Revisiting the Test of Purchasing Power Parity and Structural Breaks of East Asian Countries

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ABSTRACT

This paper re-examines the long-run purchasing power parity (PPP) relationship for five Asian countries' (Malaysia, Singapore, Indonesia, South Korea and Thailand) relative to US dollars during a period with structural breaks. The result indicates the evidence of PPP for all the countries with relative to the USA after allowing for a single break in the fourth quarter of 2008 and/or in the fourth quarter of 1997. Nevertheless, allowing for multiple breaks is warranted when testing the validity of long-run PPP for Asian countries because there is evidence that Asian countries have been impacted by 1997 Asian crisis and 2008 US financial crisis. The results suggest that if structural breaks are present but being ignored, the conventional Johansen procedure may yield erroneous results and lead policy-makers and arbitragers to make decisions which are less accurate.

Keywords: Purchasing power parity, price, Engle-Granger Cointegration Test, Error Correction Model, Asian financial crisis, Quandt Andrews Test

INTRODUCTION

The Theory of Purchasing Power Parity (PPP) is based on the constituent of "the law of one price" where goods, expressed in a common currency, ought to have identical prices across countries (Hyrina & Serletis, 2010). The theory of purchasing power parity (PPP) has drawn huge attention and been explored broadly in the recent literature using contemporary advances in the applied econometrics field.

PPP states with certainty that the relative prices of goods across borders will not be affected by exchange rates in each of the country involved. this means that exchange rate changes for two countries will be proportional to relative inflation of each country. This relationship is important it is a fundamental of exchange rate models in international economics; which provides a benchmark exchange rate and hence has some practical appeal towards policymakers and also exchange rate arbitragers (Hyrina & Serletis, 2010). Put simply, the percentage of increase in the foreign currency (e_f) should change to maintain parity in the new price indexes of the 2 countries (Madura 2008).

$$e_f \cong I_h - I_f \qquad (1)$$

where;
e_f = expected change in foreign currency
I_h = Home inflation rate
I_f = Foreign inflation rate

As an exchange rate determination model and also a key building block in international macroeconomic modelling, purchasing power parity (PPP) has attracted a wide coverage of awareness, especially after the major economic events such as the collapse of the Bretton Woods system in 1973 (Nusair 2008) and during the transition into the flexible exchange rate regime (Hyrina & Serletis 2010). Nonetheless, the recent spate between US and China in the currencies valuation brings out the question whether PPP is still relevant.

In most studies, PPP is examined using some form of unit root test to make sure whether the nominal exchange rate is proportional to the ratio of national price levels in order to bring to the results where the real exchange rate is stationary over time. This paper studies the PPP from five East Asian countries, namely, Malaysia, Singapore, Indonesia, South Korea, and Thailand. These countries were chosen due to the economic linkages among them (such as Asean free Trade Agreement – AFTA and ASEAN+3) and also that these countries were the ones affected to a great extent during the Asian financial crisis. Table 1 shows the historical exchange rate classifications for these countries.

Malaysia shifted from a fixed exchange rate regime of US$1 = RM 3.80 post Asian Financial crisis 1997 to a managed float on 21 July 2005. Singapore's monetary policy, on the other hand, has been focused on the management of their exchange rate since 1981. Rather than maintaining to a fixed value, the Singaporean dollar is allowed to fluctuate within an undisclosed policy band. South Korea uses an inflation targeting monetary policy in which the central bank sets an explicit inflation target and tries to achieve it. Similarly, in July 2005, Bank Indonesia (BI) launched a new monetary policy framework known as the Inflation Targeting Framework. Since the Asian financial crisis 1997, Thailand has adopted the

Table 1 IMF classifications for Asian countries

Country	Period	Exchange Rate Classification
Malaysia	September 1975–June 1993	Limited flexibility
	June 1993–September 1998	Managed floating
	September 1998– October 2010	Pegged to the USA dollar
Singapore	June 1973–June 1987	Limited flexibility vis-à-vis a basket
	July 1987– October 2010	Managed floating
Indonesia	November 1978–July 1997	Managed floating
	August 1997–September 2001	Independently floating
	September 2001– October 2010	Managed floating
South Korea	March 1980–October 1997	Managed floating
	November 1997– October 2010	Independently floating
Thailand	January 1977–June 1981	Pegged to the US dollar, or limited flexibility vis-à-vis a basket
	July 1981–March 1982	Managed floating
	April 1982–June 1997	Limited flexibility vis-à-vis the US dollar, or a basket
	July 1997–June 1998	Managed floating
	July 1998–October 2010	Independently floating

