The Linkage between Long-Run Purchasing Power Parity and CEPT scheme in ASEAN4 before and after Global Financial Crisis

Abdul Rahim Ridzuan, Maizatul Saadiah Mohamad and Elsadig Musa Ahmed

Faculty of Business Management, Universiti Teknologi Mara, 75300 Melaka, Malaysia.
Faculty of Business and Law, Multimedia University, 75450 Melaka, Malaysia.

Authors’ contributions
This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

ABSTRACT

This paper examines the validity of purchasing power parity (PPP) hypothesis for four founding members of the Association of Southeast Asian Nations (ASEAN4) with Singapore as base currency. A range of standard unit root tests and cointegration used in previous studies was applied to test long run PPP and four models were introduced based on the implementation of Common Effective Preferential Trade (CEPT) scheme and the impact of global financial crisis. The result from the unit root test has shown that all the data are stationary at I (1). There was no evidence of PPP detected between ASEAN4 and Singapore before the implementation of CEPT scheme using Johansen cointegration test in model 1. However, the evidence of long-run PPP were detected between Malaysia-Singapore, Thailand-Singapore and Philippines-Singapore after the implementation of CEPT scheme for model 2 and before the global financial crisis hits in U.S economy. Among these three countries, the strongest presence of PPP is found between Malaysia and Singapore where it carried both correctly signed and statistically significant variables. The strong evidence of PPP at this period has suggested that the Malaysia’s economy remains strong enough to cushion the effect of this recession due to its diversification economic policy.
1. INTRODUCTION

The issues of dynamic and the validity of Purchasing Power Parity (PPP) have been extensively investigated in international finance. Theoretically, Purchasing Power Parity (PPP) is one of the most important relationships that assert the change in exchange rates between two currencies that determined by the relative prices of two countries. Purchasing Power Parity is the cornerstone of many exchange rate determination models. Testing of PPP has continued to attract the attention of many researchers but it yields mixed results. Although there are voluminous studies investigating the validity Purchasing Power Parity and whether or it hold or not in the short and long run, there are still lack of studies examining the validity of Purchasing Power Parity with Common Effective Preferential Tariff (CEPT) scheme. The CEPT agreement, signed during the Summit, required that tariff rates levied on a wide range of products traded within the region to be reduced to 0-5%. Quantitative restrictions and other non-tariff barriers would also be eliminated. Although originally scheduled to be realized by 2008, the target of a free trade area in ASEAN has been continuously moved forward, so that it was to be established by the year 2002. In this study, we put our focus on ASEAN-4 Singapore countries (namely Malaysia, Indonesia, Thailand and Philippine). ASEAN-4 was the target location for this study because they are the origin countries that implement the CEPT scheme under AFTA and Singapore until currently are zero tariff. We may expect PPP to hold only in the long run because in the short run, market frictions such as transaction costs, taxation, trade restrictions and difference in price indices across countries, tend to interfere. The concept of PPP has a special meaning for ASEAN-4 countries because the ideal of PPP could be employed as a useful tool to select a common currency among ASEAN countries. Most studies have considered the US dollar or the Euro as the potential for the common currencies. The concept is founded in “the law of one price” the idea that absence of transaction costs, identical goods will have the same price in different markets.

1.1 An Overview of Trade Relations

Fig. 1 below reports the export volume between ASEAN-4 and Singapore from period of 1980 till 2008. The data are extracted from Direction of Trade statistic, International Monetary Fund (IMF).

Based on Fig. 1, it can be concluded that the amount of total export between ASEAN4 (Malaysia, Thailand, Indonesia and Philippines) and Singapore are showing upward trends except for Philippines from year 1980 till year 2008. This strong upward movement of trade or export is due to stronger economic base for ASEAN countries as well as the result of the implementation of AFTA between ASEAN4 and Singapore since 1994. Singapore has set a good example for other ASEAN countries as this is the first country that has fully implemented 0-5% tariff for fast track products. The downward trend of export can be seen clearly from the graph during the Asian Financial Crisis in 1997-1998 but recovering process in ASEAN4 especially in Malaysia and Singapore has slowly restored the exports between these countries. The evidence of PPP between ASEAN4 and Singapore is strongly believed to have connection with the uprising bilateral trade between these countries. As stated before, one of the conditions that will lead to the validity of PPP is the strength of bilateral trade relation between the two countries. The application of CEPT among ASEAN countries based on the reduction of tariff on goods and services has resulted in the trade among the ASEAN countries has increased tremendously in recent years. This indeed proves that the
introduction of CEPT scheme managed to facilitate the trade among the ASEAN countries. After 15 years of implementation of CEPT scheme, it is important to evaluate whether the good market in countries involved have been more integrated. Previous studies on the Law of One Price stated that “In an efficient market, all identical goods must have only one price” while the Purchasing Power Parity (PPP) theory uses the long term equilibrium exchange rate of two currencies to equalize their purchasing power. A lot of studies found that PPP hold in the long run, with this result CEPT scheme is one of the factors that leads to the law of one price.

![Fig. 1. Total Export between ASEAN4-Singapore (US dollar in million)](image)

The objective of this paper is to test whether the PPP hold in the long run among ASEAN4 by using Singapore as the base country. The PPP models introduced in this paper is categorized into two main sample sizes which are before the implementation of the CEPT scheme and after the implementation of the CEPT scheme. Four models are constructed according to this sample size. The sample size of the first model ranged between 1970 until 1993 to test the evidence of PPP before the implementation of the CEPT scheme while the other three models are constructed based on the period after the CEPT scheme implementation by including the impact of global crisis. The paper is organized as follows. The next section would briefly discuss the PPP theory and testing approach. Part 3.0 will explain the research methodologies while Part 4.0 will present the sources of data. The result were reported and analyzed in Part 5.0. Finally Part 6.0 is dedicated to the conclusion.

