TESTING PPP HYPOTHESIS IN MAJOR ASEAN ECONOMIES: DOES DATA GENERATING PROCESS MATTER?

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ABSTRACT

This study employs the Johansen and Juselius (1990) cointegration test and the recently proposed Bierens (1997) non-parametric cointegration methodology to test the purchasing power parity hypothesis for five major ASEAN economies—Indonesia, Malaysia, the Philippines, Singapore, and Thailand, with U.S. as reference. Both tests are used jointly since this approach provides a framework to address the issue of whether the underlying data generating process has strong impact on the empirical cointegration testing of PPP hypothesis. Using the Johansen and Juselius cointegration approach, the null hypothesis of no cointegrating vector for all the five ASEAN countries cannot be rejected. Further analysis using the Bierens’s method provides strong support for the PPP proposition for Malaysia, Singapore and Thailand. The discrepancy between the findings from both techniques is interpreted as a consequence of significant non-linearity in the adjustment process of real exchange rate towards its PPP equilibrium level. Specifically, these findings provide empirical evidence against the robustness of the Johansen and Juselius method at detecting cointegration when the data generating process is non-linear.

Thus, this study points to the need to examine the underlying dynamics of the data generating process before further empirical testing of PPP hypothesis, especially those utilizing Johansen approach.

Keywords: Nonparametric cointegration; Purchasing power parity; ASEAN economies; Non-linearity; Data generating process.

JEL classification: F30, H60, H62
INTRODUCTION

The hypothesis of purchasing power parity (PPP) has been one of the most extensively researched areas over the past few decades. The basic idea of PPP was initially advanced by classical economists such as David Ricardo in the 19th century. But it was Gustav Cassel, a Swedish economist, who popularized the PPP in the 1920s. The PPP hypothesis in its absolute form states that the exchange rate between currencies of two countries should be equal to the ratio of countries’ price levels: $S_t = \frac{P_t}{P_t^*}$, where $P_t$ is the domestic price level (in domestic currency) and $P_t^*$ is the foreign price level (in foreign currency). Equivalently, PPP asserts that the exchange rate, which can be calculated as $E_t = S_{t-1} \cdot \frac{P_t^*}{P_t}$, should be constant. Although short run, deviation of exchange rate from PPP might occur, most economic theories suggest that PPP should hold in the long run.

The PPP hypothesis can be considered as the oldest method of defining long-term exchange rate equilibrium, and is the central building block of many theoretical and empirical models of exchange rate determination. For example, the monetary approach by Frankel and Rose (1978) is based on two basic tenets: purchasing power parity and the quantity theory of money. Another popular sticky-price exchange rate model developed by Dornbusch (1976) also uses PPP to preserve the PPP as a long run equilibrium condition for exchange rates. On the other hand, the PPP has some practical appeal for policy makers and exchange rate arbitrageurs. Generally, one can use the PPP-determined exchange rate as a benchmark in deciding if a country’s currency is undervalued or overvalued against other currencies. In international trade, PPP also has a role to play. For example, if PPP holds, countries’ competitive positions in world export markets are not systematically affected by exchange rate changes. However, if there are deviations from PPP, changes in real exchange rates will affect the international competitive positions of countries.

Over the years, there has been an explosion of empirical research on the validity of the hypothesis in the real world. Two widely employed empirical tests for PPP are the unit root methodology and cointegration analysis. A necessary condition for PPP to hold in the long run is that the real exchange rate must be covariance stationary. The standard method for detecting non-stationary behaviour in a time series is to test for the presence of a unit root. Thus, rejection of a unit root in real exchange rate provides evidence supporting PPP. Another strand of literature is based on the cointegration technique. To provide empirical support for PPP, the bilateral nominal exchange rates and relative prices must form a cointegrated system. If an exchange rate and relative prices should move together one-for-one in the long run.