Sources: IMF Classification of Exchange Rate Arrangements and Monetary Frameworks: http://www.imf.org/external/np/mfd/er/index.asp.

managed-float exchange rate regime. Hence, we can see that there is a mixture of managed-floating and also the inflation targeting exchange rate regime in these five Asian countries. Whether PPP holds during the current exchange regime is the intent of this paper.

From the early years of the transition until the current float, empirical studies have found that PPP failed to hold continuously due to high exchange rate volatility (Rogoff, 1996). Hence, except for hyperinflation countries, PPP was strongly rejected in a short-run relationship (Frenkel 1978). In another study, Miyakoshi (2004) concludes that the results of using the cointegration technique to test PPP relationship between US dollar and Japanese yen can be categorised into two types: first is for those who use long-run spans of annual data and second, those for the recent floating periods. For long-run spans of data, there is considerable evidence to support the PPP (Kim 1990). However, the results are quite negative for recent floating periods.

Long spans and panel data have been used in order to increase the power of tests, (Baharumshah *et.al.* (2007), Taylor & Sarno (1998) and Frankel & Rose (1996)). Although the two approaches have been more supportive of PPP, they have been criticized for combining data from fixed and floating exchange rates regimes where

rejecting the null hypothesis does not provide direct evidence on the validity of PPP under the current floating system whereas the panel data approach has been criticized as it tests the null where all the series in the panel are non-stationary. In another words, the null is rejected if there is only one series that is stationary (Taylor & Sarno, 1998). The recent development of the panel data techniques has challenged the traditional time series approach fundamentally because it requires fewer time series observations. Hence, it is possible to focus on relative short time spans with homogenous exchange rate regimes by using panel data. Panel data variants of tests for unit root and cointegration have been developed in recent years (Breitung & Meyer 1994; Im *et. al.* 2003; Levin et al. 2002; Pedroni 2001). These methods have been applied to the free-float period of OECD countries, help to provide some support for a long-run PPP relationship (Wu 1996; Meier 1997; Anker 1999; Flores et al. 1999). However, the evidence for a stable PPP relationship is much weaker for less developed countries (Boyd & Smith (1999) and Breitung & Candelon (2005)).

The issue of structural breaks has also received ample attention in relation to unit root testing. Dropsy (1996) proposes that a possible reason for the failure to find evidence in favor of PPP is due to the presence of structural breaks. Perron (1989) also argues that most macroeconomic variables are trend stationary processes with structural breaks instead of the unit root processes. Hence, standard tests will fail to reject the null of a unit root when even though the null is false if a series contains a break. Gregory et al. (1994) showed that prevailing cointegration tests are biased towards accepting the null of no cointegration with the presence of structural breaks (Nusair 2008). Structural breaks are affiliated with significant economic and political events, examples are the changes in exchange rate regimes from fixed to managed or free float, financial crises, financial liberalization, and external forces such as economic sanctions and wars. For example, during the 1980s and 1990s some Asian countries experienced sudden changes in their nominal exchange rates as a result the Plaza Accord (1985), Asian financial crisis (1997) and US financial crisis (2008). A structural break may affect the model parameters and can lead to different outcomes (Hansen 2001).

The objective of this paper is to examine the long-run purchasing power parity (PPP) relationship for five Asian countries relative to US dollars during a period containing significant structural breaks. The five countries are Malaysia, Singapore, Indonesia, South Korea and Thailand. The data that is being used are monthly data for consumer price index, and the exchange rate from the year 1990 to 2009. In order to achieve this objective, the present paper utilizes the multivariate cointegration procedure proposed by Johansen et al. (2000). The structural breaks are tested with Quandt-Andrews Breakpoint test.