2. LITERATURE REVIEW

2.1 Introduction of PPP

Long run Purchasing Power Parity (PPP) to be hold is a one way of interpreting the PPP doctrine that real exchange rate must eventually return to PPP equilibrium level. If PPP holds empirically, changes in national price levels tends to equalize in the long run. This means that, the price of common basket should be similar across countries. This will increase the trade among the countries.
2.2 Literature Review for Purchasing Power Parity (PPP)

[1] investigates why a panel test of PPP should be allowed for heterogeneous means reversion. This paper analyses the properties of homogeneous and heterogeneous panel unit root test methodologies. Their finding highlights the importance of allowing for heterogeneous estimation when testing for unit root test in panel of exchange rates. A century of PPP confirmed by the role of nonlinearity by [2] that claims Purchasing Power Parity (PPP) has held over 20th century based on the strong evidence of stationary for century long real exchange rate for 20 countries. The paper by [3] however found much weaker evidence of PPP with alternative lag selection. They find strong evidence of non linear mean reversion in real exchange rate. [4] applies a range of univariate unit root tests including the Langragian multiplier (LM) and panel unit root tests to examine the PPP for 16 OECD countries. Their finding from the test, with and without structural breaks is that real exchange rates are not stationary inconsistent with PPP hypothesis. Later they incorporate two structural breaks in univariate LM test, for most countries the find that the real exchange rate are stationary. [5], examines the issues by drawing from a sample of five ASEAN countries (Malaysia, Indonesia, Philippines, Singapore and Thailand). For the purpose of this study, terms of trade regional and multilateral trade these liberalization for the countries are computed over the period (1967- 2000) to determine whether countries are moving towards regional or international term trade.

Purchasing Power Parity (PPP) and the impact of the East Asian currency crisis by [6] explores the impact of East Asian crisis from 1997-1998 on foreign exchange market and purchasing power parity within the region. The Asian economies examined are Hong Kong, Singapore, Thailand, Philippines, Indonesia, South Korea, Japan and Malaysia. The importance of changes in PPP upon in economy cannot be underestimated. Their result shows Indonesia has a usual relationship between Foreign exchange, Foreign CPI and Domestic CPI. [7] using monthly data during the current float, examines PPP for 7 Asian countries which are Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Thailand against United State (US). Using Johansen cointegration procedures, the author finds evidence of cointegration but could not accept the symmetry and proportionality restrictions. Another example, [8] used multivariate cointegration methodology to test PPP on the Malaysia ringgit for the period from 1973 (CPI) and 1984 (WPI) to 1997. This study suggests that the Malaysia’s real exchange rate follows a random walk contrary to the expectations of PPP equilibrium. It also confirms that the type of price index does matter in testing the PPP relation in this economy. Besides, [9] is using quarterly data from the first quarter of 1974 to the fourth quarter of 1997 for Japanese yen-based CPI and PPI-based real exchange rates with one and two breaks shows evidence in favour of long-run quasi-PPP for most of the southeast Asian currencies in terms of the Japanese yen by allowing changes in the mean of real exchange rates. They found weak evidence of PPP for these Southeast Asian exchange rates with the US dollar, the German mark and the Australian dollar.

Based on the past findings of PPP above, it can be concluded that PPP will most likely hold in the long run which can be seen from the result of Cointegration test. Therefore this paper use long span of data. Besides filling the gap of research interest, the finding of this paper would help us to give better understanding on the connection between CEPT scheme effect and the evidence of PPP.
3. EMPIRICAL METHODOLOGIES

3.1 Theoretical View of PPP Hypothesis

The basic building block of PPP is known as “Law of One Price” (LOP). The LOP states that in the absence of trade barriers, such as transportation costs, and tariff, competition will equalize the price of an identical and traded good across countries when prices are expressed in the same currency. PPP is the earliest and simplest version of exchange rate determination by looking on the relationship between prices (or inflation) in two countries. Following previous studies, it is possible to specify the PPP theory into the following absolute model (restricted version)

$$et = \alpha + \beta \left( \frac{Pt}{Pt^*} \right) + \epsilon_t$$

where $et$ is exchange rate (home currency / foreign currency), $Pt$ and $Pt^*$ are price indexes in home country and foreign country, respectively. Equation 1 implies that PPP holds when the estimated coefficient of price ratio is equal to unity ($\beta = 1$). The second version of PPP, unrestricted version can be obtained by log transform and the equation 1 was rearranged as follows.

$$\ln et = \alpha + \beta_1 \ln Pt + \beta_2 \ln Pt^* + \eta$$

Where $\ln et$ is the logarithm of the nominal exchange rate, defined as domestic price of foreign currency, $\ln Pt$ is the logarithm of domestic prices, $\ln Pt^*$ the logarithm of foreign prices, $\alpha$, $\beta_1$ and $\beta_2$ are the parameters, and $\eta$ is the error term. The restriction commonly imposed on parameters are $\alpha = 0$, $\beta_1 = 1$, and $\beta_2 = -1$. Taking the first difference of the absolute PPP yields

$$\Delta \ln et = \alpha + \Delta \beta_1 \ln Pt + \Delta \beta_2 \ln Pt^* + \eta$$

The PPP models introduced in this paper is categorized into two main sample sizes which are before the implementation of the CEPT scheme and after the implementation of the CEPT scheme. Four models are constructed according to this sample size. The first model’s sample size is ranged between 1970 until 1993 to test the evidence of PPP before the implementation of the CEPT scheme while the other three models are constructed based on the period after the CEPT scheme implementation. The model proposed can be view on Table 1 below. The estimation procedure that was applied in this study include unit root tests, Johansen Juselius Cointegration Analysis, Vector Error Correction Model (VECM), restriction on Cointegrating Vectors and selection of lag.