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1. The deviation can be due to factors such as transaction costs, price rigidity, the differential composition of price baskets and prices indices, and imperfect markets (as results of subsidy, taxation, trade barriers, foreign market interventions and the like).

2. Taylor (1995), Rogoff (1996) and Edison et al. (1997) have done an excellent survey on the empirical evidence of PPP.
Empirical studies on PPP have yielded contradictory results. Even in ASEAN countries, the presence of both economic growth and success in the last decade and the recent turmoil, the results have been mixed, creating a debate among policymakers. The empirical findings of Bahramshah and Ariff (1997) using unit root and Granger (1987) cointegration approach rejected the PPP proposition for all the selected ASEAN countries—Indonesia, Malaysia, the Philippines, Singapore and Thailand. Another analysis using the Johansen and Juselius (1990) multivariate approach also failed to support the PPP hypothesis in these countries. Bahmani-Oskooee (1993) who used the Engle and Granger procedure have found evidence in favour of strong PPP hypothesis in the Philippines and South Korea. In Indonesia, Malaysia, Singapore and Thailand, on the other hand, a recent study by Bahmani-Oskooee and Mirza (2000) failed to support the mean reversion in real effective exchange rate for Indonesia, Malaysia, the Philippines and Thailand by using the conventional KPSS unit root tests. To take into account the presence of structural breaks, Aggarwal and Sarno (2000) employed both the single and multiple breaks unit root tests to test the validity of PPP for ASEAN exchange rates. They found strong evidence of long run PPP hypothesis for most of the ASEAN currencies when the Japanese yen is used as the numeraire currency. However, such evidence of PPP is weaker with the U.S. dollar, German mark and the Australian dollar. Another recent study by Azali et al. (2001) using panel unit root and panel cointegration found that PPP does hold in the long run between Japan and ASEAN economies.

With the growing empirical evidence supporting the presence of non-linearity in exchange rate time-series data (see, for example, Hsieh, 1989; De Grauwe et al., 1993; Steurer, 1995; Brooks, 1996; Mahajan and Wagner, 1999), many researchers started asking themselves to what extent should trust the results of linear methods like the conventional unit root tests and cointegration analysis if the underlying data generating process is non-linear. Taylor and Peel (1997) and Sarno (2000), amongst others, illustrated that the adoption of linear stationarity tests is inappropriate for detecting mean reversion if the true data generating process of exchange rate is in fact a non-linear process. On the other hand, the Monte Carlo simulation evidence in Bierens (1997) indicated that the standard linear cointegration framework presents a mis-specification problem when the true nature of the adjustment process is non-linear and the speed of adjustment varies with the magnitude of the disequilibrium. Other related work is provided by Pippenger and Goering (1993) and Balke and Fomby (1997) which suggest a potential loss of power in standard unit root and cointegration tests under threshold autoregressive data generating process.
energized fresh attention on the PPP hypothesis. Serletis and Gogas (2000) applied non-linear techniques to test for non-linearity in real exchange rate series and found evidence that the behavior of real exchange rate series under investigation are governed by non-linear dynamics. Other studies like Micheal et al. (1997), Sarno (2000) and Baum et al. (2001) employed nonlinear models such as the threshold autoregressive (TAR), smooth transition autoregressive (STAR) and exponential smooth transition autoregressive (ESTAR) models to model the behavior of real exchange rates. All these studies provided strong support for the validity of long run PPP, in which the real exchange rates adjust non-linearly towards its equilibrium PPP level.

Theoretically, non-linearities in real exchange rate adjustment can be explained by the occurrence of market frictions such as transaction costs. According to Dumas (1992), the presence of transaction costs in international trade implies that deviations from PPP will only be arbitraged away by rational arbitrageurs if the price differentials exceed transaction costs. Thus, there will be persistent behaviour when PPP deviations are within no-arbitrage bands, that is exchange rates is left unadjusted. However, beyond this band of inaction, there will be mean reversion. Specifically, the larger the deviation, the stronger is the tendency for the exchange rate to adjust back to equilibrium. Thus, the speed of adjustment varies with respect to the size of deviation, thereby justifying the non-linear adjustment of exchange rate towards PPP.

