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Nonstationarity in real exchange rates using unit root tests with a level shift at unknown time

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Abstract

The empirical literature that tests for purchasing power parity (PPP) by focusing on the stationarity of real exchange rates has so far provided, at best, mixed results. This paper contributes to this discussion by providing new evidence on the stationarity of bilateral real exchange rates, after allowing for regime changes. We test for a unit root in real exchange rates by allowing for a level shift in the DGP. In doing so, we use the unit root tests proposed by Saikkonen and Lütkepohl [Saikkonen, P. and Lütkepohl, H., 2002, Testing for a unit root in a time series with a level shift at unknown time, Econometric Theory 18, 313–348] and Lanne et al. [Lanne, M., Lütkepohl, H., and Saikkonen, P., 2002, Comparison of unit root tests for time series with level shifts, Journal of Time Series Analysis 23, 667–685], which are based on estimating the deterministic term first by a GLS procedure under the unit root null hypothesis and subtracting it from the original series. We subject the series to three level shifts, namely: a shift dummy, an exponential shift and a rational shift. Our results confirm the nonstationarity of real exchange rate series in the presence of structural breaks during the post-Bretton Woods era. Thus, the real exchange rate behavior may not be so different after all but simply perceived to be so because of the use of previously restrictive unit root tests.

JEL classifications: C45; G15
Keywords: Real exchange rates; Unit root; Level shift; Nonstationarity

1. Introduction

Purchasing power parity (PPP) is an important theoretical concept in economics because most macroeconomics models of open economy are built upon the long-run PPP hypothesis. The relationship is important not only because it has been a cornerstone of exchange rate models, but also because of its policy implications — it provides a benchmark exchange rate and hence has some practical appeal for policymakers and exchange rate arbitragers. For example, in the case that real exchange rates are non-stationary, the principle of purchasing power parity (PPP) is no longer valid as a representation of the long-run equilibrium relation between the exchange rate and relative prices. Further, the extent to

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which real exchange rate movements are random or not provide an indication of whether countries are financially integrated or autonomous. This is particularly relevant in an area of high or perfect capital mobility.[1]

Although purchasing power parity has been studied extensively, empirical results have been mixed. The empirical consensus in the 1980s that viewed real exchange rates as random walks shuttered the Casselian view of PPP. Although this consensus has been challenged by more recent studies that employ relatively new methodologies, the weak correlation between exchange rates and national prices levels is not yet resolved. On the contrary, it seems that the division of researchers between the “whittling down half lives” and the “whittling up half lives” camps, as terms by Taylor (2001), is a vivid as ever. For example, Dueker and Serletis (1997) and Serletis and Zimonopoulos (1997) find that PPP does not hold over the recent floating exchange rate period, while studies by Phylaktis and Kassimatis (1994), Lothian and Taylor (1996), and Cheung and Lai (1998) report significant evidence favorable to long-run PPP. Recently, a view that real exchange rates are stationary, but highly persistent is emerging in the literature (see Rogoff (1996); Lothian and Taylor (1996) and Olekalns and Wilkins (1998)). Engle (1998) challenges this view, arguing that the power of the unit root tests in such studies is very low. Similarly, Caner and Kilian (1998) argue that tests of the stationary null hypothesis may suffer from severe size distortions. For example, Gogas and Serletis (2000) study the random walk behavior of the real exchange rate and conclude that real exchange rate movements might not be really random. Gil-Alana (2000) and Cheung and Lai (2001) focus on the possibility of long-memory dynamics in real exchange rate series. They apply fractionally-based tests to real exchange rate data. Gil-Alana’s (2000) results indicate that the series are fractionally integrated with mean reversion and Cheung and Lai (2001) find that the order of integration of all series considered is between zero and one. Gil-Alana (2002) studies the monthly real exchange rates (relative to the US dollar) from black markets of eight Asian developing countries and concludes with mean reversion in the long run. Henry and Olekalns (2002) examine the post Woods experience of the Australian real exchange rate, and find no evidence of the long-run equilibrium relation between the exchange rate and relative prices. There is also a growing literature on modelling exchange rates using non-linear models such as the TAR and STAR (e.g., Sarantis, 1999); Baum, Barkoulas, & Caglayan, 2001; Taylor, Peel, & Sarno, 2001).

In this paper, we examine data for real exchange rate series for evidence of nonstationarity in the presence of level shifts or structural breaks. Recent contributions to the empirical literature investigate the presence of non-linear adjustment dynamics in the real exchange rate process, and there is a growing literature on modelling exchange rates using non-linear models such as the TAR and STAR (e.g., Sarantis, 1999); Baum et al., 2001; Taylor et al., 2001, and Taylor, 2001). We employ new versions of unit root tests proposed by Saikkonen and Lütkepohl (2002) and Lanne, Lütkepohl, and Saikonen (2002), which are based on estimating the deterministic term first by a GLS procedure under the unit root null hypothesis and substracting it from the original series. Specifically, we subject the series to three level shifts, namely: a shift dummy, an exponential shift and a rational shift. By allowing for three different forms of level shifts, we confirm the nonstationarity of real exchange rate series.

The next section provides the unit root tests in the presence of level shifts. Section 3 presents the real exchange rates and empirical results, and finally Section 4 concludes.

2. Testing for unit root in the presence of level shifts

Perron (1989, 1990) has shown that if a series is stationary around a deterministic time trend which has undergone a permanent shift sometime during the period under consideration, failure to take account of this change in the slope will be mistaken by the usual Augmented Dickey-Fuller (ADF, 1979) unit root test as a persistent innovation to a stochastic (non-stationary) trend. That is, a unit root test which does not take account of the break in the series will have very low power. There is a similar loss of power if there has been a shift in the intercept (possibly in conjunction with a shift in the slope of the deterministic trend). If the break(s) in the series are known, then it is relatively simple to adjust the ADF test by including (composite) dummy variables to ensure there are as many deterministic regressors as there are deterministic components in the data generating process (DGP). However, it is unlikely that the date of the break will be known a priori, as was assumed by Perron (1989, 1990). In such situations, it is necessary to test for the possibility of a break using tests that account for these breaks. If there is a shift in the level of the DGP, it should be taken into account in testing for a unit root because the ADF test may be distorted if the shift is simply ignored. In doing so, we use the unit

[1] Froot and Rogoff (1995) and Rogoff (1996) provide excellent discussions.