Table 1. Proposed Models

| Time period | Model | Model description | Period |
|-------------|-------|-------------------|--------|
| 1970-1993   | Model 1: Evidence of PPP before the CEPT implementation | Before CEPT implementation |
| 1994-2008   | Model 3: Evidence of PPP during Global Financial Crisis | After CEPT implementation |
| 1994-2009   | Model 4: Evidence of PPP after Global Financial Crisis | After CEPT implementation |
| 1994-2007   | Model 2: Evidence of PPP before Global Financial Crisis | After CEPT implementation |
3.2 Restriction on Cointegrating Vectors

The absolute form of our PPP model is:

\[ \Delta \ln e_t = \alpha + \beta_1 \ln P_t + \beta_2 \ln P^*_t + \eta \]

In turn, each coefficient in the model was set equal to 1. The null hypothesis in the exclusion restriction analysis tests if CPI for ASEAN4 countries equal to 1 and CPI for Singapore is statistically equivalent to -1. The hypothesis used for this test is as follow:

- Ho: \( \beta_1 = 1 \) and \( \beta_2 = -1 \)
- Ha: \( \beta_1 \neq 1 \) and \( \beta_2 \neq -1 \)

Reject Ho when probability for chi-square (2) is lesser than 5% significance level. Therefore, the rejection of null hypothesis implies that the PPP do not hold in absolute form.

3.3 Selection of Lag

The selection of lag for this paper is based on the AIC, which is computed as follows.

\[ AIC = \ln (\sum) + \frac{2m}{T} \]

Where \( m \) is the number of parameters estimated in the system as a whole, \( \sum \) is the determinant of the variance-covariance matrix of the system residuals and \( T \) is the number of observations.

The AIC is often used in model selection for non-tested alternatives where smaller values of the AIC are preferred. The selection of lag can also be determined manually by using the formula proposed by [10] as follows:

\[ k = 4 \left( \frac{T}{100} \right)^{1/4} \]

where \( T \) = number of observation.

4. SOURCE OF DATA

This study used monthly time series on “end of period” exchange rate (home currency / Singapore currency) and the Consumer Price Index for ASEAN4. These data are obtained from the International Financial Statistic 2010 by International Monetary Fund (IMF).

5. EMPIRICAL RESULT

This section discusses in details the empirical results generated through applying unit root tests and cointegration tools for every model introduced in this paper. This paper also runs VECM analysis to capture the strength of each model.

5.2 Results for ADF and PP Unit Root Tests for ASEAN4-Singapore

The ADF and PP are applied to test the stationarity of the exchange rates and the consumer price indexes for ASEAN4-Singapore countries. Results of the ADF and PP unit root tests for ASEAN4 are reported in Table 2. The figures in parentheses are the lag length determined
by the Aikake Critirion (AIC). The tables are separated into four main models since we want to differentiate the sample period based on before and after the implementation of CEPT scheme. The first model in Table 4 allocates the sample period before the implementation of CEPT which is from January 1970 until December 1993. For the ADF test, at 5% level, the nominal exchange rates for ASEAN4 could not reject the null hypothesis of non-stationary in level except for Thailand which shows the evidence of stationarity at trend and intercept. The null hypothesis of non-stationary for ASEAN4 is rejected at 1% significance level, after taking the first difference. This implies the high evidence of stationarity in these variables. The CPI for ASEAN4 could not reject the null hypothesis of non-stationarity in level but after first difference, all the CPI are easily rejected at 1% significance level which also reflects the existence of high stationarity in these variables. The other three models are tested based on after the implementation of CEPT scheme according to three different range of sample period. The result showed that the three model’s nominal exchange rates as well as consumer price index for ASEAN4 countries could not reject the null hypothesis of non-stationary in level. After first difference, the null hypothesis of non-stationary is rejected at 5% significance level for Indonesia at both constant and trend with intercept while the null hypothesis for the Philippines, Malaysia and Thailand are rejected at 1% significance level for Model 2. In Model 3, the evidence of stationary is detected at first difference for Thailand’s consumer price index. Therefore, the more powerful unit root test known as PP unit root should be tested to solve this problem. The null hypothesis of non-stationary for Indonesia and Philippine nominal exchange rate and consumer price index are rejected at 1% significant level proving deeper evidence of stationary. In Model 4, all data for ASEAN4 countries showed that it were not significant at level but significant at 1% level after first difference proving that the data are stationary. The result for PP unit root test is presented in at the right side of the table. At first, we fail to reject the null hypothesis of non stationarity at 5% significance level for nominal exchange rate and CPI for both before and after the implementation of CEPT scheme sample periods. After first difference, the null of non stationarity is easily rejected at 1% significance level for both variables in that in all model introduced in this research paper. Hence, we can conclude that all the variables tested are integrated of order one, I (1).

Once all series are confirmed to be categorized as I (1), the Johansen-Juselius test is used to test whether the CPI and exchange rates exhibit fundamental long-run relationship between each other. The results for Johansen-Juselius cointegration test for Model 1 which were the period before the implementation of the CEPT scheme for ASEAN4-Singapore countries can be viewed in Table 3. It is shown that the value of trace statistic and max-eigen value for each ASEAN4 countries are smaller than the 5% and 1% critical values. Therefore, we fail to reject the null hypothesis of no cointegrating vector found in the long run.

Since in this study puts deeper focus on the effect of the implementation of CEPT scheme in ASEAN countries was given, therefore, it is already predicted that there should be no long run relationship among the variables before this scheme is implemented. During this time period, it is believed that the intra-trade among the original ASEAN countries remained low since there is no agreement among the ASEAN leaders on tariff reduction for the goods traded. Therefore, it is hard to find the evidence of Law of One Price because there are barriers of transportation costs and high tariff and non tariff barriers among these Original ASEAN countries. Subsequently, we run the Johansen-Juselius cointegration test for the period after the implementation of CEPT scheme for all ASEAN4 countries which can be divided into three models. Here, we introduce one dummy variable known as DCRISIS1 for tested countries for all three models. The dummy variable role here is to capture the
economic shock or Asian financial crisis which begins from July 1997 till the end of December 1998. The inclusion of dummy variable here is very important in order to get more precise results for this analysis. In addition, we add another dummy variable known as DCRISIS2 to capture the recent global financial crisis that occurred in U.S in model 3 and model 4. Although the primary study only used nominal exchange rates between ASEAN4 countries and Singapore, the inclusion of DCRISIS2 is very important since the U.S economy have some effect on the exchange rate movement of ASEAN4 countries as U.S is one of the largest trading partners for ASEAN countries.

