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Gozgor, Giray

1 January 2011

Online at <https://mpra.ub.uni-muenchen.de/34370/>
MPRA Paper No. 34370, posted 28 Oct 2011 22:29 UTC

Panel Unit Root Tests of Purchasing Power Parity Hypothesis: Evidence from Turkey

Giray Gozgor

Department of International Trade and Business, Dogus University, Kadikoy, Istanbul, Turkey
E-mail: ggozgor@dogus.edu.tr

Abstract

In this paper, we employ some front page panel unit root tests to examine the validity of the purchasing power parity hypothesis in Turkey. Using monthly observations panel data of nine major county's currency dates January 2003 through April 2010, we find that panel unit root tests are not rejected the mean-reversion of real exchange rates. Thus, the empirical results indicate significant support for the purchasing power parity holds in Turkey.

Keywords: Purchasing Power Parity, Real Exchange Rates, Panel Unit Root Tests, Floating Exchange Rates.

JEL classification codes: C23, F30, F31.

1. Introduction

To determine the exchange rates under floating exchange rates important for policy makers and theoretical considerations. Floating exchange rates are based on the collapsing of Bretton Woods System in 1973 and became a risk factor as the result of the transition to floating exchange rate regime as a consequence of the financial crisis in Turkey in February 2001, despite the emergence of many developed and emerging market economies have been predicated in 1973. One of the main critical issues that determining exchange rate, whether they are mean-reverting in the long run and the purchasing power parity (PPP) holds.

There is a widespread literature to examine relation between real exchange rates and PPP. Froot and Rogoff (1995), Rogoff (1996), Taylor and Sarno (1998), O'Connell (1998), Anker (1999), Sarno (2000), Taylor et al. (2001), Sarno and Taylor (2002), Killian and Taylor (2003), Taylor and Taylor (2004), Breitung and Candelon (2005), Taylor (2006), Kalyoncu and Kalyoncu (2008), Lau (2009), Cuestas (2009), Hung and Weng (2010) have showed theoretical background and empirical evidences of PPP-real exchange rates relationship. In this paper, we investigate whether real exchange rates in Turkey are mean-reverting or not. We apply contemporaneous panel unit root tests to nine exchange rates which are defined by Turkish Lira (TL). We suggest that such approach could also provide valuable insight for further investigation of this phenomenon in Turkey.

The outline of this study is as follows: Second section explains the data and the methodology, the third section presents the empirical findings and final section concludes.

2. Data and Methodology

In this section, we define the real exchange rates as panel framework from nominal exchange rates of Australian Dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), Euro (EUR), Great Britain Pound (GBP), Japanese Yen (JPY), Norwegian Kroner (NOK), Swedish Kroner (SEK) and United States Dollar (USD) against Turkish Lira (TL). We use 87 observations from January 2003 to April 2010 and the frequency of data is monthly. The data used for this study come from the

International Financial Statistics from the International Money Fund. Nominal exchange rates are converted into real exchange rates by using the consumer prices indices. Real exchange rates are constructed defining relative prices as the ratio of each country's CPI to Turkey CPI, and employed the method as follows:

$$\log(RER) = \log(NER) + \log(P^*) - \log(P)$$

Where RER is the real exchange rate, NER is the nominal exchange rate and P^* and P are the foreign and domestic prices, respectively.

And we define the following equation which shows the model of mean-reverting real exchange rate,

$$\log(RER)_t = \alpha + \beta \log(RER)_{t-1} + \varepsilon_t$$

α and ε are constant and error term respectively. PPP suggest that real exchange rate series should be stationary. If there is a unit-root in the real exchange rate this implies that shocks to the real exchange rate are permanent and PPP does not exist between two countries.

The classical unit root tests of the real exchange rates such as Dickey and Fuller (1979) are subject to some criticism that is occurred from the low power of these tests in small samples in order to define PPP relationship. Consequently, panel unit root tests began to be widely used in literature. In this study, we employ panel unit root tests can be arranged in groups by cross section dependence or independence, heterogeneous or homogenous unit roots which are defined by Maddala and Wu (1999), Breitung (2000), Hadri (2000), Choi (2001), Levin et al. (2002), Im et al. (2003).

To define these test's approach, we consider a following AR(1) process for panel data:

$$y_{it} = \rho_i y_{it-1} + X_{it} \delta_i + \varepsilon_{it}$$

Where $i = 1, 2, \dots, N$ cross-section units or series that are observed over periods $t = 1, 2, \dots, T$; X_{it} represent the exogenous variables in the model, including any fixed effects or individual trends, ρ_i are the autoregressive coefficients, and the errors ε_{it} are assumed to be mutually independent idiosyncratic disturbance. If $|\rho_i| < 1$, y_i said to be weakly (trend) stationary. On the other hand, if $|\rho_i| = 1$ then y_i contains a unit root.

