Perspectives on Purchasing Power Parity for the Middle East

Tsangayo Chang*, Chia-Hao Lee** & Pei-I Chou***

Abstract: This paper analyzes purchasing power parity (PPP) for the Middle East and applies Panel Seemingly Unrelated Regressions Augmented Dickey-Fuller (Panel SURADF) tests, proposed by Breuer et al. (2001), to test the validity of long-run PPP in a sample of Middle East countries over the January 1980 to August 2008. Our methodology exploits the cross-sectional dependence across real exchange rates and allows for heterogeneity in the rates of mean reversion. The empirical results indicate that the unit root hypothesis cannot be rejected for real exchange rates. However, when the restriction of a common mean reversion coefficient is relaxed, we reject the unit root hypothesis for the most Middle East countries, with the exception of Bahrain. We conclude that the process of economic integration in Middle East has accelerated convergence toward PPP.

JEL: C21; F31.

Keywords: Purchasing Power Parity; Middle East Countries; Panel SURADF Test.

1. INTRODUCTION

During much of the past few decades, considerable effort has been put into testing the validity of purchasing power parity (hereafter, PPP) hypothesis as it has important implications in the international macroeconomics. The basic idea behind the PPP hypothesis is that since any international goods market arbitrage should be traded away over time, we should expect the real exchange rate to return to a constant equilibrium value in the long run. Studies on this issue are critical not only for empirical researcher but also for policymakers. In particular, a non-stationary real exchange rate indicates that there is no long-run relationship between nominal exchange rate, domestic and foreign prices, thereby invalidating the purchasing power parity (PPP). As such, PPP can not be used to determine the equilibrium exchange rate and invalid PPP also disqualifies the monetary approach to exchange rate determination, which requires PPP to hold true.

The theory of PPP remains the cornerstone of modern international macroeconomics and thus there have been a number of studies attempts to test the validity of PPP in the theoretical and especially the empirical literature. Details about previous studies see the work of Rogoff (1996) and Sarno and Taylor (2002) who provide details on the theoretical and empirical on PPP and the real exchange rate.

While numerous studies support a unit root in real exchange rate, critics have claimed that the drawing of such conclusions may be attributed to the lower power of the conventional unit

* Feng Chia University, Dept. of Finance, Taichung, Taiwan, R.O.C.
** National Chung Hsing University, Dept. of Finance, Taichung, Taiwan, R.O.C., (Corresponding author: E-mail:d9521002@mail.nchu.edu.tw)
*** National Chung Hsing University, Dept. of Finance, Taichung, Taiwan, R.O.C.
root tests employed. More recently, it has been reported that conventional unit root tests not only fail to consider information across regions, thereby leading to less efficient estimations, but also have lower power when compared with near-unit-root but stationary alternatives. It is not surprising that these factors have cast considerable doubt on many of the earlier findings that have been based on a unit root in real exchange rate. In order to increase the power in testing for a unit root, many researchers have employed panel data. Levin et al. (2002) and Im et al. (2003), for instance, have developed the asymptotic theory and the finite-sample properties of ADF tests for use with panel data. These two tests have significantly improved power even in relatively small panels, but the problem inherent to both is cross-sectional dependence. Zellner (1962) put forth a straightforward approach to handle cross-sectional dependence across countries, and this is to estimate equations using the seemingly unrelated regression (SUR) estimator. Furthermore, O’Connell (1998) demonstrated that size distortions can be avoided without a significant loss of power by basing the panel-based test on SUR estimations instead of OLS estimations.

Important here, Taylor and Sarno (1998) and Breuer et al. (2001) have shown that the “all-or-nothing” nature of the tests has not been fully addressed by recent methodological refinements to the Levin-Lin-Chu (2002) test. Although Im et al. (2003), Maddala and Wu (1999) and Taylor and Sarno (1998) developed tests that permit the autoregressive parameters to differ across panel members under the stationary alternative, they are not informative in terms of the number of series that are stationary processes when the null hypothesis is rejected. The reason is simple: they are not joint tests of the null hypothesis. In this regards, Breuer et al. (2001) claim that, by analogy to a simple regression, when an F-statistic rejects the null that a vector of coefficients is equal to zero, it is not necessarily true that each coefficient is nonzero. Likewise, when the unit-root null hypothesis is rejected, it may very well not be justified to assume that all series in the panel are stationary.