In model 2, the maximum eigen value and trace statistics for Thailand showed that the null hypothesis of zero \((r=0)\) cointegrating vector is rejected using 99\% critical value but the null hypothesis of at most one cointegrating vector could not be rejected at 1\% significance level. This implies that there is at least one cointegrating vector offers a stable relationship among variables. We obtain similar result for Malaysia where at least one cointegrating vector exists among variables as the null hypothesis of no cointegrating vector is rejected but the null hypothesis of at most one cointegrating vector could not be rejected by both trace statistic and max-eigen values. Result from the Philippines also shows that the null hypothesis of zero \((r=0)\) cointegrating vector is rejected using 95\% critical value but the null hypothesis of at most one cointegrating vector could not be rejected at 5\% significance level for both trace statistics and max-eigen values. Lastly, the result from Indonesia cointegration test shows us that there is no long run relationship between the variables for Indonesia as their trace statistics and max-eigen values are smaller than 1\% and 5\% critical values which failed to reject the null hypothesis. There is an evidence of long run relationship in model 3 after the implementation of CEPT scheme for Thailand and Philippines. The null hypothesis of at most one cointegrating vector could not be rejected at 1\% significance level for both Thailand and Philippine while Malaysia and Indonesia do not show any sign of long run cointegration given at that sample period of time. We fail to detect any long-run cointegration in Model 4 for all ASEAN4 countries. This may due to slower recovery pace for all the countries after the global financial cr.

Table 4 report the long-run cointegrating vectors obtained from Johansen-Juselius cointegration tests for the period after implementation of CEPT scheme. From the theory, it is expected that the coefficient for domestic (foreign) price level should be positive (negative). Result from model 2 showed that Malaysia PPP is the only model that carried all the expected signs correctly and statistically significant. The PPP for Thailand carried all the wrong signs. The coefficient for the Philippines' price level is correctly signed, however it is insignificant. In model 3, we found out that strong evidence of PPP is still detected for Malaysia and this strong evidence was supported as both the coefficient for price level in Malaysia and price level for Singapore carried out all the right expected sign and significant at 1\% significance level. For Philippines model, the evidence of PPP is weak due to wrong expected sign found at price level for Singapore and the country price level was not significant. Hence, we found strong evidence of PPP in the case of Malaysia-Singapore. As a conclusion, the effect of reduction on tariff and non-tariff barriers for goods especially the inclusion list goods under the CEPT scheme between Malaysia and Singapore lead to an evidence of PPP in model 2 and model 3. In model 3, the PPP was detected strongly between Malaysia and Singapore although at that period, U.S's economy was affected by global financial crisis.
### Table 2. ADF and PP unit root test

| ASEAN4- Singapore | DF/ADF Unit Root Test | PP Unit Root Test | Condition for JJ Test |
|-------------------|------------------------|-------------------|-----------------------|
|                   | Level | First Difference | Level | First Difference | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Malaysia          |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexmly           | 1.7987 (0) | -1.0535 (0)  | -14.939 (0)$a$ | -15.232 (0)$a$ | 1.6264 (5)  | -1.1325 (5) | -14.995 (3)$a$ | -15.159 (7)$a$ | Pass |
| Lnccpimly         | -0.9786 (14) | -2.0089 (14) | -5.2753 (13)$a$ | -5.3334 (13)$a$ | -1.1704 (12) | -2.2706 (12) | -9.3035 (6)$a$ | -9.1090 (5)$a$ | Pass |
| Indonesia         |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexind           | -0.3551 (0) | -2.4415 (0)  | -16.175 (0)$a$ | -16.174 (0)$a$ | -0.3653 (1)  | -2.5470 (3) | -16.170 (2)$a$ | -16.141 (2)$a$ | Pass |
| Lnccpindlnd       | -2.3600 (14) | -2.3042 (14) | -3.6574 (13)$a$ | -4.0161 (13)$a$ | -2.2687 (4)  | -0.5738 (4)  | -11.658 (6)$a$ | -11.920 (9)$a$ | Pass |
| Thailand          |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexthd           | -0.6123 (0) | -3.8293 (1)$b$ | -16.000 (0)$a$ | -15.972 (0)$a$ | -0.5789 (7)  | -0.6157 (5) | -15.997 (7)$a$ | -15.966 (7)$a$ | Pass |
| Lnccpithd         | -1.7327 (6) | -1.9327 (6)  | -3.7736 (5)$a$ | -3.9904 (5)$a$ | -1.6656 (11) | -1.1002 (11) | -12.617 (8)$a$ | -12.699 (8)$a$ | Pass |
| Philippines       |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexlp            | 0.2284 (8) | -1.8891 (8)  | -5.8612 (7)$a$ | -5.8939 (7)$a$ | -1.1861 (6)  | -2.4483 (7) | -20.649 (8)$a$ | -20.683 (7)$a$ | Pass |
| Lnccpilp          | -2.0539 (14) | -2.4039 (14) | -5.8690 (5)$a$ | -6.3581 (5)$a$ | -2.2687 (4)  | -0.5738 (4)  | -11.658 (6)$a$ | -11.920 (9)$a$ | Pass |
| Malaysia          |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexmly           | 1.8501 (0) | -2.0809 (0)  | -13.865 (0)$a$ | -13.864 (0)$a$ | -1.8174 (3)  | -2.0780 (4)  | -13.859 (3)$a$ | -13.861 (3)$a$ | Pass |
| Lnccpimly         | -1.5582 (1) | -1.8110 (1)  | -11.249 (0)$a$ | -11.349 (0)$a$ | -1.7487 (4)  | -1.9165 (4)  | -11.277 (3)$a$ | -11.373 (2)$a$ | Pass |
| Indonesia         |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexind           | -1.7912 (9) | -2.0156 (9)  | -3.4607 (13)$a$ | -3.5843 (13)$a$ | -1.7154 (2)  | -1.7793 (3)  | -11.570 (1)$a$ | -11.531 (2)$a$ | Pass |
| Lnccpindlnd       | 0.7408 (12) | -1.7252 (12) | -3.9225 (4)$a$ | -3.9457 (4)$a$ | 0.1119 (1)  | -1.7849 (3)  | -15.796 (4)$a$ | -15.783 (4)$a$ | Pass |
| Thailand          |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexthd           | -2.3173 (7) | -2.1550 (7)  | -5.3235 (6)$a$ | -5.4566 (6)$a$ | -2.3303 (1)  | -2.1676 (2)  | -11.261 (3)$a$ | -11.297 (4)$a$ | Pass |
| Lnccpithd         | -1.6438 (0) | -1.8345 (0)  | -13.101 (0)$a$ | -13.138 (0)$a$ | -1.5563 (5)  | -1.8860 (5)  | -13.158 (6)$a$ | -13.176 (5)$a$ | Pass |
| Philippines       |       |                  |       |                  | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend | No Trend | With trend |
| Lnexlp            | -1.5988 (2) | -0.8590 (2)  | -7.4385 (1)$b$ | -7.5838 (1)$a$ | -1.6027 (4)  | -0.7095 (4)  | -13.599 (4)$a$ | -13.721 (3)$a$ | Pass |
| Lnccpilp          | -1.1425 (8) | -1.7410 (8)  | -4.1622 (7)$a$ | -4.2287 (7)$a$ | -1.0541 (8)  | -1.5423 (8)  | -6.1959 (1)$a$ | -6.2150 (1)$a$ | Pass |
Table 2 Continued....