Along this line of inquiry, the main objective of this study is to utilize the Johansen and Juselius (1990) cointegration test and Bierens’s (1997) non-parametric cointegration test in a sequence way to examine whether the underlying data generating process plays an important role in the PPP hypothesis. As pointed out by Bierens (1997), the non-parametric cointegration test is in the same spirit with Johansen and Juselius (1990) approach. The test statistics involved in both approaches are obtained from the solutions of a generalized eigenvalue problem, but Bierens’ approach a data generating process does not need to be specified and thus this is a completely non-parametric. Therefore, in principle, both approaches should generate a same outcome. Since the Bierens’s method allow for non-linearity in the data generating process, any discrepancy of the findings from both methods indicate the presence of non-linearity and adjustment process of the real exchange rates under investigate. This is consistent with interpretations in Ma and Kanas (2000) and Coakley and Fuertes (2001).

This paper is organized as follows. Following this introduction, a brief description of methodology used in this study is given. This is followed in Section III by a discussion and empirical results. Concluding remarks are given at the end of the paper.
METHODOLOGY

The PPP hypothesis states that the nominal exchange rate (in domestic currency per foreign) should be equal to the ratio of domestic to foreign price as:

$$S_t = \frac{P_t}{P_t^*}$$

where $S_t$ is the domestic currency per unit of foreign currency, $P_t$ and $P_t^*$ are the domestic and foreign price indices respectively. If PPP holds, the deviation from long run PPP:

$$E_t = \frac{P_t}{P_t^*}$$

where $E_t$ is the real exchange rate, should imply a stationary process or that no permanent effect. In the methodology of cointegration, long run PPP is implied by cointegrating relationship between nominal exchange rates and relative prices, with the cointegrating vector being $[1, -1]$. Specifically, if real exchange rates are stationary, the nominal exchange rates and relative prices should move together one-for-one in the long run. This study with the Johansen and Juselius (1990) and Bierens's (1997) non-parametric cointegration exam to examine the long run PPP hypothesis.

Johansen and Juselius (1990) Cointegration Test

The Johansen and Juselius (JJ) (1990) multivariate cointegration technique uses maximum likelihood procedures to determine the number of cointegrating vectors among a vector of time series. Assume that $y_t$ is modelled as a vector autoregression (VAR):

$$y_t = \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + \ldots + \Pi_k y_{t-k} + \mu_t$$

where $y_t$ is a column vector of two endogenous variables. Equation (2) can be transformed into first-difference form as follows:

$$\Delta y_t = \sum_{j=1}^{k-1} \Gamma_j \Delta y_{t-j} + \Pi_1 y_{t-k} + \mu_t$$

where $\Pi$ is the long run relationship between the variables in $y_t$ process. The estimation of the cointegrating vectors can be determined from the matrix of $\Pi$, which is written as:

$$\Pi = \alpha \beta^*$$

where $\beta^*$ is the $(r \times p)$ matrix of cointegrating vectors and $\alpha$ is the $(p \times r)$ matrix of error correction parameters that measure the speed of adjustment in $\Delta y_t$. Since the rank of $\Pi$ is related
to the number of cointegrating vectors, thus, if the rank of \( \Pi \) equals to \( p \) or full rank, then \( y_t \) is a stationary process. If the rank of \( \Pi \) is \( 0 < r < p \), implying that there are \( r \) cointegrating vectors and hence the group of time series contain a \((p-r)\) common trends. However, if the rank of \( \Pi \) is zero, then the variables in \( y_t \) are non-cointegrated. Here, two likelihood ratio (LR) test statistics, namely the trace and maximum eigenvalue statistics are used to determine the number of cointegrating vectors.