For purposes of testing, there are two natural assumptions that we can make about the ρ_i . First, one can assume that the persistence parameters are common across cross-sections so that $\rho_i = \rho$ for all i Levin et al. (2002), Breitung (2000), and Hadri (2000) tests all employ this assumption. Alternatively, one can allow ρ_i varying freely across cross sections. The Im et al. (2003), and Fisher-ADF and Fisher-PP tests define by Maddala and Wu (1999) and Choi (2001) are of this form.

Levin et al. (2002), Breitung (2000), and Hadri (2000) tests all assume that there is a common unit root process so that ρ_i is identical across cross-sections. The first two tests employ a null hypothesis of a unit root while the Hadri (2000) test uses a null of no unit root. Levin et al. (2002) and Breitung (2000) both consider the following basic ADF specification:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X'_{it} \delta + \varepsilon_{it}$$

Where we assume a common $\alpha = \rho - 1$ but allow the lag order for the difference terms, ρ_i to vary across cross-sections. The null and alternative hypotheses for the tests may be written as $H_0: \alpha = 0$ $H_1: \alpha < 0$ so under the null hypothesis, there is a unit root, while under the alternative, there is no unit root.

The Im et al. (2003), the Fisher-ADF and PP tests all allow for individual unit root processes so that may ρ_i vary across cross-sections. The tests are all characterized by the combining of individual unit root tests to derive a panel-specific result. Im et al. (2003) begin by specifying a separate ADF regression for each cross section:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X'_{it} \delta + \varepsilon_{it}$$

$$H_0: \alpha = 0 \text{ for all } i \text{ while the alternative hypothesis is given by } H_1 \begin{cases} \alpha_i = 0 \text{ for } \dots i = 1, 2, N_1 \\ \alpha_i < 0 \text{ for } \dots i = N+1, N+2, \dots, N \end{cases}$$

(Where they may be reordered as necessary) which i may be interpreted as a non-zero fraction of the individual processes is stationary.

An alternative approach to panel unit root tests uses Fisher's (1932) results to derive tests that combine the p-values from individual unit root tests. This idea has been proposed by Maddala and Wu (1999) and by Choi (2001).

3. Empirical Results

We apply panel unit root tests which are defined by Maddala and Wu (1999), Breitung (2000), Hadri (2000), Choi (2001), Levin et al. (2002), Im et al. (2003) to mentioned real exchange rates. Following Kalyoncu and Kalyoncu (2008), we employ the panel unit root tests are performed on the level of variable. The model trend is adopted in the empirical analysis, because recent studies a time trend is included in the unit root test. According to Marcela et al. (2003), allowing for a trend in the data is equivalent to accepting the existence of factors with a systematic influence on the real exchange rate due to Balassa-Samuelson effect and a demand-side bias in favor of non-traded goods. Another argument for inclusion of time trend is motivated by the non-stationary of real exchange rates for traded goods because of menu costs or pricing-to-market strategies. Therefore we apply the panel unit root tests including constant and trend, results are shown in table 1 as follows:

Table 1: Panel Unit Root Tests Results

Cross Section Independence	Cross Section Independence
Homogenous Unit Roots	Trend and Constant
Hadri (2000) HC Z-stat	1.649** (0.0495)
Levin, Lin and Chu (2002) t-stat	-5.556* (0.0000)
Breitung (2000) t-stat	-6.486* (0.0000)
Heterogeneous Unit Root	Trend and Constant
Im, Pesaran and Shin (2003) W-stat	-6.408 *(0.0000)
Cross Section Dependence	Cross Section Dependence
Heterogeneous Unit Root	Trend and Constant
Maddala and Wu (1999) ADF-Fisher Chi Square	76.026* (0.0000)
Choi (2001) ADF-Choi Z-stat	-6.148* (0.0000)
Maddala and Wu (1999) PP-Fisher Chi Square	46.626* (0.0002)
Choi (2001) PP-Choi Z-stat	-4.199* (0.0000)

All panel unit root tests are null hypothesis tests of non-stationary real exchange rates, except that Hadri (2000) is stationary.

All panel unit root tests are defined by Barlett kernel and Newey-West (1994) bandwidth, except that Hadri (2000) is defined by quadratic spectral kernel and Andrews (1991) bandwidth selection.

Hadri (2000) assumes that the unit root test uses heteroskedasticity consistent.

The optimal number of lags is chosen by Akaike Information Criterion (AIC).

Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

The p-value is in parentheses, ** and * denote the rejection of the null hypothesis at 5% and 1% significance, respectively.

We find that the panel unit root tests result strongly support to stationary of real exchange rates except Hadri (2000). However, Hadri's panel unit root test experiences significant size distortion in the presence of autocorrelation when there is no unit root. According to Hlouskova and Wagner (2006), the Hadri test appears to over-reject the null of stationarity, and may yield results that directly contradict those obtained using alternative test statistics.

4. Conclusion

The evidence concludes that the Turkey show significant support for the PPP hypothesis existence of both cross-sectional dependence or independence in panel unit root tests except the rejection of the null hypothesis Hadri (2000) 5% significance. Empirical finding implies that the real exchange rates of Turkey among major countries can be described as stationary and support long-run purchasing power parity.

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