual pseudo t -ratio for testing $\delta_i = 0$ in (3), and $E(t_i)$ and $Var(t_i)$ are obtained using Monte Carlo simulation. The authors show that as $N \rightarrow \infty$, $T \rightarrow \infty$ and $N/T \rightarrow k$, the limiting distribution of both test statistics is standard Normal.

Finally, Maddala and Wu (1999) propose to combine the individual p-values (π_i) associated to the pseudo t -ratio for testing $\delta_i = 0$ in (3). The test is given by MW $\chi^2 = -2 \sum_{i=1}^N \ln(\pi_i)$, which under the null hypothesis is distributed according to MW χ^2_{2N} .²

²In order to facilitate computation of π_i we have carried out 100,000 replications to obtain the empirical percentiles for the ADF test for a DGP given by a random walk without drift. Then a response surface has been estimated to approximate the corresponding p-values using the logistic functional form given by:

$$\pi_i = \frac{\exp(\alpha_i)}{1 + \exp(\alpha_i)}$$

It should be stressed that the limiting distributions of all these tests rely on the assumption of cross-section independence. But this is a strong assumption when testing the PPP hypothesis –see for instance O’Connell (1997). Thus, following Maddala and Wu (1999) here we apply Bootstrap techniques to compute the empirical distribution of the tests –we have performed 1,000 replications for the parametric Bootstrap. This allows us to deal with the presence of cross-section correlation when performing the unit root testing in the panel data framework.

3. Results

The data used in this paper is provided by the Spanish National Institute of Statistics (INE) and refers to the monthly aggregate CPI for fifty Spanish cities from 1939:7 to 1992:12. From 1993:1 onwards there was a change in the methodology used to compute the CPIs that avoids including more recent observations in the analysis. As price indexes are used, only the weak version of the PPP is tested. The cities considered in the analysis correspond with the capitals of the Spanish provinces (NUTS3 EUROSTAT regional breakdown of the EU), that shared the same currency all over the period. This defines a panel data set with $N = 50$ individuals and $T = 642$ time periods, that is used to test the presence of a unit root in (2).

Here we will supply results for the case in which the national CPI is used as the numerarie. It should be mentioned that the selection of the numeraire can be a controversial question when working at an international level, as different results can be drawn depending on it –see Papell and Theodoridis (2001). Although dependence on the choice of the numeraire is supposed to be mitigated when the analysis is carried out at an intranational level, because of the absence of the nominal exchange rate effect, we tried with alternative numeraires (*i.e.* the cross-section mean and the price in each city in the sample) and the results were

where $x_i \otimes \mathbb{I} \otimes \mathbb{I} \otimes x_i \otimes x_i^2 \otimes x_i^3 \otimes x_i^4$, with x_i being the value of the ADF test and π_i the corresponding percentile.

substantially the same.³ Additionally, using the national CPI as the benchmark is in accordance with the common practice of governmental agencies when reporting price differentials within a country.

Table 1. Panel data unit root tests for the Spanish cities

Panel A: Cross-section independence							
ρ $\overline{LM}$	p-val	ρ $\overline{t}$	p-val	MW	p-val	LLC	p-val
7.869	0.00	-6.077	0.00	201.705	0.00	0.688	0.75

Panel B: Empirical distributions (Bootstrap)							
	5%	10%	25%	50%	75%	90%	95%
ρ $\overline{LM}$	-2.12	-1.82	-1.09	-0.28	0.51	1.42	1.88
ρ $\overline{t}$	-1.17	-0.73	0.02	0.82	1.63	2.42	2.85
MW	68.02	71.96	81.08	91.26	102.50	113.61	121.75
LLC	-0.39	0.15	0.92	1.81	2.70	3.56	3.99

Table 1 presents results for the LLC, MW and IPS tests including individual fixed effects in the deterministic component of (3), since this is the specification consistent with the PPP hypothesis. Following Ghysels, Lee and Noh (1994), who analyse the performance of unit root tests applied to seasonal time series, we have set the order of the autoregressive correction equal to $p = 12$. Panel A reproduces the test statistics and the corresponding p-values from the standard distributions, that is, imposing cross-section independence. The MW and IPS tests lead to the rejection of the null hypothesis of unit root, thus supporting the PPP for the Spanish cities. However, the LLC test does not reject the null of non-stationarity.