The trace statistic tests the \( H_0(r) \) against \( H_1(p) \), and is written as:

\[
\text{Trace} = -T \sum_{j=r+1}^{p} \ln(1-\hat{\lambda}_j) \tag{5}
\]

On the other hand, the maximum eigenvalue statistic tests the \( H_0(r) \) against \( H_1(r+1) \), which is given by:

\[
\text{Maximum eigenvalue} = -T \ln(1-\hat{\lambda}_{r+1}) \tag{6}
\]

In testing for long run PPP hypothesis in the bivariate case, nominal exchange rates and relative prices must exhibit only one cointegrating vector \((p-1)\) or one common trend, thus require the imposition of restriction on the coefficients of \( J \) long-run cointegrating vector in the form of \([1, -1]\). If the restriction test fails to reject the null hypothesis, then nominal exchange rates will move one-for-one with relative prices, suggesting that PPP holds in the long run.

**Bierens (1997) Non-parametric Cointegration Test**

The Bierens non-parametric cointegration test considers the general framework as:

\[
z_t = \pi_0 + \pi_1 t + y_t \tag{7}
\]

where \( \pi_0(q \times 1) \) and \( \pi_1(q \times 1) \) are optimal mean and trend terms, and \( y_t \) is a zero-mean unobservable process such that \( \Delta y_t \) is stationary and ergodic. The general framework assumes that \( z_t \) is observable \( q \)-variate process for \( t = 0, 1, 2, \ldots, n \).
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Estimation from some mild regularity conditions, or estimation of structural and/or nuisance parameters,
better specification of the data-generating process for $x_t$ are not required and thus this test is
completely non-parametric.

The Bierens's method is based on the generalized eigenvalues of matrices $A_m$ and $B_m + n^2 A_m^{-1}$, where $A_m$ and $B_m$ are defined in the following matrices:

\[ a_m = \frac{1}{n} \sum_{k=1}^{n} k^2 \left[ \frac{1}{n} \sum_{t=1}^{n} \cos(2k\pi(t-0.5)/n)z_t^2 \right] \times \left[ \frac{1}{n} \sum_{t=1}^{n} \cos(2k\pi(t-0.5)/n)z_t \right] \]

\[ b_m = \frac{1}{n} \sum_{k=1}^{n} k^2 \left[ \frac{1}{n} \sum_{t=1}^{n} \cos(2k\pi(t-0.5)/n) \Delta z_t \right] \times \left[ \frac{1}{n} \sum_{t=1}^{n} \cos(2k\pi(t-0.5)/n) \Delta z_t \right] \]

which are computed as sums of outer-products of weighted means of $z_t$ and $\Delta z_t$, and $n$ is the
sample size. To ensure invariance of the test statistics to drift terms, the weight functions of
$\cos(2k\pi(t-0.5)/n)$ are recommended here.

Similar to the properties of the Johansen and Juselius likelihood ratio method, the ordered
generalized eigenvalues of this non-parametric method are obtained as solution to the problem
\[ \text{det}(P_n - \lambda Q_n) = 0 \]
where $P_n = A_m$ and $Q_n = B_m + n^2 A_m^{-1}$ are
defined. Thus, it can be used to test hypothesis on the cointegration rank $r$.

To estimate $r$, two test statistics are used. First, Bierens (1997) derived the 'lambda-min'
\[ \hat{\lambda}_{m-r,m} \] , which corresponds to the Johansen's maximum likelihood procedure, to test for
the hypothesis of $H_0(r)$ against $H_1(r + 1)$. The critical values for this test are tabulated in the
same article. Second, Bierens's approach also provides the $g_m(r)$ which is computed from the
Bierens's generalized eigenvalues:

\[ \hat{g}_m(r) = \left( \prod_{k=1}^{r} \hat{\lambda}_{k,m} \right)^{-1} \quad \text{if } r = 0 \]
This statistic uses the tabulated optimal values (see Bierens, 1997, Table 1) for $r$, provided $r > q$, and $m = q$ is chosen when $r = n$. Then $\hat{g}_m(r)$ converges in probability to infinity if the true number of cointegrating vectors is unequal to $r$, and $\hat{g}_m(r) = O_p(1)$ if the true number of cointegrating vector is equal to $r$. Therefore, we have $\lim_{n \to \infty} P(r_n = r) = 1$.