LITERATURE REVIEW

The Purchasing Power Parity (PPP) theory states that the long-run equilibrium exchange rate between two countries' currencies is equal to the ratio of their price levels (Tsukuda & Miyakoshi 2000). There is abundant evidence of long-run PPP which support the notion that temporary disequilibrium may take place, but the deviations will be stationary in the long run (Frenkel (1981) & Rogoff (1996)). Zhao (2009) proposed that when a country's domestic price level is increasing (for example, when country experiences inflation), that country's exchange rate must depreciate in order to stay align with theory of PPP. Many practitioners in the business world perceive that the PPP relation should hold in the long run. Nevertheless, in reality, relationship between exchange rates and national price levels can be altered by many other factors such as the imperfect competitions, trade restrictions, transport costs, measurement errors and differential productivity shocks (Pedroni, 2001).

Testing for purchasing power parity is important in many areas of international finance and economics. It has also allowed analysts to draw conclusions regarding the connection between economic growth and real exchange rate valuations (Allsopp, Rammal, & Zurbruegg, 2005). PPP testing has been instrumental to guide policy makers in their choice of exchange rate regimes and the decision to form monetary unions. Moreover, it has also been applied to anticipate current account difficulties and liquidity crises. As evidenced in the literature covered, the results have been mixed. Nevertheless, it is undeniably still a very popular and useful policy tool by a large number of central banks and treasury departments around the world as it helps to pre-determine possible current account difficulties before they become a significant problem within a country. In fact, combined with other economic, political and legal variables, it can also serve as an early warning system in order to forecast a future economic crisis within a country (Allsopp, Rammal, & Zurbruegg 2005).

Tests for PPP have played a key role in understanding a number of different economic scenarios. This also explains why both professionals and academics put in effort on testing for PPP within countries. As a matter of fact, when economic and financial circumstances change, the need to periodically test for PPP becomes a necessity and it is unlikely to disappear from economic literature in the near future. In order to test the validity of PPP, empirical studies usually focus on unit root tests (Serletis& Zimonopoulos 1997), long-horizon regression tests (Serletis & Gogas 2004), and cointegration tests (Serletis, 1994; Coe & Serletis, 2002). In addition, there are a few researches who concluded that PPP does not hold during the current floating exchange rate period with respect to their empirical evidence. For example, Mark (1990), Flynn & Boucher (1993), Serletis & Zimonopoulos (1997) and Wu & Chen (1999). A number of researchers have used similar tests with different groups of countries and contended that real exchange rates are mean-

reverting or stationary over the same period, for example, Huizinga (1987), Sarno & Taylor (1998), and Luintel (2000).

Early cointegration tests such as the ADF (augmented Dickey-Fuller) cointegrating regression and Johansen maximum likelihood (ML) procedures tend to reject the null hypothesis of long run PPP, especially for the recent floating exchange rate period. One of the problems of these tests was the low power of such tests against stationary alternatives. In response to this, researchers use the panel unit root test developed by Levin & Lin (1993) to further analyse PPP (MacDonald 1996, Oh 1996, Wu 1996). Panel tests are able to offer more power than conventional tests and their evidence which supported mean reversion in real exchange rates overturned previous findings for the recent floating system. (Coakley & Fuertes 1997) The panel-based procedures also allowed for the time-series information to remain enclosed within the period of floating nominal exchange rate. This provides more desirable and accurate result, because when the degree of volatility on real exchange rate is higher under flexible than under fixed nominal exchange rate, mixing data from the two exchange rate regimes in PPP studies may bias the results towards acceptance of the PPP hypothesis (Meier 1997).

The empirical methodology focuses on the long-run cointegration link between exchange rates and relative prices. Testing the real exchange rate for stationarity is used to test the PPP relationship empirically as it assumes a strict proportionality between the nominal exchange rates and relative prices. Nonetheless, the long-run relationship between nominal exchange rates and relative prices is not exclusively proportional with each other. This is because the weaker form of the PPP relationship can be investigated using a cointegration framework due to Engle& Granger (1987) and Johansen & Juselius (1990). By using both approaches, empirical studies managed to find some support for a long-run PPP relationship (Taylor& McMahon 1988, Johnson 1990, Kim 1990, Fisher & Park 1991, Zumaquero & Urrea 2002) although the evidence is still far from being overwhelming (Breitung & Candelon, 2005).

