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The persistence in real exchange rate: Evidence from East Asian countries

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ABSTRACT

In this article, we examine the degree of persistence in monthly real exchange rate of six East Asian countries in relation to their two major trading partners, the United States and Japan, to study the validity of PPP for the 1976:01–2009:03 period. To investigate the persistency in real exchange rate series, we use sum of the autoregressive (AR) coefficients and the confidence interval for it using grid-bootstrap procedure recently developed by Hansen (1999). We have two findings: first, we find evidence for high persistency in real exchange rate in terms of the Japanese yen for five countries and for four countries in terms of the US dollar the for the full and pre-crisis sample periods. Second, for the post-crisis period, the presence of low persistency in real exchange rate supports PPP for three countries in terms of the Japanese yen and five countries in terms of the US dollar. These findings indicate that real exchange rate series of five East Asian countries are mean-revert based on their exchange rate policies and East Asian countries can form a currency union.

1. Introduction

The degree of persistence in real exchange rate has potentially important implications for theoretical models in international economics. The key role played by the real exchange rates in well-known theoretical model is purchasing power parity (PPP) in macroeconomics that motivates our interest in the degree of real exchange rate. PPP, which states that nominal exchange rates adjust to reflect difference in price levels across countries, is examined by many studies (e.g.,Taylor, 2003, 2006; Diebold et al., 1991; Lothian and Taylor, 1996; Mollick, 1999; Wu, 1996; Papell, 1997; O'Connell, 1998). Econometric tests of PPP examine whether the real exchange rate tends to revert to an average level. However, empirical research has not reached a consensus view on whether or not PPP holds. Different econometric tools have yielded mixed results about the validity of PPP.[1]

The PPP hypothesis can turn into a serious consideration for East Asia, because the model of PPP could be in use as a useful instrument with which to select a common currency for a future currency union among East Asian countries. Many relevant studies turned their attention into US dollar, the Japanese yen or the Euro when it comes to investigating issues related to real exchange as the common currency (e.g., Karras, 2005; Kwan, 2001; McKinnon, 2001; Williamson, 1999). In order to evaluate the relationship between the US dollar and the Japanese yen; and the currencies of East Asian countries, the extent of agreement on persistence in real exchange rate could be of great use to serve this purpose.

Based on a conventional ADF, there are many empirical studies which have failed to reject the unit root hypothesis for Asian real exchange rates. In order to rise above this problem, it is observed that a spate of studies have concentrated on more advanced econometric methodologies, some of which are panel unit root tests, unit root tests with structural breaks, and nonlinear unit root tests (e.g., by Azali et al., 2001; Liew et al., 2004; Breitung and Candelon, 2005; Ho, 2009; Bhandari and Upadhyaya, 2010). Since traditional unit root tests do not take into consideration that some structural breaks are present, they are known to have low power. For instance, Zurbruegg and Allsoppb (2004), using the cointegration tests of Inoue (1999) and Johansen et al. (2000) and allowing for one-time structural breaks, investigated the impact of East Asian crisis on PPP. Their findings reveal that the hypothesis of PPP is supported within the context of Asian crisis. Their findings are regarded as a significant indicator of the robustness of PPP to structural shifts because of the sample period covering the duration of the Asian crisis. Such researches as Adler and Lehman (1983), Hakkio (1986), Mark (1990), Grilli and Kaminsky (1991), Corbae and Ouliaris (1991), Flynn and Boucher (1993), Bahmani-Oskooee (1995, 1998), Serletis and Zimonopoulos (1997), Narayan (2005), using stationary techniques, show that a current change in the real exchange rate is permanent, which means real exchange rate contains unit root. Liew et al. (2004) consider the nonlinear stationarity test of Kapetanios et al. (2003) to 11 real Asian exchange rates and find evidence for eight US dollar-based rates and six Japanese yen-based rates. Most recently, utilising a panel cointegration test by Westerland (2007) with multiple structural breaks and by Pedroni (1999), the study by Narayan (2010) has found that when a panel cointegration test with

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[1] See Kalyoncu and Kalyoncu (2008) for a review of this literature.

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multiple structural breaks employed shows that there is strong evidence on providing for PPP for Asian countries, namely Malaysia, Thailand, India, Pakistan, Sri Lanka and the Philippines, while finding of the study indicates weak evidence in favour of the co-integration between nominal exchange rates in terms of the US dollar and relative prices. Kim et al. (2009) find that the time-varying PPP relationship in terms of the US dollar holds for Indonesia, Korea, Philippines, and Singapore and it holds in terms of the Japanese yen for Hong Kong, Indonesia, Malaysia, and Philippines.

The limited information is provided on the extent of persistence in real exchange rate by conventional unit root tests, for these tests rely on the testing of null hypothesis that the sum of the autoregressive (AR) coefficients is unity in an AR representation of a series against the alternative hypothesis that the sum of the AR coefficients is less than unity. A more informative statistical description of a variable's persistence is provided by a confidence interval for the sum of the AR coefficients. Because conventional asymptotic or bootstrapped confidence intervals are not valid for this key measure when the data are generated by a nearly integrated process, there is a difficulty in determining the confidence intervals for the sum of AR coefficients. For this reason we use the Hansen (1999) grid-bootstrap method in order to obtain the first-order coverage. According to Hansen (1999), his method provides good coverage in finite samples as well as obtaining valid confidence intervals. We also measure persistence through half-life, which is the number of years required for a shock to a variable to divide by one-half along with the sum of the AR coefficients.