As mentioned above, independence across individuals is likely to be an unrealistic assumption so that we have computed the empirical distributions of the tests using Bootstrap techniques. Percentiles for each test are reproduced in Panel B of Table 1. Comparison of the test statistics in Panel A with these critical values

³These results are available from the authors upon request. Further discussion on the choice of the numeraire can be found in *e.g.* O'Connell (1997), Culver and Papell (1999) and Cecchetti, Mark and Sonora (2002).

lead to the same conclusions, that is, we reject the null hypothesis of a non-stationary panel data set when using the MW and IPS tests, whereas the LLC test does not provide evidence in favour of the PPP –the hypothesis testing is performed on the left tail of the distribution for the ρ_{τ} and LLC tests and on the right tail for the ρ_{LM} and MW tests.

To sum up, three of the four panel data unit root tests that we have computed provide evidence in favour of the PPP in the sample of Spanish cities. The reason that might be behind the contradictory results of the IPS and MW tests, on the one hand, and the LLC test, on the other, is likely to be the amount of parameter heterogeneity that they allow in their underlying data generating process. Note that under the alternative hypothesis the MW and IPS tests specify a different autoregressive parameter for each individual, while the LLC assumes a common parameter. Moreover, Maddala and Wu (1999) show that the MW and IPS tests encompass the LLC test in terms of empirical size and power. In all, we can conclude that the evidence that has been showed here points to the PPP hypothesis, a conclusion that seems to be robust, first, to different choices of the numerarie and, second, to cross-section dependence in the sample.

4. Persistence of the PPP deviations

Results above allow rejecting permanent deviations from the PPP in the panel of Spanish cities over a long time period. It is now interesting to measure the speed of convergence towards the PPP when city prices suffered transitory shocks. The most popular measure of persistence of a shock is its half-life, which is defined as the number of time periods required for a unit impulse to dissipate by one half. There is some consensus in the literature on half-lives of deviations from the PPP of around 3-5 years, which is based on analyses using long-horizon data sets and applying univariate methods –see [Rogoff96]. Although application of panel data methods slightly decreases persistence to around 2.5 years –see Papell (1997)–, estimates of half-lives are far from negligible. Accordingly, it has been suggested

that departures from the PPP should be driven by factors other than nominal rigidities.

Estimates of half-lives are not free of criticisms. First, the picture based on point estimates is incomplete, as they do not come with confidence intervals. Second and even more striking, these half-lives are not appropriately computed, as it has been common practice to estimate them as $\ln(0.5)/\ln(\alpha)$ where α is the autoregressive coefficient in the Dickey-Fuller (DF) equation, $q_{i,t} = \alpha q_{i,t-1} + \varepsilon_{i,t}$. The problem arises when $q_{i,t}$ follows an autoregressive process of order higher than one. In this case, the ADF-type equation should be used to test the null hypothesis of unit root, and the half-life should no longer be computed as $\ln(0.5)/\ln(\alpha)$. Instead, it ought to be computed from the impulse response function – see Cheung and Lai (2000) and Murray and Papell (2002). Moreover, these half-life point estimates can be supplemented with Bootstrap confidence intervals, which offer a measure of precision for the point estimates. Murray and Papell (2002) still outline a third pitfall when computing half-lives. It is related to the bias of estimates of the autoregressive parameters in finite samples. Since the impulse response function is build upon these biased estimates, the half-life might turn out to be a biased measure. In this regard, Murray and Papell (2002) follow Andrews (1993), and Andrews and Chen (1994) and compute median-unbiased estimations of the autoregressive parameters and the half-lives. Here we have decided not to follow this suggestion since our time series are long enough to assume that the bias effect should not significantly alter our half-life estimations.

Table 2 presents point estimates and Bootstrap 95% confidence intervals for half-lives in each city in our sample. It should be stressed the large heterogeneity in the rate of adjustment of the Spanish cities to the national CPI. While shocks in some of them vanish quite rapidly –half-lives of around 2 years–, for others they last more than a decade. The mean point estimate of half-lives is 4.5 years. But the mean confidence interval is rather wide –lower bound of 1.2 years and upper bound of 9.2 years. To prevent the effect of outliers, we have also computed the median of the estimated half-lives. In this case, the point estimate is 3.6 years, with a shorter range for the confidence interval –1.1 and 5.9 years, for the lower and

upper bounds respectively.

Our estimates are thus in accordance with the 3-5 years consensus found with international data. This casts doubts on the idea that we should expect lower deviations from the PPP in highly integrated economies. In addition, confidence intervals show that the lower limit is below 1.5 years, a threshold sometimes used to conclude that deviations from PPP are due to nominal rigidities. However, upper bounds are large enough to rule out real rigidities –differentials in productivity or different sectorial economic structures– as a potential determinants of the persistence of these deviations –see Engel and Rogers (2001) and O’Connell and Wei (2002).

