

# Purchasing power parity, unit roots, and dynamic structure

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## Abstract

Recent studies of purchasing power parity (PPP) account for the possible presence of unit roots in nominal exchange rates and relative price indices by applying standard unit-root tests to real exchange rates, which are ratios of nominal exchange rates and relative price indices. These studies occasionally find evidence of PPP, but as a whole, the evidence is not definitive. Standard unit-root tests impose a restrictive dynamic structure between nominal exchange rates and relative price indices. I specify and estimate a generalized dynamic structure. I reject the dynamic restrictions implicit in standard unit-root tests of PPP, and find stronger evidence of PPP than do most other recent studies.

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## 1. Introduction

With arbitrage, the exchange rate between two currencies should equal the cost of purchasing a basket of goods with one currency divided by the cost of purchasing the same basket with the other currency; this arbitrage condition is known as purchasing power parity (PPP). A large number of studies test for PPP using time-series data, with early studies generally providing some support for

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PPP.<sup>1</sup> A shift in empirical methodology occurred following Meese and Singleton's result that nominal exchange rates apparently contain unit roots (Meese and Singleton, 1982). To accommodate unit roots, many recent studies test for PPP by testing for a unit root in the *real* exchange rate, defined to be the nominal exchange rate divided by the relative price of a basket of commodities. Under PPP deviations from a constant real exchange rate should not be permanent. Because unit-root processes have deviations that are permanent, these studies therefore take rejection of a unit root in the logarithm of the real exchange rate as evidence of PPP, and failure to reject a unit root as failure to find evidence of PPP.

Interestingly, unit-root tests as often as not fail to turn up evidence of PPP. One possible explanation, of course, is that purchasing power parity may simply not hold. (This would be striking given the large volume of international trade in commodities and currencies.) A second possible explanation is that unit-root tests generally have difficulty distinguishing unit-root processes from stationary processes with substantial persistence. This is an issue of the span of the data. With a short data span, it is difficult to reject a unit root and thereby find evidence of PPP, even if PPP holds.<sup>2</sup> With longer data spans there is some tendency to find evidence of PPP but even with longer data spans the evidence is not definitive.<sup>3</sup>

A third possible explanation, studied here, is that the unit-root tests typically used to test PPP implicitly impose a restrictive dynamic structure on the adjustment process relating nominal exchange rates and relative price indices. Two dynamic restrictions are implicit in traditional unit-root tests. First, a change in the relative price is assumed to be reflected immediately and fully in a change in the exchange rate; second, the coefficients on any lag of the relative price index and on the corresponding lag of the nominal exchange rate sum to zero. Failure to find evidence of PPP using unit-root tests on the real exchange rate may therefore simply be evidence against these two restrictions. To test PPP without imposing the restrictions, I develop and estimate a more general dynamic structure.

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<sup>1</sup> The early literature dates at least to Cassel (1916). For a survey of early studies see Officer (1976); see also Krugman (1978), Roll (1979), Frenkel (1981), Hakkio (1984), and McCloskey and Zecher (1984).

<sup>2</sup> Studies by Abuaf and Jorion (1990), 15 years, Darby (1983), 7 years of data, Baillie and Selover (1987), 10 years, Meese and Rogoff (1988), 12 years, and Mark (1990), 15 years fail to find evidence of PPP; Cheung and Lai (1993), 16 years, and Oh (1994), 30 years of panel data, on the other hand, find evidence of PPP.

<sup>3</sup> For instance, Abuaf and Jorion (1990), 72 years, find evidence of PPP for 6 of their 8 country pairs, Lothian (1990), 113 years, finds evidence of PPP for 4 of 6 country pairs, and Grilli and Kaminsky (1991), 102 years, find evidence of PPP between the United States and the United Kingdom, which is the only country pair they study. Diebold et al. (1991), 123 years, find evidence of fractional integration, which tends to support PPP, but after removing the fractional differencing term, they also find evidence that unit roots are present in the real exchange rate, which may indicate a failure to find evidence of PPP. Even with fairly long data spans, Adler and Lehmann (1983), 73 years, and Corbae and Ouliaris (1991), 95 years, still find essentially no evidence of PPP.

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