In contrast to those panel-based unit root tests that are joint tests of a unit root for all members of a panel and that are incapable of determining the mix of I(0) and I(1) series in a panel setting, Panel SURADF tests investigate a separate unit-root null hypothesis for each and every individual panel member. In so doing, they clearly identify how many and which series in the panel are stationary processes. Hence, this empirical study uses Panel SURADF tests to test the validity of PPP for a sample of Middle East countries. Breuer et al.’s (2001) Panel SURADF tests unequivocally indicate that PPP is valid for most of these Middle East countries, with the exception of Bahrain.

The paper is organized as follows. Section 2 discusses theoretical model of real exchange and the theory of PPP. Section 3 presents the data used in our study. Section 4 outlines the methodology we employ and then Section 5 discusses the empirical findings. Finally, Section 6 reviews the conclusions we draw.

2. THE THEORETICAL MODEL OF PURCHASING POWER PARITY

Our bilateral real exchange rate is defined as the nominal exchange rate deflated by a ratio of foreign (U.S. in our case) and domestic price levels:

\[ r_t = e_t \frac{p_t^*}{p_t} \]  

(1)
where $e_t$ is the nominal exchanger defined in local currency units per U.S. dollar; $r_t$ is the real exchange rate; $p_t$ and $p_t^*$ are the domestic and foreign price levels. We use consumer price index (CPI) in our study. Taking the logarithm of both sides of the Eq. (1) and rearranging the terms yields:

$$r_t = e_t + p_t^* - p_t$$

(2)

From a statistical point of view, the validity of the purchasing power parity (PPP) hypothesis reduces to a unit root test of $r_t$. If PPP holds perfectly, the real exchange rate is constant. In practice, the presence of a unit root in the real exchange rate series would imply that PPP does not hold in the long run. If the null hypothesis of a unit root is rejected, the real exchange rate is mean-reverting and therefore real exchange rates tend to revert to their PPP level in the long run. If the series contain a unit root, however, there is no mean-reversion and PPP does not hold. Non-stationarity in real exchange rates has many macroeconomic implications. For example, Dornbusch (1987) has argued that if real exchange rate depreciates, it could bring a gain in international competitiveness, which in turn, could shift the employment toward the depreciating country. Therefore, it is important to establish the empirical validity of the purchasing power parity theory. Another important implication of non-stationary in real exchanger is that unbounded gains from arbitrage in traded goods are possible. In fact, Parikh and Williams (1998) have mentioned that a non-stationary real exchange rate can cause severe macroeconomic disequilibrium that would lead to real exchange rate devaluation in order to correct for external imbalance.

3. DATA

Our empirical analysis covers a sample of 7 Middle East countries: Bahrain, Israel, Jordan, Kuwait, Saudi Arabia, Syria, and Turkey. Monthly data are employed in this study, and the time span is from January 1980 to August 2008 period. All consumer price indices, CPI (based on 2000 = 100) and nominal exchange rates relative to the USA dollar data are taken from the International Monetary Fund’s International Financial Statistics CD-ROM. Each of the consumer price index and nominal exchange rate series was transformed into natural logarithms before the econometric analysis. Testing for PPP against the USA is based on the argument that internal foreign exchange markets are mostly dollar dominated. In addition, the USA is the major trading partner for these 7 Middle East countries.

A summary of the statistics is given in Table 1. Our Jarque-Bera test results indicate that all the bilateral real exchange rate data sets are approximately non-normal. The Syria/USD with values varying from -2.041 to -2.549 and a standard deviation of 0.312 is the most volatile currency, whereas the Kuwait/USD with values varying from 1.147 to 1.454 and a standard deviation of 0.075 is the less volatile currency.

4. METHODOLOGY

There has been a clear evolution in the methodologies employed in PPP studies. Early papers predominantly use univariate unit root tests. However, the lack of power of the Dickey–Fuller unit root test can deter rejection of the unit root in favor of PPP even though the log real exchange rate under consideration is, in fact, stationary. Increasing the length of the sample has been
offered as a solution (see Lothian and Taylor, 1996). Froot and Rogoff (1995) show that a very long time series is needed to overcome the power problem. This implies that data from both fixed and floating rate periods have to be used, which blurs the interpretation of the results. As an alternative way of increasing the power of the unit root tests, many studies turn to panel data models, see Jorion and Sweeney (1996). A principal problem with the panel approach is formulated by O’Connell (1998), who demonstrates that spurious rejections of a unit root can occur when cross-sectional dependence is unaccounted for. Imposing severe restrictions on the variance-covariance matrix in a panel of real exchange rates leads to serious biases in the size and the power of the test.