Structural Breaks

In terms of the Asian countries, most of the previous studies which do not allow for structural breaks showed no evidence or only weak evidence in favor of long-run PPP (Baharumshah & Ariff (1997), Wu & Chen (1999), Wang (2000)). On the other hand, studies that addressed the issue of structural breaks found some evidence in favor of PPP although the results are still mixed. Zurbruegg & Allsopp (2004) use monthly data from 1990 to 2002 to examine the impact of the Asian crisis on the PPP relationship for Asian countries vis-à-vis the USA. The authors who employ Inoue's (1999) cointegration procedure which allows for an endogenously determined structural break, and then incorporating the estimated breaks into the Johansen *et. al.* (2000) procedure found out that they could not reject the null of

no cointegration with estimated breaks around the 1997 crisis in all cases. After allowing for a single break in the cointegrating vector, they found evidence in favor of PPP for Japan, Korea, Malaysia, Singapore and Thailand (Nusair, 2008).

Even after allowing for two breaks using monthly data from 1990 to 2005, Hooi & Smyth (2005) fail to find evidence of PPP for India and Malaysia relative to the USA. On the other hand, according to Nusair (2004), after allowing for a break in the third quarter of 1997 (using quarterly data from the second quarter of 1973 to the first quarter of 2000), he manage to find evidence of PPP vis-à-vis the USA for Indonesia, Korea, Malaysia and Thailand. By using monthly data from April 1973 to December 1995, Cheung & Lai (1998) find evidence of trend shifts and thus reject the null of a unit root for Hong Kong, Indonesia, Malaysia and Singapore relative to the USA except Korea. In addition, Aggarwal et al. (2000) asserts that by 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, the author finds no evidence for Indonesia and Korea when the PPI is used and no evidence of PPP for Indonesia and Singapore when the CPI is used.

Perron (1989) illustrated the importance of allowing for structural break in unit root tests. He asserted the ability to reject a unit root decreases when the existing structural break is ignored even though the stationary alternative is true. The hypotheses implied in endogenous break unit root tests differ from those in Perron's (1989) exogenous break unit root test, which allowed for the possibility of a break under both the null and alternative hypotheses. Allowing for breaks under the null is vital in Perron's test, so that the unit root test statistic will not diverge when the size of a break under the null increases.

METHODOLOGY

Meese & Singleton (1982) marked the turning point in the investigation of PPP when they discovered that nominal exchange rate has a unit root. This finding is being further interpreted as evidence where the nominal exchange rate follows a random walk which implies that its impact is not mean-reverting. In other words, changes in nominal exchange rate are expected to be permanent. As a result, the long run PPP hypothesis could not be confirmed (Anoruo, Braha, & Ahmad, 2002). On the other hand, if the unit root does not exist, the data exhibits long-run mean reversion and long-run PPP holds. According to Baharumshah, Aggrawal& Chan (2007), all variants of PPP assume that the real exchange rate reverts to a mean. This paper uses the Augmented Dickey Fuller test for stationary test;

$$\Delta X_t = \lambda_0 + \lambda_1 T + \lambda_2 X_{t-1} + \Sigma \lambda_i \Delta X_{t-i} + \varepsilon_t \text{ where } i = 1, 2, 3\ldots k \qquad (3)$$

The hypotheses being tested are:
H_0: $\lambda_2 = 0$ (the data is not stationary, it contains unit root)
H_1: $\lambda_2 < 0$ (data is stationary, it does not contain unit root)

