Getting PPP right: Identifying mean-reverting real exchange rates in panels

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ABSTRACT

Recent advances in testing for the validity of Purchasing Power Parity (PPP) focus on the time series properties of real exchange rates in panel frameworks. One weakness of such tests, however, is that they fail to inform the researcher as to which cross-section units are stationary. As a consequence, a reservation for PPP analyses based on such tests is that a small number of real exchange rates in a given panel may drive the results. In this paper we examine the PPP hypothesis focusing on the stationarity of the real exchange rates in up to 25 OECD countries. We introduce a methodology that when applied to a set of established panel unit-root tests, allows the identification of the real exchange rates that are stationary. Our results reveal evidence of mean-reversion that is significantly stronger as compared to that obtained by the existing literature, strengthening the case for PPP.

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1. Introduction

Given the central role of the Purchasing Power Parity (PPP) concept in theoretical open economy models and the inconclusive results of the existing empirical literature on its validity, PPP has emerged as the most popular topic of empirical research in international macroeconomics. Testing for unit roots in real exchange rates using panels is popular partly because the results of such studies tend to uncover more evidence for PPP. Other advantages of panel unit root tests include the ability to mitigate problems such as the "survivorship bias" and the presence of structural shifts in exchange rate behavior.

Panel frameworks are not free of drawbacks, however, and most recent developments emphasized those relating to cross-sectional dependence. Nevertheless, from an economist's point of view, a major weakness of the existing unit root panel methodologies is that the null of non-stationarity is a joint hypothesis for all the real exchange rates in the panel. As a consequence the null hypothesis of a unit root may be rejected even if only one of the real exchange rates is stationary.[3] Thus, the possibility emerges that small groups of cross-sectional units in the panel, that share particular features, may drive the results. Therefore, panel unit root tests are sensitive to the selection of series included in the panel.

In this paper we consider the PPP hypothesis in panels of up to 25 OECD countries using an approach that overcomes the limitations mentioned above. In particular, we introduce a methodology that when applied to a battery of panel-unit-root tests, allows the identification of the real exchange rates that are stationary within the panel. We apply those procedures to a set of tests that accounts for a number of other potential pitfalls in panels, such as cross-sectional dependence. Our results reveal evidence of mean-reversion that is significantly stronger compared to that obtained by standard stationarity tests, strengthening the case for PPP. Our methodology has some straightforward advantages as compared to the typical panel unit root approaches. In particular, while we exploit all the advantages of the panel structure (such as the potential enhanced power of panel unit root tests), we are able to identify the stationary real exchange rates within the panel. This

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[3] Taylor and Sarno (1998) emphasized this point.

allows a direct comparison of the panel test results with the univariate tests results, i.e., focusing on individual real exchange rates – something that the existing literature on real exchange rates and PPP was not able to do so far.

Our ability to identify mean-reverting series within the panel, allows us to focus on the half-lives of the mean-reverting real exchange rates only. We find that the half-lives are shorter than the prevailing literature consensus. Thus, we revisit the so-called "PPP puzzle" in the light of our new results providing half-life estimates that pertain only to the stationary real exchange rates of the panel and comparing them with those based on the full panels.

Finally, we discuss the implications for a number of issues including the validity of PPP across different exchange rate regimes and the role of the numeraire currency. The implications of the methodological innovations of the paper go beyond the issue of PPP. Clearly, the proposed methodology can be used to consider a number of other topics which require focusing on the stationarity properties of a series.

The next section provides a brief discussion of the evidence and the issues that emerge from recent studies on PPP that use panel unit root tests. Section 3 describes the methodology for separating stationary from non-stationary and poolable from non-poolable series. Section 4 discusses the data and Section 5 presents and discusses the results of our analysis. Section 6 revisits the "PPP puzzle" using the results of Section 5. Finally, Section 7 concludes.

2. A review of some issues related to PPP

The relevance of PPP for policy purposes is important in both traditional and new approaches in open economy macroeconomics. In the traditional framework for example, whether PPP holds is a valuable piece of information for policymakers who want to assess the effects of a devaluation, since under PPP the effects of the devaluation on competitiveness will disappear in the long-run. In the recent new open economy macroeconomics literature PPP is a required condition for market completeness and the equalization of the marginal utility of home and foreign currency that in turn allows for perfect risk sharing. A stylized fact of the post-Bretton Woods float, however, is the difficulty of distinguishing real exchange rate behavior from random walks and therefore the relatively weak evidence for PPP. Empirical research has successively relied on various methodological approaches to consider the validity of PPP, including cointegration tests for nominal exchange rates and prices, variance ratios tests, long horizon regressions (Serletis and Goras, 2004), quantile regressions (Nikolaou, 2008), and unit root tests on real exchange rate series[4] but despite the voluminous literature the profession's conventional wisdom concerning PPP remains, in general, inconclusive.