Table 2. Point and confidence interval estimates of half-lives

Half-lives (years)				Half-lives (years)			
95% C. I.				95% C. I.			
	HL	L	U		HL	L	U
A Coruña	6.8	1.4	11.7	León	3.3	1	5.3
Alacant	1.7	0.8	2.8	Logroño	6.4	1.4	10.5
Albacete	2.3	0.8	3.7	Lugo	3.8	1.3	6.1
Almería	1.6	0.8	2.8	Lleida	2.6	0.9	3.8
Ávila	3.3	1.1	5.6	Madrid	2.9	1	4.2
Badajoz	1.8	0.6	3	Málaga	2.8	1	4.6
Barcelona	3.6	1.1	5.8	Murcia	1.7	0.5	2.7
Bilbo	3.8	2.1	81.5	Ourense	3.6	1.1	5.8
Burgos	3.8	1.2	6	Oviedo	1.6	0.8	2.8
Cáceres	13.3	2	35.8	Palencia	2.4	0.8	3.5
Cádiz	13.3	1.8	21.2	P. Mallorca	6.5	1.6	12.4
Castelló	9.4	1.7	14.2	Pontevedr	3.6	1.2	5.9
				a			
C. Real	4.9	1.5	7.9	Salamanca	2.9	1	4.7
Córdoba	3	1	4.9	Santander	2.6	0.8	4.2
Cuenca	3.1	1	5.2	Segovia	3.7	1.2	6.1
Donosti	15	1.8	27.2	Sevilla	3.7	1.1	6.3
Gasteiz	11.2	1.7	15.8	Soria	6.3	1.4	11.6
Girona	5.6	1.4	9.1	Tarragona	4.1	1.2	6.7
Granada	2.2	0.8	3.7	Tenerife	2.8	0.9	4.5
Guadalajar	1	0.4	1.6	Teruel	8.9	1.6	14.3
a							
Huelva	0.8	0.4	1.3	Toledo	5.1	1.4	8.4
Huesca	2	0.8	3.2	València	1.2	0.6	1.8
Iruña	4.6	1.3	7.9	Valladolid	7.2	1.4	11
Jaén	5.7	1.4	9.5	Zamora	7.6	1.6	12
Las Palmas	3.9	1.2	6.7	Zaragoza	2.9	1	4.6

	95% C. I.		
	HL	L	U
Mean	4.5	1.2	9.2
Median	3.6	1.1	5.9

5. Concluding remarks

Using a set of long time series for a sample of Spanish cities this paper has shown evidence in favour of the PPP. The unit root hypothesis is strongly rejected through the application of panel data tests that allow for heterogeneity in the parameters for each city. In performing the tests we have taken into account cross-section correlation that can arise when dealing with real exchange rates. In addition, results are robust to the choice of the numerarie.

Although the unit root hypothesis is rejected, this does not prevent to find large persistence of short-run deviations from the PPP, particularly in some of the cities. Estimation of half-lives, based on the impulse response function, are of a magnitude comparable to estimates obtained using international data. In addition, confidence intervals show that these deviations might be long enough to be caused just by nominal rigidities. Thus, our results suggest that further research should be done in order to identify real factors that are behind the slow rates of price convergence in economies such as the EU in which formal barriers between member states have almost vanished and share a common currency.

References

- Abuaf, N. and P. Jorion, 1990. Purchasing Power Parity in the Long Run, *Journal of Finance*, 45 1, 157–174.
- Andrews, D. W. K., 1993. Exactly Median-Unbiased Estimation of First Order autoregressive / Unit Root Models, *Econometrica*, 61, 139–165.

- Andrews, D. W. K. and H. Y. Chen, 1994. Approximately Median-Unbiased Estimation of Autoregressive Models, *Journal of Business and Economic Statistics*, 12, 187–204.
- Cecchetti, S. G., N. C. Mark and R. J. Sonora, 2002. Price Index Convergence Among United States Cities, *International Economic Review*, 43 4, 1081–1099.
- Chen, L. L. and J. Devereux, 2003. What Can US City Price Data Tell Us About Purchasing Power Parity?, *Journal of International Money and Finance*, 22, 213–222.
- Cheung, Y. W. and K. S. Lai, 2000. On the Purchasing Power Parity Puzzle, *Journal of International Economics*, 52 2, 321–330.
- Corbae, D. and S. Ouliaris, 1991. A Test of Long-run Purchasing Power Parity Allow-ing for Structural Breaks, *The Economic Record*, 67, 196, 26–33.
- Culver, S. E. and D. Papell, Panel Evidence of Purchasing Power Parity Using In-tranational and International Data, Technical Report, Department of Economics. University of Houston 1999.
- Engel, C. and J. H. Rogers, 2001. Deviations from Purchasing Power Parity: Causes and Welfare Costs, *Journal of International Economics*, 55, 29–57.
- Esaka, T., 2003. Panel Unit Root Tests of Purchasing Power Parity Between Japanese Cities 1960-1998: Disaggregated Price Data, *Japan and the World Economy*, 15,