Evidence of long run PPP can be provided by a test of a unit root in real exchange rates. If the unit root null hypothesis can be rejected in favor of a level stationary alternative, then there is long-run mean reversion and, thus long-run PPP holds (Froot & Rogoff, 1995; Rogoff, 1996). On the other hand, if the real exchange rate follows a random walk without reverting to a constant mean, nominal exchange rates and relative price levels will not converge in the long run (*i.e.* PPP not supported). Once this requirement is met, X and Y variables are said to be cointegrated and a method of Error Correction Model (ECM) can be pursued. Vector Error Correction Model (VECM) is a restricted Vector Autoregressive method which involves Johansen-Juselius' multivariate cointegration. VECM restricts the long run behaviour of endogenous variables to converge to their cointegrating relationship while allowing for short run adjustments. The VECM model is shown below:

$$\Delta X_t = \lambda_i + \sum_{i=1}^{n} A_i \, \Delta X_{t-i} + \sum_{i=1}^{n} \hat{\xi}_i \, \grave{E}_{t-i} + v_t \qquad (3)$$

where,

X_t is in the form of nx1 vector

A_i and ξ_i are the estimated parameters

Δ is the difference operator

v_t is the reactional vector which explains unanticipated movements in Y_t and

Θ (error correction term)

Monthly data of exchange rate and monthly consumer price index rfrom 1990-2009 will be used for this analysis.

Finally, the Quandt-Andrews Breakpoint Test were used to determine whether there are significant breakpoints without using previous predetermined time of break. This test probes for one or more unknown structural breakpoints The Quandt-Andrews test is the extension of Chow's test (1960) in that a single Chow Breakpoint Test is performed at every observation between two dates, τ_1 and τ_2. The test statistics from those Chow tests are then combined into one test statistic for a test against the null hypothesis of no breakpoints between τ_1 and τ_2.

$$\text{MaxF} = \max_{\tau_1 \tau_2 \tau_3}(F(\tau)) \qquad (4)$$

FINDINGS

Below are the graphs (Figure 1 to 5) of each of the exchange rates of the country with respect to US dollar for the period under analysis.
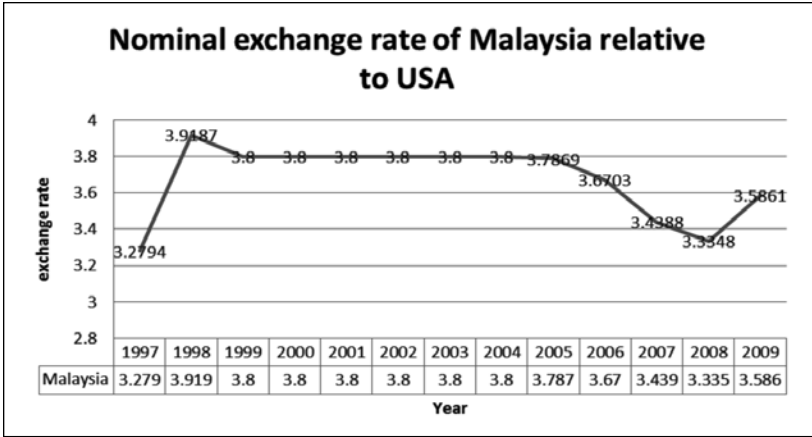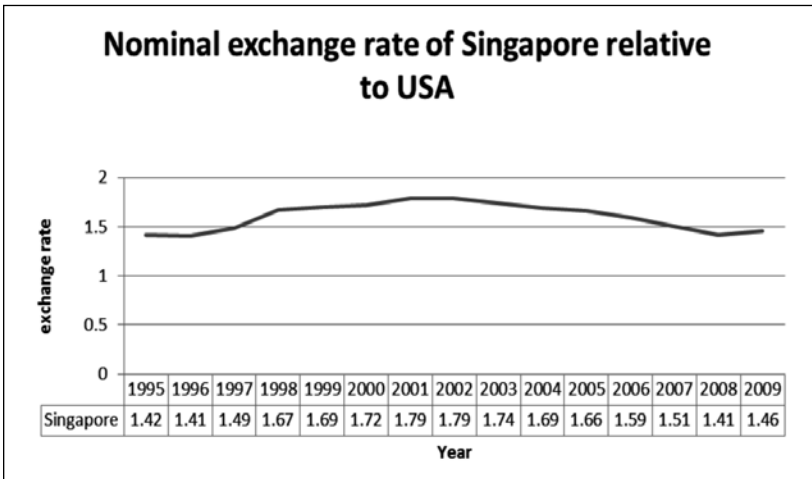
Figure 1 Malaysia