Hakkio (1984), Abuaf and Jorion (1991) and Wu (1996) represent early attempts to utilize panel datasets as a means of increasing the power of unit root tests in PPP studies. Tests for unit roots within heterogeneous panels, however, are currently well established, and most of them utilize the frameworks of Levin and Lin (1992) and Im et al. (2003) (IPS).[5] Until the emergence of non-stationary panel techniques the evidence supporting the existence of PPP had not only been weak (see Macdonald (1995)) but also lacked robustness. In particular, the results tended to depend on the length of the sample period, the frequency of the series, the choice of countries in the sample, and the choice of numeraire currency. Evidence in favour of PPP was more likely to be found if the tests were based on long samples (of around 100 years) of annual data and if the US dollar was not used as a numeraire (see, e.g., Papell and Theodoridis (2001)). Studies of PPP using panel unit-root tests reversed the relatively gloomy PPP picture. Research focusing on industrial countries provided increased evidence of real exchange stationarity using panel frameworks (see Frankel and Rose (1996), MacDonald (1996), Oh (1996), Papell (1997), Taylor and Sarno (1998) and so on). Despite the increased ability to uncover evidence that validates PPP when panel data are used the existing evidence of panel data studies are still inconclusive. A set of evidence based on panel data methodologies exists that is less favorable to PPP (O'Connell, 1998; Papell and Theodoridis, 1998; Papell and Theodoridis, 2001). In summary, while the results on balance are supportive of PPP, the fact that a number of studies employing panel tests fail to always rescue the PPP hypothesis makes the issue more contentious.

A critical issue that emerges when panel unit roots are employed is the problem of cross-sectional dependence. As O'Connell (1998) suggested, the non-zero covariances of the errors across the units in panel tests for unit roots (and cointegration) imply short-run linkages among the units.[6] Using a generalized least squares (GLS) approach to control for intercountry dependence O'Connell produces results that are not supportive to PPP. Subsequent studies that employed GLS, however – including Papell and Theodoridis (1998) and Taylor and Sarno (1998) – came to the rescue of PPP. Papell (1997), using the Levin and Lin (1992) tests, shows that the rejection of the unit root hypothesis depends critically on the cross-sectional size, and whether or not the critical values have been adjusted to account for serial correlation. Recent advances have provided sophisticated methods which are clearly advantageous to the conventional practice of simply de-meaning the series. Being aware that one cannot completely eliminate cross-sectional dependence, we use some tests that account for this possibility. Our two chosen tests are put forward by Chang (2002) and Pesaran (2007). In Section 5, we provide details on why we choose these two tests.

Many authors, however, have pointed out some fundamental problems in using panel unit-root tests (e.g., Mark (2001) and Taylor and Sarno (1998)). In particular, attention has been drawn to the fact that the null hypothesis in such tests is specified as a joint non-stationarity hypothesis. Thus, cases may exist where the panel appears as stationary but a (possibly large) number of individual series display unit roots. In fact, even one stationary series may suffice to reject the unit root null for the whole panel. In this case one may incorrectly conclude that the panel is on balance stationary or – in the best case – they will not be able to distinguish which are the cross-sectional units that display stationarity. While some attempts have been made to circumvent this problem (Taylor and Sarno, 1998), to our knowledge there is no formal procedure available so far that directly considers stationarity of the individual cross-sectional units in a panel framework.

Another closely related dimension of analyzing PPP issues in panels that has received scant – if any – attention refers to the validity of pooling specific sets of real exchange rate series. Applying panel methods on a set of real exchange rates that are not poolable may lead to wrong conclusions. Inappropriate pooling across cross-sectional units, in the case where different real exchange rate series exhibit different rates of convergence, is likely to lead to upwardly biased panel estimators (see Choi et al. (2004)). We avoid such potential pitfalls using a new methodology that tests for the poolability of the series. Our results show that almost all series we find stationary are also poolable.

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[4] For surveys on the stationarity properties of the real exchange rates, see Boucher Breuer J. (1994), Froot and Rogoff (1995), and Mark (2001). See Murphy and Zhu (2008) for a general discussion of empirical irregularities in exchange rates.

[5] Other approaches exist in testing for the presence of unit roots in heterogeneous panels, such as, e.g, Harris and Tzavalis (1999).

[6] More recently, Banerjee et al. (2004) suggested that since the panel unit root tests assume away the presence of cross-section cointegrating relationships, if this assumption is violated the tests become oversized.