Our primary objective in the present paper is to examine the persistency and to provide such confidence intervals for real exchange rates of six East Asian countries, namely Indonesia, Malaysia, Philippines, South Korea, Singapore and Thailand, vis-à-vis the Japanese yen and the US dollar for the 1976:01–2009:03 period to overcome the well-known problem of possible structural breaks associated with the recent financial crisis, the data was truncated into two sub-periods. These are, first, the January 1976–June 1997 period that coincides with the era of financial deregulation and the fast growing phase of the East Asian countries; and second, the July 1997 to March 2009 period that incorporates the post-crisis years along with the major structural and financial reforms undertaken by the crisis-affected East Asian countries. The first sub-period of January 1976–June 1997 has been the focus of interest in earlier studies. We find evidence for high persistency in real exchange rate for the Japanese yen and thus there is no finding for PPP, except for Malaysia, for the full and pre-crisis periods under consideration. The real exchange rate for the US dollar shows high persistency only for Malaysia and Singapore during the same periods. Nevertheless, the finding of this paper strongly supports that there is low persistency in real exchange rate for the post-crisis period in the US dollar, which indicates long-run real exchange rate mean-reversion and supports PPP, except for Singapore. As for the post-crisis period, there is low persistency for Indonesia, Malaysia and South Korea in terms of the Japanese yen.

The rest of the article is organized as follows: Section 2 introduces the measure of persistence and construction of its confidence intervals. Section 3 reports the data and the empirical results. Section 4 presents the conclusion.

2. Econometric methodology

In order to explain the persistence in the real exchange rate series, consider the following AR(p) process for the variable y_t:

$$y_t = \gamma + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \cdots + \alpha_p y_{t-p} + \varepsilon_t \quad (1)$$

for $t=1,2,\ldots,T$. It is argued by Andrews and Chen (1994) that an informative scalar measure of persistence in the AR process is the sum of the AR coefficients, $\alpha=\sum_{i=1}^{p}\alpha_i$, as the cumulative impulse response (CIR) is associated with α by $\mathrm{CIR}=1/(1-\alpha)$. Given that two AR($p$) models with identical largest roots can have very different persistence properties, they consider α as more informative than the largest root of the AR(p) model.

The variable y_t is a unit-root process if $\alpha=1$, while y_t is stationary, or mean-reverting, if $|\alpha|<1$. Focusing on the case where $\alpha>0$, as this is an appropriate range for RER data that is considered, a point estimate can be obtained by re-writing Eq. (1) and by means of OLS to estimate the well-known augmented Dickey and Fuller (1979, ADF) and Said and Dickey (1984) regression model:

$$\Delta y_t = \gamma' + \alpha y_{t-1} + \sum_{j=1}^{k}\beta_j \Delta y_{t-j} + \varepsilon_t \quad (2)$$

Here, $\Delta y_t = y_t - y_{t-1}$. Since the asymptotic distribution of the OLS estimator is different in the stationary and unit root cases, the obtaining of confidence intervals for α is problematic. If α is near unity, the conventional asymptotic procedure is poor in finite samples. If the near unit root case is formalized in a local-to-unity framework, then the conventional t-statistic used to form asymptotic confidence intervals for α has a non-standard distribution. Therefore, the conventional confidence interval is not valid asymptotically. At the same time, in finite samples, the conventional confidence interval will likely perform very poorly. This problem cannot be solved by a conventional bootstrap procedure, since the confidence intervals with correct first-order asymptotic coverage will be failed to be generated by the conventional bootstrap (Basawa et al., 1991). Therefore, we used the grid-bootstrap procedure by Hansen (1999), an alternative procedure to the conventional percentile-t bootstrap that provides correct first-order asymptotic coverage in a local-to-unity framework, for constructing confidence intervals for α.[2]

The half-life is also considered as a measure of persistence. The half-life is calculated from the impulse response function for an AR(p) in levels and is defined as the number of periods required for a unit shock to dissipate by 0.5: $\sup_{l\in L}\partial y_{t+l}/\partial\varepsilon_t \geq 0.5$, as in Cheung and Lai (2000). The persistence of the process over different horizons can be analyzed by studying the moving average representation for y_t:

$$y_t = C(L)\varepsilon_t \quad (3)$$

where $C(L)=1+c_1L+c_2L^2+\ldots$, obtained from $C(L)=(1-\alpha_1L-\alpha_2L^2-\cdots-\alpha_pL^p)^{-1}$. The moving average coefficients, $(c_1, c_2, \ldots)$, are referred to as impulse responses. In general, c_j tracks the impact of a unit shock at time t on the level of y at time $t+j$. For a stationary process, which contains no unit root, $C_\infty=0$; the process thus has zero long-run persistence. Over time horizons much shorter than infinity, nonetheless, $c_j=0$ and sizable persistence may still exist (Cheung and Lai, 2000). As it is explained in Rapach and Wohar (2004) and Inoue and Kilian (2002), the conventional bootstrap confidence intervals are not valid for the sum of the AR coefficients, α, while they are valid asymptotically for the individual slope coefficients of the AR(p) model, Eq. (1), and some functions of these coefficients – including the impulse response function – even in a local-to-unity framework, as long as $p>1$. We compute percentile grid-bootstrap 95% confidence intervals for the half-life of the impulse response function using the procedure outlined in Gospodinov (2004) in order to eliminate to have poor coverage in finite samples for a persistent series of conventional bootstrap confidence intervals for the half-life when $p>1$.

3. Data and empirical analysis

The data under study are monthly real exchange rate constructed from nominal exchange rates and consumer price indices obtained

[2] See Rapach and Wohar (2004) for the detailed information about the procedure.