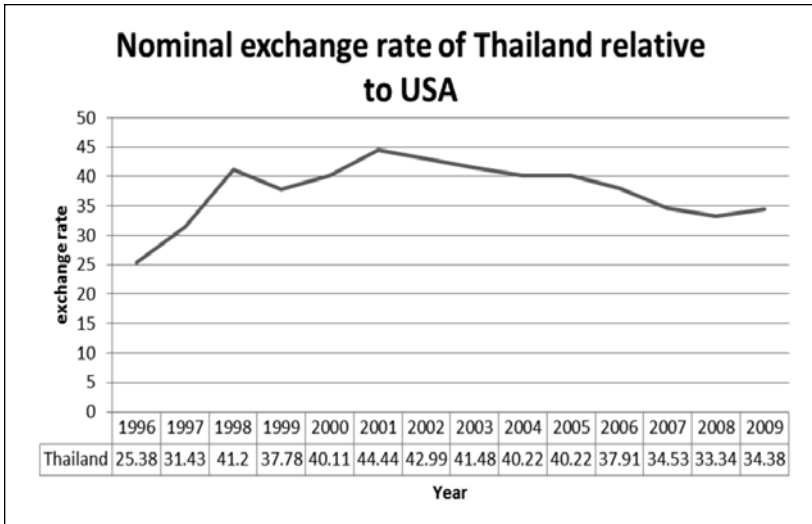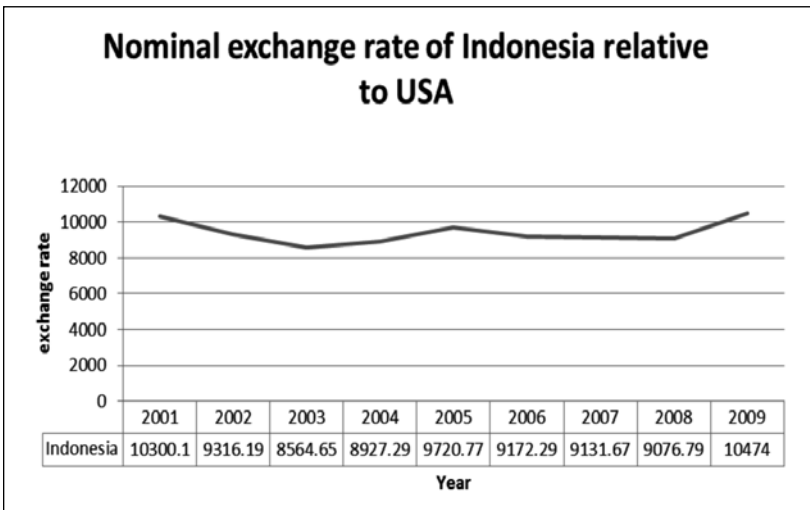**Figure 2** Singapore

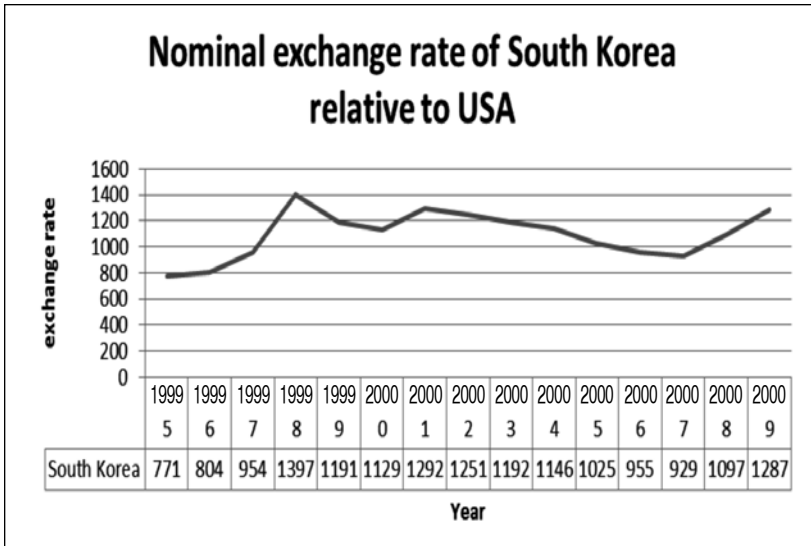**Figure 3** Thailand

Figure 4 Indonesia

Figure 5 South Korea

The figures shown above indicate noticeable movements of currency exchange rate around the 1997 Asian crisis and 2008 U.S. financial crisis for most of the Asian countries. It is evident that the nominal exchange rates for most of the Asian countries being studied experienced a sudden increase (depreciation) around 1997 and 2008.