233–244.

Fleissig, A. R. and J. Strauss, 2000. Panel Unit Root Tests of Purchasing Power Parity

for Price Indices, *Journal of International Money and Finance*, 19, 489–506.

Frankel, J., *International Capital Mobility and Crowding Out in the US Economy: Im-perfect Integration of Financial Markets or of Goods Markets?*, Lexington Books, 1986.

Froot, K. A. and K. Rogoff, *Perspectives on PPP and Long-Run Real Exchange Rates*, Elsevier, North-Holland.

Ghysels, E., H. S. Lee and J. Noh, 1994. Testing for Unit Roots in Seasonal Time Series, *Journal of Econometrics*, 62, 415–442.

Im, K. S., M. H. Pesaran and Y. Shin, 2003. Testing for Unit Roots in Heterogeneous Panels, *Journal of Econometrics*, 115, 53–74.

Jenkins, M. A., 1997. Cities, Borders, Distances, Non-Traded Goods and Purchasing Power Parity, *Oxford Bulletin of Economics and Statistics*, 59 2, 203–213.

Levin, A., C. F. Lin and C. S. J. Chu, 2002. Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties, *Journal of Econometrics*, 108, 1–24.

Lothian, J. and M. Taylor, 1996. Real Exchange Rate Behaviour: The Recent Float from the Perspective of the Past Two Centuries, *Journal of Political Economy*,

104, 488–509.

Maddala, G. S. and S. Wu, 1999. A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test, *Oxford Bulletin of Economics and Statistics*, Special Issue, 631–652.

Meese, R. and K. Rogoff, 1988. What is Real? The Exchange Rate Interest Differential Relation over the Modern Floating Rate Period, *Journal of Finance*, 43, 933–948.

Montañés, A. and J. Clemente, 1999. Real Exchange Rates and Structural Breaks: Evidence for the Spanish Peseta, *Applied Economics Letters*, 6, 349–352.

Murray, C. J. and D. H. Papell, 2002. The Purchasing Power Parity Persistence Paradigm, *Journal of International Economics*, 56 1, 1–19.

Nenna, M., Price Level Convergence Among Italian Cities: Any Role for the Harrod-Balassa-Samuelson Hypothesis?, Technical Report, Faculty of Economics. Uni-versity of Rome La Sapienza 2001.

O'Connell, P., 1997. The Overvaluation of Purchasing Power Parity, *Journal of International Economics*.

O'Connell, P. and S. J. Wei, 2002. "The Bigger They Are, the Harder They Fall": Retail Price Differences Across U.S. Cities, *Journal of International Economics*, 56, 21–53.

Oh, K. Y., 1996. Purchasing Power Parity and Unit Root Tests Using Panel Data, *Journal of International Money and Finance*, 15 3, 405–418.

Papell, D., 1997. Searching for Stationarity: Purchasing Power Parity under the Current Float, *Journal of International Economics*, 43, 313–332.

Papell, D., 2002. The Great Appreciation, the Great Depreciation, and the Purchasing Power Parity Hypothesis, *Journal of International Economics*, 57, 51–82.

Papell, D., and H. Theodoridis, 1998. Increasing Evidence of Purchasing Power Parity over the Current Float, *Journal of International Money and Finance*, 17, 41–50.

Papell, D. H. and H. Theodoridis, 2001. The Choice of Numeraire Currency in Panel Tests of Purchasing Power Parity, *Journal of Money, Credit, and Banking*, 33, 790–803.

Parsley, D. C. and S. J. Wei, 1996. Convergence to the Law of One Price Without Trade Barriers or Currency Fluctuations, *Quarterly Journal of Economics*, pp. 1211–1236.

Rogoff, K., 1996. The Purchasing Power Parity Puzzle, *Journal of Economic Literature*, 34 2, 647–468.