In this paper, we employ the heterogeneous seemingly unrelated regressions augmented Dickey-Fuller (SURADF) methodology introduced by Breuer et al. (2001) to test the PPP hypothesis. This model is not only able to cope with the cross-sectional dependence, but also with the different speeds of mean reversion across real exchange rates. The system of the ADF equations that we estimate here is:

\[
\begin{align*}
\Delta X_{1,t} &= \alpha_1 + \beta_1 X_{1,t-1} + \sum_{j=1}^{J} \theta_{1,j} \Delta X_{1,t-j} + \epsilon_{1,t} \\
\Delta X_{2,t} &= \alpha_2 + \beta_2 X_{2,t-1} + \sum_{j=1}^{J} \theta_{2,j} \Delta X_{2,t-j} + \epsilon_{2,t} \\
&\vdots \\
\Delta X_{N,t} &= \alpha_N + \beta_N X_{N,t-1} + \sum_{j=1}^{J} \theta_{N,j} \Delta X_{N,t-j} + \epsilon_{N,t} 
\end{align*}
\]

(3)

Where \( t = 1, 2, \ldots, T \), we test the \( N \) null and alternative hypotheses individually:

\[
\begin{align*}
H_0^1 : \beta_1 = 0; & H_A^1 : \beta_1 < 0 \\
H_0^2 : \beta_2 = 0; & H_A^2 : \beta_2 < 0 \\
& \vdots \\
H_0^N : \beta_N = 0; & H_A^N : \beta_N < 0
\end{align*}
\]

Table 1
Summary Statistics

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</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>1.152</td>
<td>1.533</td>
<td>0.838</td>
<td>0.209</td>
<td>0.373</td>
<td>1.882</td>
<td>25.281***</td>
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<td>-1.237</td>
<td>-1.808</td>
<td>0.121</td>
<td>-0.570</td>
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<td>18.227***</td>
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<td>Jordon</td>
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<td>0.958</td>
<td>0.314</td>
<td>0.179</td>
<td>1.002</td>
<td>2.494</td>
<td>59.802***</td>
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<td>0.673</td>
<td>2.484</td>
<td>29.122***</td>
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<td>0.251</td>
<td>0.779</td>
<td>2.661</td>
<td>35.624***</td>
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<td>-2.549</td>
<td>-2.041</td>
<td>-3.196</td>
<td>0.312</td>
<td>-0.574</td>
<td>1.922</td>
<td>34.736***</td>
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<tr>
<td>Turkey</td>
<td>0.481</td>
<td>1.141</td>
<td>-0.005</td>
<td>0.249</td>
<td>0.738</td>
<td>3.084</td>
<td>30.600***</td>
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Note: 1. The sample period is from 1980M1 to 2008M8.
2. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
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where we compute the test statistics from the SUR estimates of system (3). Breuer et al. (2001) have demonstrated that the imposition of an identical lag structure across panel members could bias test statistics; thus, we select the lag structures for each equation based on the approach adopted by Perron (1989).

The major difference between the Panel SURADF and other panel unit tests, such as the MADF test of Sarno and Taylor (2002), lies in the formulation of the null hypothesis. While the others are joint tests of a unit root for all members of a panel, the Panel SURADF tests test a separate unit-root null hypothesis for each individual panel member and, therefore, are able to identify how many and which series in the panel are stationary processes.

5. EMPIRICAL RESULTS

Several traditional unit root tests are first employed to examine the null of a unit root in bilateral real exchange rates for these 7 Middle East countries that we study. ADF and PP tests both fail to reject the null of a unit root for real exchange rates in all 7 Middle East countries. The KPSS test yields the same results. Our results signify that bilateral real exchange rates for these 7 Middle East countries are all random process (see Table 2).