Finally, a linear restriction on the cointegrating vectors in the form of $[1, -1]$ is needed for long run PPP. For this purpose, Bierens proposed the use of the trace and lambda-max statistics. The critical values of trace ($m = 2q, F_q(x) = \cos(2k\pi x)$) and lambda-max ($m = 2q, F_q(x) = \cos(2k\pi x)$) are given in Bierens (1997, Tables 3 and 4).

**EMPIRICAL RESULTS**

**Data**

This study is based on monthly data from 1974.1 to 2002.5 for five major ASEM countries: Indonesia, Malaysia, the Philippines, Singapore and Thailand, with the U.S. data as reference. The consumer price indices are used to construct the relative price series, which are the price of domestic to foreign (U.S.) prices. The nominal exchange rates are expressed as units of foreign currency per U.S. dollar. All the data used in this study are obtained from the International Financial Statistics database published by the International Monetary Fund. Both the exchange rates and relative prices are transformed into logarithm form.

**Unit Root Tests**

It is important to determine the characteristic of the individual series (in this case, the exchange rates and relative prices) before conducting the cointegration analysis. This is the fact that only variables of the same order of integration may constitute a potential cointegrating relationship. Specifically, cointegration means that the nominal exchange rate and relative
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may be individually non-stationary, but there may exist a linear combination of these two which is stationary. Thus, in a cointegrated system, the variables involved cannot move far apart from each other and any short-run deviation from the long-term trend will be

Tests for non-stationary behaviour in the time series of nominal exchange rates and relative prices, we use the non-parametric PP test (Phillips and Perron, 1988) and non-parametric and Guo (1993) Cauchy test #3 (BG3). The null hypotheses for both the PP and BG3 are nonstationarity and stationarity respectively. Table 1 and 2 report the results of the stationarity tests on both the nominal exchange rates and relative prices. The results from both PP and BG3 tests clearly indicate that both variables are not stationary in the level but are able to attain stationarity in the first-difference. In other words, all nominal exchange rates and relative prices are integrated of the same order one, or denoted as I(1). With these findings, we can proceed with the cointegration tests to check the validity of the long run PPP hypothesis.

Table 1
Unit Root Tests Results (Series in Level)

<table>
<thead>
<tr>
<th>Nominal Exchange Rates</th>
<th>Relative Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PP</td>
</tr>
<tr>
<td><strong>Indonesia</strong></td>
<td>-0.1251</td>
</tr>
<tr>
<td></td>
<td>(0.8160)</td>
</tr>
<tr>
<td><strong>Malaysia</strong></td>
<td>-1.6383</td>
</tr>
<tr>
<td></td>
<td>(0.7350)</td>
</tr>
<tr>
<td><strong>Philippines</strong></td>
<td>-0.3673</td>
</tr>
<tr>
<td></td>
<td>(0.9010)</td>
</tr>
<tr>
<td><strong>Singapore</strong></td>
<td>-2.6778</td>
</tr>
<tr>
<td></td>
<td>(0.7020)</td>
</tr>
<tr>
<td><strong>Thailand</strong></td>
<td>-0.5455</td>
</tr>
<tr>
<td></td>
<td>(0.7620)</td>
</tr>
</tbody>
</table>