Augmented Dickey-Fuller (ADF) Unit Root Tests

Table 2 provides the summary results of the conventional augmented Dickey-Fuller (ADF) test for the nominal exchange rate and price ratios relatives to the USA. The number of lags in parentheses is selected using the Schwarz information criterion. The conventional ADF tests indicates that all the variables are stationary in their first differences and non-stationary in their levels, except for the exchange rate of Malaysia, Thailand, Indonesia and South Korea relative to the USA. Since the condition to apply cointegration test has been fufilled (the variables are non-stationary and integrated of order one), the cointegration test is then performed.

Table 2 Unit root tests for relative prices and exchange rates
relatives to the USA

	ADF test	
	Levels	**First difference**
Malaysia		
P	-0.49(1)	-8.06(0) ***
S	-4.80(0) ***	-9.97(0) ***
Singapore		
P	0.36(3)	-5.19(2) ***
S	-1.15(0)	-12.16(0) ***
Thailand		
P	-0.71(1)	-8.74(0) ***
S	-3.15(1) **	-9.40(1) ***
Indonesia		
P	-0.05(0)	-8.49(0) ***
S	-3.11(0) **	-11.26(0) ***
South Korea		
P	-0.18(3)	-9.31(2) ***
S	-3.00(1) **	-9.65(1) ***

P = Price and S = Exchange rate.
* , ** and *** denote rejection of the null hypothesis of a unit
root at the 10%, 5% and 1% significance levels, respectively.

Johansen Cointegration Tests

The results of applying the Johansen *et al*. (2000) procedure is reported in Table 3
with relative to USA. The table presents the result from the conventional Johansen
procedure without break, the results from allowing for a single break in the fourth
quarter of 2008 (US financial crisis), a single break in the fourth quarter of 1997
(Asian financial) crisis and two breaks jointly in the fourth quarter of 2008 and
1997. The number of lags is chosen by Schwarz information criterion.

The results without break indicate that PPP with relative to the USA holds for
Malaysia only. The conventional Johansen procedure fails to detect any evidence
in favour of PPP for Singapore, Thailand, Indonesia and South Korea. Only after
allowing for a break in the fourth quarter of 2008 then the author is able to find
evidence for both Thailand and South Korea. This suggests that the PPP relationship
for these two countries has been affected by the crisis. The break in the fourth
quarter of 1997 helped to further reveal evidence in favour of PPP.

Besides that, the results for Singapore and Indonesia might suggest that the
2008 economic crisis caused by the US financial crisis did not have a significant
impact on the long-run PPP relationship for both of these countries with relative
to the USA as they failed to reject the null hypothesis of a unit root. In addition

Table 3 Johansen cointegration tests (λtrace) relative to the USA

	No breaks	**TB$_1$ = 2008** quarter 4	**TB$_2$ = 1997** quarter 4	**TB$_1$ and TB$_2$**
Malaysia				
r = 0	33.24 *	26.51 *	19.46 *	27.31 *
r ≤ 1	0.06	6.96 *	3.98 *	0.75
Singapore				
r = 0	6.29	10.10	19.14 *	16.57 *
r ≤ 1	0.99	0.15	7.23 *	0.59
Thailand				
r = 0	13.77	24.39 *	27.91 *	22.12 *
r ≤ 1	0.02	1.71	5.82 *	0.90
Indonesia				
r = 0	13.18	8.07	nil	nil
r ≤ 1	0.06	0.18		
South Korea				
r = 0	7.38	16.08 *	45.60 *	27.57 *
r ≤ 1	0.20	0.28	5.62 *	0.78

TB stands for time of break. TB$_1$ indicates time of break during quarter 4 in 2008 while TB$_2$ indicates time of break during quarter 4 in 1997.