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Conventional Unit Root Test</th>
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<tr>
<td></td>
<td>Level</td>
<td>ADF</td>
</tr>
<tr>
<td>Bahrain</td>
<td></td>
<td>-0.899(0)</td>
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<tr>
<td>Israel</td>
<td></td>
<td>-2.379(0)</td>
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<td>Jordan</td>
<td></td>
<td>-2.102(0)</td>
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<tr>
<td>Kuwait</td>
<td></td>
<td>-2.185(0)</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td></td>
<td>-1.661(3)</td>
</tr>
<tr>
<td>Syria</td>
<td></td>
<td>-2.152(0)</td>
</tr>
<tr>
<td>Turkey</td>
<td></td>
<td>-2.517(0)</td>
</tr>
</tbody>
</table>

Note: 1. The number in parentheses indicates the selected lag orders. Lags are chosen based on Perron (1989).
2. The number in brackets indicates the selected lag truncation for the Bartlett kernel, as suggested by the Newey-West (1987) test.
3. The ***, **, and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Breuer et al.’s (2001) Panel SURADF test results, substantiate there is a unit root in real exchange rate for only one bilateral real exchange rates, Bahrain/USD, as shown in Table 3. These results indicate that PPP holds for most of the Middle East countries. To avoid the small-sample size bias, we estimate the 1%, 5%, and 10% critical values, obtained from simulations based on observations for each series and 10,000 replications using the lag and covariance structure from the panel of real exchange rate data series for each of the 7 panel members. These are presented in Table 3. Table 3 further reports the autocorrelation coefficients along with the half-life estimates from the Panel SURADF unit root tests. The autocorrelation coefficients are all negative and the estimates of the half-life indicate that the speed of adjustment towards the mean-reverting processes among Middle East countries...
ranges between 17.8 (1.48 years) and 330.7 months (27.55 years). The results suggest that bilateral real exchange rate of the Bahrain/USD had the slowest rate of adjustment towards the long run equilibrium, or the slow degree of mean-reverting process. One justification of this finding is that in the case of Bahrain, the exchange rate is known to be especially ill-behaved.

| Country     | $\beta$ | Half Life (Months) | SURADF | Critical value
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</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>-0.002</td>
<td>330.744</td>
<td>-0.836</td>
<td>2.395</td>
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<td>Israel</td>
<td>-0.030</td>
<td>22.742</td>
<td>-2.324***</td>
<td>1.204</td>
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<td>Jordan</td>
<td>-0.017</td>
<td>40.012</td>
<td>-3.039***</td>
<td>1.631</td>
</tr>
<tr>
<td>Kuwait</td>
<td>-0.028</td>
<td>24.415</td>
<td>-2.560***</td>
<td>1.423</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>-0.007</td>
<td>93.581</td>
<td>-4.412***</td>
<td>1.176</td>
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<tr>
<td>Syria</td>
<td>-0.007</td>
<td>100.925</td>
<td>-1.453*</td>
<td>1.341</td>
</tr>
<tr>
<td>Turkey</td>
<td>-0.038</td>
<td>17.822</td>
<td>-2.678***</td>
<td>1.558</td>
</tr>
</tbody>
</table>

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Critical values are calculated by Monte Carlo simulation with 10,000 draws, tailored to the present sample size. The half-life, \(\ln(0.5)/\ln(1 + \beta)\), is defined as the time horizon from which the percentage deviation from equilibrium is one half.

Apparently, the Panel SURADF test employed in our study provided strong evidence favoring the long-run validity of PPP for these 7 Middle East countries under study. It is noteworthy that the results here contrast with that of Drine and Rault (2008), which provided weak (or no) support PPP for Middle East countries. However, our results here are consistent with those of Bahmani-Oskooee (1998), Sarno (2000), Hassanain (2004), Narayan and Prasad (2005), they found PPP holds true for most of the Middle East countries under study.

The major policy implication that emerges from this study is that PPP can be used to determine the equilibrium exchange rate for most of these Middle East countries, with the exception of Bahrain, and the unbounded gains from arbitrage in traded goods are not possible among these Middle East countries.

6. CONCLUSIONS

Using monthly data over the January 1980 to August 2008 period, this study empirically tests whether PPP holds among a sample of Middle East countries. In this empirical study, we employ Breuer et al.’s (2001) Panel SURADF unit tests to assess the non-stationary properties of the bilateral real exchange rate for 7 Middle East countries. Based on the results from the Breuer et al.’s (2001) Panel SURADF test, we find PPP holds true for most of the Middle East countries. As concerns major policy, our study implies that PPP can be used to determine the equilibrium exchange rate for most of these 7 Middle East countries under study, with the exception of Bahrain.
Acknowledgements

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Note

1. The real exchange rate series of a country at time $t$ is defined as $(S_t \times P_{tUS}) / P_{tH}$, where $S_t$ is the nominal exchange rate of home country per dollar, $P_{tUS}$ and $P_{tH}$ denote the consumer price indices of home country and the USA, respectively.

References