| Model 3. Evidence of PPP (during Global Financial Crisis) |
|---------------------------------------------------------|
| **Malaysia**                                            |
| Lnexmly                                                   |
| 0.4463 (2)                                               |
| Lncpimly                                                 |
| -0.5417 (1)                                              |
| **Indonesia**                                           |
| Lnexind                                                  |
| -0.8442 (2)                                              |
| Lncpiind                                                 |
| -1.2893 (8)                                              |
| **Thailand**                                            |
| Lnexthd                                                  |
| -2.3591 (7)                                              |
| Lncpithd                                                 |
| -1.7326 (12)                                             |
| **Philippines**                                         |
| Lnexpip                                                  |
| -1.3649 (2)                                              |
| Lncpiplp                                                 |
| -1.0301 (1)                                              |
| **Model 4. Evidence of PPP (after Global Financial Crisis)** |
| **Malaysia**                                            |
| Lnexmly                                                   |
| -1.7453 (2)                                              |
| Lncpimly                                                 |
| -0.7405 (1)                                              |
| **Indonesia**                                           |
| Lnexind                                                  |
| -0.8805 (2)                                              |
| Lncpiind                                                 |
| -1.4376 (8)                                              |
| **Thailand**                                            |
| Lnexthd                                                  |
| -2.4919 (7)                                              |
| Lncpithd                                                 |
| -1.9597 (1)                                              |
| **Philippines**                                         |
| Lnexpip                                                  |
| -1.4861 (2)                                              |
| Lncpiplp                                                 |
| -1.0964 (1)                                              |

Notes: Lag length selected by using Schwarz info Criterion. A maximum of 13 lags are used for Model 1, 14 for Model 2 and 15 for Model 3 countries listed above. The null hypothesis is that the series is non-stationary, or contain unit root. Figures within parentheses indicate the number of lag structure for DF/ADF Test and lag truncation selected automatically by Newey and West Bandwidth using Barlett Kernal Spectral estimation method for PP Test. All variables are transformed by taking their natural logarithm. A and b denotes significance at 1% and 5% level. JJ refer to Johansen Juselius Test.
Table 3. Johansen Juselius cointegration test