* denote rejection of the null hypothesis of a unit root at 5% significance level.

to that, allowing for a single break in the fourth quarter of 1997 indicates that all of the countries being studied (except Indonesia) rejected the null hypothesis of a unit root at 5% significance level. This shows that the 1997 economic crisis have a significant impact on all of the four countries on their long-run PPP relationship with relative to the USA. By allowing for the two breaks jointly in the fourth quarter of 2008 and fourth quarter of 1997, it is shown that the results are not different from those obtained from allowing for a break in the fourth quarter of 2008. In a nutshell, the results indicate the evidence of PPP for all the countries with relative to the USA after allowing for a single break in the fourth quarter of 2008 or both in the fourth quarter of 2008 and the fourth quarter of 1997.

Quandt-Andrews Breakpoint Test

Quandt-Andrews Breakpoint Test is used to further check on the probability of breakpoints within trimmed data. It tests for one or more unknown structural breakpoints in an equation's sample. The analysis outputs showed that there are no breakpoints within trimmed data at specified breakpoints as they failed to reject the null hypothesis for all countries.

Table 4 Quandt-Andrews unknown breakpoint test result

	Malaysia	**Singapore**	**South Korea**	**Thailand**	**Indonesia**
Maximum L-R F-statistics	29.9 (0.000)	363.9 (0.000)	106.5 (0.000)	228.47 (0.000)	30.907 (0.000)
Maximum Wald F-statistics	29.9 (0.000)	363.9 (0.000)	106.5 (0.000)	228.47 (0.000)	30.907 (0.000)
Exp LR F Statistics	11.85 (0.000)	177.239 (1.000)	48.87 (0.000)	111.809 (1.000)	13.585 (0.000)
Expected Wald F Statistics	11.85 (0.000)	177.239 (1.000)	48.87 (0.000)	111.809 (1.000)	13.585 (0.000)
Average LR F Statistics	16.60 (0.0001)	197.615 (1.000)	64.18 (0.000)	153.62 (1.000)	19.534 (0.0001)
Average Wald F Statistics	16.60 (0.0001)	197.615 (1.000)	64.18 (0.000)	153.62 (1.000)	19.534 (0.0001)

The Quandt–Andrews test examines for one or more structural break points in a sample. The null hypothesis for this test is that there is "no breakpoints". The test statistics are based on the Maximum statistic, the Expected Statistic, and the Average statistic. Based on the Maximum statistics, the test showed that there is no structural breaks in all the currency exchange rates in each of the country analysed.

CONCLUSION

The objective of this paper is to re-examine the long-run purchasing power parity (PPP) relationship for five Asian countries' (Malaysia, Singapore, Indonesia, South Korea and Thailand) relative to US dollars during a period containing significant structural breaks such as the Asian crisis and also the US financial crisis in September 2008.

The results indicate the evidence of PPP for all the countries with relative to the USA after allowing for a single break in the fourth quarter of 2008 and/or in the fourth quarter of 1997. However, there is one limitation in this study. The results are based on the breakpoints that has/have been pre-determined, this approach can be criticized because it is subject to problems associated with wrongly estimated breaks. In addition to that, even if events that may cause structural break, such as the 1997 Asian crisis or the 2008 US financial crisis, can be observed, the precise timing of the break is still not known. As a result, by imposing a date for a structural break, it can lead to misspecification of the model, which eventually will bias the result. The method introduced by Bai and Perron (1998) can be used to overcome this. Nonetheless, the Quandt-Andrews Breakpoint Test is used to determine whether there are significant breakpoints without using previous predetermined time of break failed to fine any significant structural breaks during the period that is being tested.

Nevertheless, allowing for multiple breaks is warranted when testing the validity of long-run PPP for Asian countries because there is evidence that Asian countries have been impacted by 1997 Asian crisis and 2008 US financial crisis. The results of the present paper suggest that if structural breaks are present but being ignored, the conventional Johansen procedure may yield erroneous results and lead policy-makers and arbitragers to make decisions which are less accurate. This is in line with Baharumshah and Ariff (1997), Wu & Chen (1999) & Wang (2000).

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