



Is the evidence for PPP reliable? A sustainability examination of the stationarity of real exchange rates

Su Zhou^a, Ali M. Kutan^{b,c,d,*}

^a Department of Economics, University of Texas at San Antonio, San Antonio, TX 78249-0633, USA

^b Department of Economics and Finance, Southern Illinois University Edwardsville, Edwardsville, IL 62026-1102, USA

^c The Center for European Integration Studies (ZEI), Bonn, Germany

^d The William Davidson Institute, MI, USA

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ABSTRACT

Some recent time series studies testing the stationarity of real exchange rates (RERs) produce conflicting results. Using nonlinear unit root tests and recursive analysis, this paper tests whether the evidence on the stationarity of RERs is sensitive to different numeraire currencies, different sample periods covering regional and global crises, and the inclusion of countries with different levels of economic or regional integration. The results indicate that evidence for a stationary RER could be substantially sensitive to sample period changes, but not so for the currencies of the countries involved in forming the euro area. We also find that financial crises have a notable impact on testing the stationarity of RERs, depending on the numeraire currency used. We discuss the policy implications of the findings.

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1. Introduction

Purchasing power parity (PPP) has been an important building block in many macroeconomic models, representing a constant long-run equilibrium real exchange rate. The significant fluctuations in exchange rates since the beginning of the post-Bretton Woods period have been an important concern for policy makers, requiring a deeper understanding of the underlying relationships driving real exchange rates. In addition, the recent institutional changes, such as the launching of the euro area and frequent financial crises have added to these concerns. For example, there have been wide fluctuations in the euro exchange rate since its establishment in 1999 and several financial crises took place in the recent past, including the Asian crisis and the more recent global crisis. It is therefore particularly important for policymakers to know whether and when exchange rate changes constitute movements towards or away from some long-term equilibrium level. As a result, PPP has been subject to a significant amount of empirical testing using various time series models.

Recent reviews of empirical research on the validity of PPP (see, for example, Taylor and Taylor, 2004; Murray and Papell, 2005; Bahmani-Oskooee and Hegerty, 2009) show that whether PPP holds is still a subject of heated debate in academia. As these studies indicate, earlier tests of PPP focused on conventional linear unit root tests, which are followed by recent unit root studies accounting for nonlinearity in exchange rates. After taking nonlinearity in real exchange rates into consideration, recent studies provide more evidence for the stationarity of real exchange rates, supporting PPP, than earlier studies. For example, compared with previous work using conventional linear unit root tests, studies employing the unit root tests developed by Kapetanios, Shin, and Snell (KSS) (2003) based on exponential smooth transition autoregressive (ESTAR) models generally show more supportive results for real exchange rates to have stationary properties than other studies.

Taking a closer look at some recent studies, one may find some inconsistency in results, however, especially in the findings associated with the yen real exchange rates. For instance, using the KSS tests for a sample of period 1960–2000 as well as for a sub-sample period 1974–2000, Chortareas and Kapetanios (2004) found that “the yen real exchange rate may be stationary after all.” Similar findings are also reported in Liew et al. (2004) with the sample period over 1968 to 2001. On the contrary, with the same test for a sample of period 1957–1998, KSS (2003) were not able to reject

* Corresponding author at: Department of Economics and Finance, Southern Illinois University Edwardsville, Edwardsville, IL 62026-1102, USA. Tel.: +1 618 650 3473; fax: +1 618 650 3047.

E-mail addresses: su.zhou@utsa.edu (S. Zhou), akutan@siue.edu (A.M. Kutan).

the nonstationarity in the real yen–dollar exchange rate. On the other hand, Zhou, Bahmani-Oskooee and Kutan (ZBK) (2008) obtain some evidence for the yen–dollar, yen–French currency, or yen–German currency real exchange rates to be stationary when applying the KSS tests to a sample of period 1973–1998, yet no such evidence is found for a sample of period 1973–2006.

It is known that all unit root tests may have low power in revealing the stationarity of time series for small samples. Failure to reject the null of nonstationarity with the data of a shorter time span but rejecting the null with a longer time span of data could be viewed as evidence for the series to have stationary behavior. However, when there is a rejection of the null of nonstationarity for the yen real exchange rates for a shorter time span but failure to do so for a longer time period, it would be the evidence against the stationarity of the yen real exchange rates.

Another likely problem associated with some recent studies is the impact of the financial crisis of 1997–1998 in Asia and large changes in the values of the yen and US dollar during the recent global crisis on the unit root test results. Innovation outliers and large changes can be observed in a number of yen, dollar and Asian real exchange rates. The effect of outliers and break changes could be in dual direction. While it is widely recognized that the outliers and breaks in data may lower the power of unit root tests and lead toward over-acceptance of the unit-root hypothesis,¹ Franses and Haldrup (1994) demonstrate that the presence of outliers may also generate large size distortion in the unit root tests and causes them to reject a unit root too often. This implies that the findings of stationary yen and dollar real exchange rates of Asian currencies by Chortareas and Kapetanios (2004) and Liew et al. (2004) could be the outcome of over-rejecting the unit-root hypothesis due to the use of a sample period ended shortly after the 1997–1998 Asian crisis.