| Country       | Lag | Hypothesis | Eigen Value | Trace Statistic | Critical Value (1%) | Critical Value (5%) | Critical Value (1%) | Critical Value (5%) |
|---------------|-----|------------|-------------|-----------------|---------------------|---------------------|---------------------|---------------------|
| **Model 1. Evidence of PPP before the CEPT implementation** |     |            |             |                 |                     |                     |                     |                     |
| Thailand      | 16  | None       | 0.060254    | 25.68823       | 35.65               | 29.79               | 17.46295            | 25.52               | 21.13               |
|               |     | At most 1  | 0.025001    | 8.225282       | 20.04               | 15.49               | 7.114698            | 18.63               | 14.26               |
|               |     | At most 2  | 0.003944    | 1.110584       | 6.65                | 3.84                | 1.110584            | 6.65                | 3.84                |
| Philippines   | 16  | None       | 0.048505    | 21.49768       | 35.65               | 29.79               | 13.97156            | 25.52               | 21.13               |
|               |     | At most 1  | 0.024734    | 7.526114       | 20.04               | 15.49               | 7.037562            | 18.63               | 14.26               |
|               |     | At most 2  | 0.001737    | 0.488552       | 6.65                | 3.84                | 0.488552            | 6.65                | 3.84                |
| Malaysia      | 17  | None       | 0.062356    | 26.28184       | 35.65               | 29.79               | 18.02779            | 25.52               | 21.13               |
|               |     | At most 1  | 0.027004    | 8.254059       | 20.04               | 15.49               | 7.665000            | 18.63               | 14.26               |
|               |     | At most 2  | 0.002102    | 0.589059       | 6.65                | 3.84                | 0.589059            | 6.65                | 3.84                |
| Indonesia     | 110 | None       | 0.060254    | 25.68823       | 35.65               | 29.79               | 17.46295            | 25.52               | 21.13               |
|               |     | At most 1  | 0.025001    | 8.225282       | 20.04               | 15.49               | 7.114698            | 18.63               | 14.26               |
|               |     | At most 2  | 0.003944    | 1.110584       | 6.65                | 3.84                | 1.110584            | 6.65                | 3.84                |
| **Model 2. Evidence of PPP before Global Financial Crisis** |     |            |             |                 |                     |                     |                     |                     |                     |
| Thailand      | 11  | None       | 0.197267    | 41.80384       | 35.65               | 29.79               | 34.29830            | 25.52               | 21.13               |
|               |     | At most 1  | 0.043444    | 7.525545       | 20.04               | 15.49               | 6.928862            | 18.63               | 14.26               |
|               |     | At most 2  | 0.003818    | 0.596683       | 6.65                | 3.84                | 0.596683            | 6.65                | 3.84                |
| Philippines   | 12  | None       | 0.129608    | 34.39294       | 35.65               | 29.79               | 21.51580            | 25.52               | 21.13               |
|               |     | At most 1  | 0.065679    | 12.87714       | 20.04               | 15.49               | 10.52992            | 18.63               | 14.26               |
|               |     | At most 2  | 0.015029    | 2.347224       | 6.65                | 3.84                | 2.347224            | 6.65                | 3.84                |
| Malaysia      | 19  | None       | 0.297935    | 60.28946       | 35.65               | 29.79               | 55.88933            | 25.52               | 21.13               |
|               |     | At most 1  | 0.020856    | 4.400132       | 20.04               | 15.49               | 3.39036             | 18.63               | 14.26               |
|               |     | At most 2  | 0.006750    | 1.070096       | 6.65                | 3.84                | 1.070096            | 6.65                | 3.84                |
| Indonesia     | 19  | None       | 0.031320    | 8.407252       | 35.65               | 29.79               | 5.027737            | 25.52               | 21.13               |
|               |     | At most 1  | 0.020403    | 3.379516       | 20.04               | 15.49               | 3.257064            | 18.63               | 14.26               |
|               |     | At most 2  | 0.000775    | 0.122452       | 6.65                | 3.84                | 0.122452            | 6.65                | 3.84                |
| Model 3. Evidence of PPP during Global Financial Crisis | Johansen Juselius Cointegration Test after CEPT implementation (1994-2008) |
|-----------------------------------------------------|-------------------------------------------------------------|
| Thailand                                            | None                                                        |
| At most 1                                           | 0.152706                                                   |
| At most 2                                           | 0.046263                                                   |
| At most 2                                           | 0.016935                                                   |
| At most 1                                           | 0.28714                                                    |
| At most 2                                           | 0.001737                                                   |
| At most 1                                           | 0.137282                                                   |
| At most 2                                           | 0.01204                                                    |
| At most 1                                           | 0.29026                                                    |
| At most 2                                           | 0.04632                                                    |
| At most 1                                           | 0.058251                                                   |
| At most 2                                           | 0.015834                                                   |
| At most 1                                           | 0.24342                                                    |
| At most 2                                           | 0.054223                                                   |
| At most 1                                           | 0.017706                                                   |
| At most 2                                           | 0.001429                                                   |
| At most 1                                           | 0.038534                                                   |
| At most 2                                           | 0.040526                                                   |
| At most 2                                           | 0.006588                                                   |
| At most 1                                           | 0.104526                                                   |
| At most 2                                           | 0.051479                                                   |
| At most 2                                           | 3.69E-05                                                   |
| At most 1                                           | 0.036077                                                   |
| At most 2                                           | 0.027591                                                   |
| At most 2                                           | 0.004114                                                   |
| At most 2                                           | 0.034898                                                   |
| At most 1                                           | 0.020390                                                   |
| At most 2                                           | 0.001420                                                   | |

| Philippines                                         | None                                                        |
| At most 1                                           | 39.12626                                                   |
| At most 2                                           | 10.95606                                                   |
| At most 2                                           | 2.903565                                                   |
| At most 1                                           | 24.66045                                                   |
| At most 2                                           | 28.17020                                                   |
| At most 1                                           | 5.001055                                                   |
| At most 2                                           | 2.9026                                                    |
| At most 1                                           | 29.66145                                                   |
| At most 2                                           | 5.145860                                                   |
| At most 1                                           | 24.32442                                                   |
| At most 2                                           | 12.75735                                                   |
| At most 1                                           | 3.28007                                                   |
| At most 2                                           | 0.243087                                                   | |

| Malaysia                                            | None                                                        |
| At most 1                                           | 25.43518                                                   |
| At most 2                                           | 9.429807                                                   |
| At most 2                                           | 5.145860                                                   |
| At most 1                                           | 2.432442                                                   |
| At most 2                                           | 12.75735                                                   |
| At most 1                                           | 3.28007                                                   |
| At most 2                                           | 0.243087                                                   | |

| Indonesia                                          | None                                                        |
| At most 1                                           | 26.52                                                      |
| At most 2                                           | 25.52                                                      |
| At most 1                                           | 25.52                                                      |
| At most 2                                           | 21.13                                                      |
| At most 1                                           | 15.49                                                      |
| At most 2                                           | 3.84                                                       |
| At most 1                                           | 29.79                                                      |
| At most 2                                           | 28.17020                                                   |
| At most 1                                           | 15.49                                                      |
| At most 2                                           | 3.84                                                       |
| At most 1                                           | 25.52                                                      |
| At most 2                                           | 21.13                                                      |
| At most 1                                           | 15.49                                                      |
| At most 2                                           | 3.84                                                       |
| At most 1                                           | 15.49                                                      |
| At most 2                                           | 3.84                                                       | |