Notes: p-values of both tests are given in brackets.
* and ** denote significant at the 5% and 1% levels respectively.
<table>
<thead>
<tr>
<th></th>
<th>Nominal Exchange Rates</th>
<th>Relative Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PP</td>
<td>BG-3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>-272.0997**</td>
<td>4.1177</td>
</tr>
<tr>
<td></td>
<td>(0.0090)</td>
<td>(0.15167)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>-319.0172**</td>
<td>1.0566</td>
</tr>
<tr>
<td></td>
<td>(0.0010)</td>
<td>(0.48249)</td>
</tr>
<tr>
<td>Philippines</td>
<td>-430.9464**</td>
<td>2.7912</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.21901)</td>
</tr>
<tr>
<td>Singapore</td>
<td>-320.7142**</td>
<td>4.5307</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.13829)</td>
</tr>
<tr>
<td>Thailand</td>
<td>-236.6784**</td>
<td>1.1593</td>
</tr>
<tr>
<td></td>
<td>(0.0010)</td>
<td>(0.45311)</td>
</tr>
</tbody>
</table>

Notes: $p$-values of both tests are given in brackets.

** denoted significant at the 1% level.

Johansen and Juselius (1990) Cointegration Test

Under the Johansen and Juselius method, we use the Akaike Information Criterion (AIC) to determine the order of the VAR model. Table 3 reports the trace and maximal eigenvalue statistics based on unrestricted intercepts and no trend in the VAR options. Both statistics are then used to determine the number of cointegrating vectors. In this bivariate case, if both the nominal exchange rates and relative prices are cointegrated, we proceed with the restriction on the cointegrating vector in the form of [1, -1]. The acceptance of the null hypothesis provides empirical support for the long run PPP hypothesis.

Results summarized in Table 3 show that both the trace and maximal eigenvalue statistics cannot reject the null hypothesis of no cointegrating vector ($r = 0$) for all the five ASEAN countries. In this case, there is no need to proceed with the restriction test on the cointegrating vector. These results are in line with those reported in Baharumshah and Ariff (1997), Aggarwal et al. (2000), and Wang (2000) using Johansen cointegration technique.
Table 3
Johansen and Juselius (1990) Cointegration Test Results

<table>
<thead>
<tr>
<th></th>
<th>Lag</th>
<th>$\lambda$-max</th>
<th>$\lambda$-trace</th>
<th>$\beta'$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$H_0$: $r = 0$</td>
<td>$H_0$: $r \leq 1$</td>
<td>$H_0$: $r = 0$</td>
<td>$H_0$: $r \leq 1$</td>
</tr>
<tr>
<td>Indonesia</td>
<td>7</td>
<td>6.134229</td>
<td>0.022675</td>
<td>6.156904</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2</td>
<td>11.21203</td>
<td>1.428881</td>
<td>12.64092</td>
</tr>
<tr>
<td>Philippines</td>
<td>2</td>
<td>7.244978</td>
<td>0.095913</td>
<td>7.340891</td>
</tr>
<tr>
<td>Singapore</td>
<td>1</td>
<td>8.377750</td>
<td>1.904240</td>
<td>10.28199</td>
</tr>
<tr>
<td>Thailand</td>
<td>8</td>
<td>11.33645</td>
<td>1.373445</td>
<td>12.70990</td>
</tr>
</tbody>
</table>

Note: The critical values for the trace and maximal eigenvalue statistics are tabulated in Osterwald-Lenum (1992)

Bierens (1997) Non-parametric Cointegration Test

Further analysis using the Bierens’s nonparametric cointegration method can serve to check the robustness of the Johansen and Juselius (1990) method in views of the superiority of non-parametric method at detecting cointegration when the data generating process is non-linear. Table 4 reports the results of the Bierens’s test. These results provide evidence of cointegration for Malaysia, the Philippines, Singapore and Thailand. By imposing the $[1, -1]$ restriction, Malaysia, Singapore and Thailand fail to reject the null hypothesis. The evidence of mean reversion in dollar denominated real exchange rates for these three ASEAN countries are in sharp contrast with earlier findings obtained from Johansen and Juselius method.

