



# **Understanding the empirical literature on purchasing power parity: the post-Bretton Woods era**

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This paper argues that the empirical failure of statistical tests of PPP in post-Bretton Woods data is largely due to the low power of the tests employed. This result is demonstrated using Monte Carlo experiments on the size and power of different testing procedures. A new procedure based on Horvath and Watson (*Econometric Theory*, 11, pp. 984–1014, 1995) has greater power than previous approaches. Using the Horvath–Watson procedure we find moderate evidence in favor of PPP in the post-Bretton Woods era. (JEL F31, C15). © 1997 Elsevier Science Ltd

**Purchasing power parity (PPP) in the post-Bretton Woods era by and large has failed to stand up to empirical scrutiny. This paper sheds light on this failure by**

\*We would like to thank Mark Watson, Jon Faust and the editor of this journal for comments and suggestions that improved this article substantially. We also acknowledge the helpful comments of John Ammer, Janice Breuer, Yin-Wong Cheung, Clive Granger, Wouter den Haan, Neil Ericsson, William Helkie, David Hendry, Andrew Levin, Jaime Marquez, and the seminar participants at the University of Pennsylvania, University of Basel, University of Neuchatel, Swiss National Bank, Swiss Volksbank, and the Division of International Finance. The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System or other members of its staff.

documenting the low small-sample power of existing empirical tests.<sup>1</sup> We also implement new, more powerful tests that find moderate evidence in favor of PPP.

The PPP hypothesis states that the ratio of domestic to foreign prices determines the ‘fundamental’ or ‘equilibrium’ exchange rate,

$$\langle 1 \rangle \quad E = \lambda \frac{P^*}{P},$$

where  $E$  denotes the exchange rate (that is, the foreign price of one unit of domestic currency),  $P^*$  denotes an index of foreign prices,  $P$  denotes an index of domestic prices, and  $\lambda$  is a constant. In its strictest form, PPP is always rejected empirically because equation  $\langle 1 \rangle$  does not hold exactly for any pair of countries over any time period. However, PPP may be said to hold in the long run if deviations from PPP are not permanent.<sup>2</sup> Since the early 1980s, it has been noted that exchange rates and prices are non-stationary; thus, a necessary condition for finding PPP is that  $E$ ,  $P$ , and  $P^*$  are cointegrated. PPP also implies two additional properties: (1) *symmetry* between domestic and foreign prices, and (2) *proportionality* between relative prices and the exchange rate.

Two classes of econometric methods have been developed for the analysis of non-stationary data. In the early 1980s, univariate and single-equation methods were formulated (e.g. Dickey and Fuller, 1979; Engle and Granger, 1987); more recently, systems methods have been developed (e.g. Johansen, 1991; Stock and Watson, 1993). With regard to tests of PPP on post-Bretton Woods data, the univariate and single-equation methods generally are unable to find cointegration between the three variables, while systems methods often find cointegration but reject the proportionality and symmetry conditions.

Our results indicate that previous studies have failed to find evidence for PPP in the post-Bretton Woods era largely because they do not have sufficient power given the short sample period. Univariate and single-equation methods fail because they do not efficiently model the interaction between, and the different dynamic behavior of, prices and exchange rates. Systems methods better model these interactions and dynamics, but they typically do not impose the symmetry and proportionality restrictions implied by PPP. By testing against the diffuse alternative of cointegration in general, rather than the specific alternative of PPP, they lose power to reject the null hypothesis that PPP does not hold. Many of the apparent findings of cointegration by multivariate methods in the literature are due to inappropriate critical values. Most studies use asymptotic critical values, but we show that the appropriate small-sample critical values are much larger.

Using a newly devised test based on Horvath and Watson (1995), which imposes the symmetry and proportionality restrictions and tests for cointegration in a multi-equation setting, we often can reject the null hypothesis that PPP does not hold. Using Monte Carlo techniques we show that the Horvath–Watson test has more power than the Johansen tests commonly used in the existing systems literature.<sup>3</sup>

The rest of the paper is organized as follows: Section I briefly describes the results of previous studies of PPP, focusing on the post-Bretton Woods period.

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