| Model 4. Evidence of PPP after Global Financial Crisis | Johansen Juselius Cointegration Test after CEPT implementation (1994-2009) |
|------------------------------------------------------|-------------------------------------------------------------|
| Thailand                                            | None                                                        |
| At most 1                                           | 0.085534                                                   |
| At most 2                                           | 0.045026                                                   |
| At most 2                                           | 0.006588                                                   |
| At most 1                                           | 0.104526                                                   |
| At most 2                                           | 0.051479                                                   |
| At most 2                                           | 3.69E-05                                                   |
| At most 1                                           | 0.036077                                                   |
| At most 2                                           | 0.027591                                                   |
| At most 2                                           | 0.004114                                                   |
| At most 2                                           | 0.034898                                                   | |

| Philippines                                         | None                                                        |
| At most 1                                           | 25.43518                                                   |
| At most 2                                           | 9.429807                                                   |
| At most 2                                           | 5.145860                                                   |
| At most 1                                           | 2.432442                                                   |
| At most 2                                           | 12.75735                                                   |
| At most 1                                           | 3.28007                                                   |
| At most 2                                           | 0.243087                                                   | |

| Malaysia                                            | None                                                        |
| At most 1                                           | 25.43518                                                   |
| At most 2                                           | 9.429807                                                   |
| At most 2                                           | 5.145860                                                   |
| At most 1                                           | 2.432442                                                   |
| At most 2                                           | 12.75735                                                   |
| At most 1                                           | 3.28007                                                   |
| At most 2                                           | 0.243087                                                   | |

| Indonesia                                          | None                                                        |
| At most 1                                           | 25.43518                                                   |
| At most 2                                           | 9.429807                                                   |
| At most 2                                           | 5.145860                                                   |
| At most 1                                           | 2.432442                                                   |
| At most 2                                           | 12.75735                                                   |
| At most 1                                           | 3.28007                                                   |
| At most 2                                           | 0.243087                                                   | |

Notes: a and b denote rejection of the hypothesis at 1% and 5% critical values. The optimum lag length is selected once all the residual free from autocorrelation. None that r indicates the number of cointegrating vectors where none represents r=0, at most 1 represents r ≤ 1, and at most 2 represents r ≤ 2. The model above proposed by [11]
5.3 Cointegration Analysis for ASEAN4

The existence of strong PPP for Malaysia and Singapore have proven that the goods market between Malaysia and Singapore are highly integrated. Additional reason that might contribute to this evidence is the geographical factor as Malaysia is situated closer to Singapore compared to other ASEAN countries and therefore, the activities of goods trading are more accessible due to cheaper transportation cost. Besides, Singapore is also one of the closest trading partners for Malaysia as initially showed from the introduction part.

5.4 VECM Analysis for ASEAN

Table 4. Long run cointegrating vectors

| Cointegrating Vector. \( \text{Inet} = \alpha + \beta_1 \text{lnPt} + \beta_2 \text{lnPt}^* + \eta \) where \( \beta_1 \) is expected to be positive and \( \beta_2 \) is expected to be negative |
|-----------------|-------------------|
| Model 2         | Thailand          |
| Evidence of PPP | \( \text{Inet} = -17.78 - 0.62\text{LNCPITHD} + 5.15\text{LNCPISGP}^* + \eta \) |
| before Global   | Philippines       |
| Financial Crisis| \( \text{Inet} = -23.52 + 0.57\text{LNCPIPLP} + 5.23\text{LNCPISGP} + \eta \) |
| (after CEPT     | Malaysia          |
| implementation) | \( \text{Inet} = 18.31 + 3.31\text{LNCPIMLS}^a - 7.12\text{LNCPISGP}^a + \eta \) |

Notes: \( a \) and \( b \) denote significance at 1% and 5% levels. \( \eta \) is residual.

Model 3

| Evidence of PPP | Philippines       |
|-----------------| \( \text{Inet} = -4.41 + 1.16\text{LNCPIPLP} + 0.55\text{LNCPISGP}^* + \eta \) |
| during Global   | Malaysia          |
| Financial Crisis| \( \text{Inet} = 10.74 + 3.75\text{LNCPIMLY}^a - 6.32\text{LNCPISGP}^a + \eta \) |

Notes: \( a \) and \( b \) denote significance at 1% and 5% levels. \( \eta \) is residual.

5.5 Restriction Test

Next, we are interested to test whether the PPP holds in absolute form. The findings of cointegrating vector allowed us to impose restriction on nominal exchange rates and the CPI for Thailand, the Philippines, and Malaysia. If the PPP holds in absolute form, \( \beta_1 \) should equal to 1 and \( \beta_2 \) should equal to -1. The following hypotheses will be tested.

\[ \text{Ho: } \beta_1 = 1 \text{ and } \beta_2 = -1 \]
\[ \text{Ha: } \beta_1 \neq 1 \text{ and } \beta_2 \neq -1 \]

The results of the restriction tests for model 2 and model 3 are reported as Table 5. In both models, the Chi-Square test statistics rejected the restrictions of unity for price variables. This means that all models are not hold in absolute version of PPP although long run cointegrating vector are detected. Therefore, the PPP models hold in the relative version.
5.6 Short Run Dynamic ASEAN4-Singapore for Model 2 and Model 3

Lastly, we are interested to know the short-run dynamic fashion of PPP. Based on Table 6, Thailand and Malaysia PPP models had the negative sign for ECT coefficient while in Table 7, Malaysia model is the only model that had negative sign while Philippine model had the positive sign. These negative error-correction term coefficients (ECTs) suggested that when there is a deviation in the short-run, exchange rate will adjust towards the long-run equilibrium (converges). The rate of response is rapid in the case of Malaysia (0.23) while it is slower for Thailand (0.10). The ECT coefficient for the Philippines is positive for both model 2 and model 3 and this means that whenever there is a shock to the system, the exchange rate will diverge hence has a weaker evidence of PPP. Based on Table 7, the rate of response for Malaysia is slightly decrease from (0.23) to (0.22) and Philippine from (0.11) to (0.10) because of the impact global financial crisis occurred in year 2008.