Table 4
Bierens (1997) Non-parametric Cointegration Test Results

<table>
<thead>
<tr>
<th></th>
<th>$\lambda$-min</th>
<th>$\gamma_m(r)$</th>
<th>$\beta'$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$H_0$: $r = 0$</td>
<td>$r = 0, 1, 2$</td>
<td>$H_0$: $\beta' = [1, -1]$</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.03113</td>
<td>3.52019</td>
<td>-</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.00395*</td>
<td>0.84960</td>
<td>31.45882926E+001</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.00280*</td>
<td>4.57014</td>
<td>23.64402085E+002</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.00787*</td>
<td>0.30551</td>
<td>54.53836448E+001</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.00227*</td>
<td>0.47225</td>
<td>96.79173390E+001</td>
</tr>
</tbody>
</table>

Note: * denotes significant at the 5% level.
As pointed out by Bierens (1997), the Bierens's method is in the same spirit with Johansen and Juselius (1990) approach. Therefore, in principle, both approaches should generate a similar outcome. Since the Bierens's method allows for non-linearity in the data generating process, the discrepancy between the findings from both approaches is interpreted as a consequence of significant non-linearity in the real exchange rate adjustment to PPP. According to Bierens (1997), deviation of Johansen test and estimation results from the corresponding non-parametric test may indicate mis-specification of the error-correction model. More specifically, Coakley and Fuertes (2001) explained that the non-linear adjustment process in the real exchange rate would cause the standard linear cointegration approach which assumes a constant speed of adjustment to present a mis-specification problem. In other words, the failure of Johansen and Juselius method to establish real exchange rate stationarity does not necessarily invalidate the long run PPP hypothesis. Instead, it is the presence of non-linearity that contributes to its poor performance at detecting cointegration.

CONCLUSIONS

In views of the profound significance of PPP hypothesis to international trade and finance, there has been an explosion of empirical research on this body of literature over the past few decades. Most of these earlier studies have generally make an implicit assumption that exchange rate behaviour is linear in nature (Taylor and Peel, 1997). However, with abounding evidence supporting the presence of non-linearity in exchange rate time series data, coupled with the growing literature suggesting real exchange rates adjust non-linearly towards its equilibrium PPP level, researchers could no longer take for granted that exchange rate movements are linearly dependent. Thus, this study attempts to address the issue of whether the underlying data generating process of time series data has strong bearing on the empirical cointegration testing of PPP hypothesis, in which the Johansen and Juselius (1990) method is widely employed.

To do that, this study employs both the Johansen and Juselius (1990) cointegration test and the recently proposed Bierens (1997) nonparametric cointegration methodology in a sequential way to test the purchasing power parity (PPP) hypothesis, with application on five major ASEAN economies—Indonesia, Malaysia, the Philippines, Singapore and Thailand. Using the Johansen and Juselius cointegration approach, the null hypothesis of no cointegrating vector for these five ASEAN countries cannot be rejected. Further analysis using the Bierens's method provides strong support for the PPP proposition for Malaysia, Singapore and Thailand. Since the Bierens method allows for non-linearity in the data generating process, the discrepancy between findings from both techniques is interpreted as a consequence of significant non-linearity in the real exchange rate adjustment to PPP. Specifically, these findings provide empirical evidence...
against the robustness of the Johansen’s method at detecting cointegration when the data generating process is non-linear. Thus, this study points to the need to examine the underlying dynamics of the data generating process before further empirical testing. If the data generating process is non-linear in nature, then it would be inappropriate to employ linear methods, like the Johansen and Juselius (1990) cointegration test, which has been widely employed in the empirical testing of PPP hypothesis.

REFERENCES


Hypothesis in Major Asian Economies: Generating Process Matter?


It is proposed to use the Engle-Granger two-step method for cointegration testing.