The inconsistency in the results of the studies and the possible impact of outliers and breaks in data on the test results cast doubt upon the recent findings in favor of stationary real exchange rates. They imply that the conclusions of the studies might not be reliable if the results are rather sensitive to small changes in the sample periods utilized in the studies. Further investigation for the robustness of these findings is therefore required in order to clarify the issue.

The present study intends to contribute to this area of research by seeking the answers to the following questions. First, do the findings for real exchange rates being stationary endure a robustness examination? Failure to show sustainability in the stationarity of real exchange rates may overturn the conclusion in support of PPP. Second, how different are the results of robustness examination for the real exchange rates with different numeraire currencies?² Third, are the results sensitive to employing data from developing countries versus industrial economies or to whether countries belong to an economic union such as the European Union (i.e., to countries with different levels of economic integration)? Finally, how significant are the effects of the Asian financial crisis in 1997–1998 and large changes in the value of the yen and US dollar in the recent global crisis on testing a unit root in the real exchange rates?³

¹ See Perron (1989, 1990) and Perron and Vogelsang (1992) for the proofs and demonstrations. Erlat (2003) and Kasman et al. (2010), among others, provide evidence about the sensitivity of PPP tests to structural breaks.

² Several studies show that inferences on PPP may be sensitive to sample period changes or using different numeraire currencies. See, among others, Papell and Theodoridis (2001), Koedijk et al. (2004), Serletis and Gogas (2004), Sarno and Valente (2006), and Kasman et al. (2010).

³ In a recent study, Nikolaou (2008) uses unit root test for non-normal processes based on quantile autoregression inference in semi-parametric and non-parametric settings to analyze the impact of different magnitudes of actual shocks on mean reversion in RERs.

The study re-examines the stationarity of real exchange rates by focusing on the bilateral rates against three main currencies: the US dollar, Japanese yen, and a European currency. These rates have been studied for years in the existing literature for testing the PPP hypothesis on the bilateral basis. Among the recent studies, a comprehensive investigation has been carried out in Chortareas and Kapetanios (2004) for the yen real exchange rates and in ZBK (2008) for the US dollar and the European currency real exchange rates. These two studies show contrary results for the rates of yen–dollar and yen–European currency. We re-investigate the real exchange rates employed in these two articles with updated data in attempt to shed light on the sources of contradiction in their test results.

In the current study, we utilize both conventional unit root tests versus the alternative hypothesis of linear stationarity and recently developed tests for a unit root versus the alternative of nonlinear stationarity. This allows us to uncover that whether or not the presence of nonlinearity in the convergence toward PPP is likely to occur for certain groups of countries.⁴

The examination for the robustness of linear or nonlinear stationarity in the real exchange rates is carried out through a recursive analysis. By conducting the tests for a unit root recursively with gradually extended sample periods, the pattern of varying test statistics may clearly reflect the sensitivity of the test results to small changes in the time span of the sample. This procedure not only is a robustness check, but also may provide the information regarding the effects of large local and/or global crisis on the evidence for PPP.

Section 2 describes the methodology and empirical testing procedures utilized in the study. The empirical results are presented in Section 3. In Section 4, we provide additional statistical analysis to further explain the factors that may cause deviations from PPP or generate instability of the test results. Section 5 provides a summary of main findings and conclusions.

2. Methodology and test procedures

In this study, we re-examine the stationarity of bilateral real exchange rates (RERs) of three main currencies: the US dollar, Japanese yen, and French currency. The reason of using French instead of German currency as numeraire is based on the concern that the 1990 German unification may have had an impact on, probably slowed down, the European convergence to PPP. In fact, ZBK (2008) discover that evidence for stationary RERs is stronger for the European rates versus the French franc than those versus the German mark.

Both a conventional unit root test, the augmented Dickey–Fuller (ADF) test, and a more recently developed test by KSS (2003) are utilized for the study.⁵ The two tests have the same null hypothesis of a unit root, but the alternative hypothesis of the ADF is linear stationarity while KSS allow for nonlinear stationarity in the alternative. For y_t being the de-meaned or de-meaned and de-trended series

⁴ Another important branch of studies for PPP is based on panel data. Recent studies include Wu (1996), Alba and Papell (2007), and Chortareas and Kapetanios (2009). We focus on evidence using bilateral real exchange rates based on univariate unit root tests in order to (a) gain information on which particular bilateral real exchange rates are stationary, i.e., for which country pairs PPP hold, and (b) take nonlinearity in real exchange rates into account. Studies using panel data are often unable to do (a) and/or (b). In addition, Banerjee et al. (2005) show that, if important underlying assumption of panel unit root tests is violated, one may get wrong inferences on the validity of PPP. Hence, one needs to be cautious about using the inferences from panel unit root tests. Alternative evidence from non-panel time series model is useful and provides complimentary information to that from panel tests.

⁵ The results of a preliminary investigation indicate that using French or German currency as one of numeraire currencies would not make a qualitative difference in the conclusions of this study.

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