Table 6. The Short-run Error-correction Model 2

| Model 2 | Country     | Coefficient for error-correction term |
|---------|-------------|---------------------------------------|
| Evidence of PPP before Global Financial Crisis (after CEPT implementation) | Thailand | -0.10<sup>a</sup> |
|         | Philippines | 0.11<sup>a</sup>                     |
|         | Malaysia   | -0.23<sup>a</sup>                    |

*Notes: a and b denote significance at 1% and 5% levels.*

Table 7. The Short-run Error-correction Model 3

| Model 3 | Country     | Coefficient for error-correction term |
|---------|-------------|---------------------------------------|
| Evidence of PPP during Global Financial Crisis (after CEPT implementation) | Philippines | 0.10<sup>a</sup> |
|         | Malaysia   | -0.22<sup>a</sup>                    |

*Notes: a and b denote significance at 1% and 5% levels.*

6. CONCLUSION

This paper applied the cointegration test to investigate the evidence of Purchasing Power Parity (PPP) before and after the implementations of Common Effective Preferential Tariff (CEPT) Scheme between ASEAN4 and Singapore. The summary of the result tested on model 1, 2, 3 and 4 can be viewed in following Table 8.
There is no evidence of PPP detected between ASEAN4 and Singapore before the implementation of CEPT scheme. This may due to the existence of tariff and non-tariff barriers of the good and services among the ASEAN4 and Singapore that leads to a failure of PPP theory. However, the evidence of long-run PPP was detected between Malaysia-Singapore, Thailand-Singapore and Philippines-Singapore after the implementation of CEPT scheme under the AFTA plan for model 2 before the global financial crisis occurred in U.S. Among these three countries, the strongest presence of PPP was found between Malaysia and Singapore where it carried both correctly signed and statistically significant variables. In addition, the RM/SD responses fast when there is a shock to prices. This implies that CEPT Scheme is fully implemented between Malaysia and Singapore where the integration of goods market between these countries is significantly high. While the evidence of PPP for Thailand and the Philippines seems weaker due to its contradicted expected sign. In Model 3, the existence of PPP is strongly detected for Malaysia-Singapore, and weakly detected for Philippines-Singapore during the global financial crisis that hits U.S economy. The strong evidence of PPP at this period suggest that the Malaysia’ economy is still strong enough to cushion the effect of this recession due to its diversified policy. In Model 4, we fail to detect any evidence of PPP for ASEAN4-Singapore. This shows that the ASEAN4-Singapopre countries still in the progress of recovery after global recession. Here we come out with the conclusion that although the progression of CEPT scheme is already takes place after its implementation on 1994, the evidence of PPP might also strongly depend on the condition of the economy tested in this research paper besides other related factors that relate to PPP evidence.

### Table 8. Summary of testing the evidence of PPP for ASEAN4-Singapore

| Model | Evidence of PPP | Strength of the PPP evidence |
|-------|-----------------|-----------------------------|
|       | Yes | No | Strong | Weak |
| **Before the CEPT scheme implementation** | | |
| Model 1. Evidence of PPP before the CEPT implementation | | |
| Thailand | √ | | | |
| Malaysia | √ | | | |
| Philippines | √ | | | |
| Indonesia | | | | |
| **After the CEPT scheme implementation** | | |
| Model 2. Evidence of PPP before Global Financial Crisis | | |
| Thailand | √ | | | |
| Malaysia | √ | | | |
| Philippines | √ | | | |
| Indonesia | | | | |
| Model 3. Evidence of PPP during Global Financial Crisis | | |
| Thailand | √ | | | |
| Malaysia | √ | | | |
| Philippines | √ | | | |
| Indonesia | | | | |
| Model 4. Evidence of PPP during Global Financial Crisis | | |
| Thailand | √ | | | |
| Malaysia | √ | | | |
| Philippines | √ | | | |
| Indonesia | | | | |
COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kees G Koedijk, Ben Tirms, Mathhijs A, van Dijk. Why panel tests on Purchasing Power Parity should allow for heterogeneous mean reversion. Journal of International Money and Finance. 2011;30:246-267.
2. Hyeongwoo Kim, Young-kyu Moh. A century of purchasing power parity confirmed: the role of nonlinearity. Journal of International Money and Finance. 2010;29:1398-1405.
3. Lopez, Claude & Murray, Christian J, Papell, David H. State of the Art Unit Root Tests and Purchasing Power Parity. Journal of Money, Credit and Banking. 2005;37(2):361-69.
4. Paresh Kumar Narayan. The purchasing power parity revisited: New evidence for 16 OECD countries from panel unit root test with structural breaks. Journal of International finance and Money. 2008;18:137-146.
5. Ahmad Zubaidi Baharumshah, Kevin Odulukwe onwuka, Muzafar Shah Habibullah. Is a regional trade bloc a prelude to multilateral trade liberalization? Empirical evidence from the ASEAN-5 economies. Journal of Asian Economies. 2007;18:384-402.
6. R.Zurbruegg, L.A Ilsopp. Purchasing power parity and the impact of the EAST Asian currency crisis. Journal of Asian Economies. 2004;15:739-758.
7. Wang P. Testing PPP for Asian countries during the recent floating period. Applied Economics Letters. 2000;7:545–48.
8. Goh Soo Khoon, Dawood M, Mithani. Deviation from Purchasing Power Parity: Evidence from Malaysia, 1973–1997. Asian Economic Journal. 2000;14(1):71-85.
9. Aggarwal R, Montanes A, Ponz M. Evidence of Long-Run Purchasing Power Parity: Analysis of Real Asian Exchange Rates in terms of the Japanese Yen. Japan and the World Economy. 2000;12:351–361.
10. Schwert GW. Effects of Model Specification on Tests for Unit Roots in Macroeconomic Data. Journal of Monetary Economics. 20:73–103.
11. Johansen S, Juselius K. Maximum likelihood estimation and inference on cointegration with application to the demand for money. Oxford Bulletin of Economics and Statistics. 1990;52:169—209.

© 2014 Ridzuan et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/3.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=540&id=25&aid=4819