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PURCHASING POWER PARITY (PPP) IN A TRANSITION ECONOMY-CAMBODIA: EMPIRICAL EVIDENCE FROM BILATERAL EXCHANGE RATES

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ABSTRACT

PURCHASING POWER PARITY (PPP) IN A TRANSITION ECONOMY-CAMBODIA: EMPIRICAL EVIDENCE FROM BILATERAL EXCHANGE RATES

This study contributes to the existing literature by examining the validity of PPP hypothesis for Cambodia. The standard unit root tests (ADF and PP) and the panel unit root tests fail to support PPP hypothesis for the nine Cambodia's trading partners. The unit root tests with structural break support the PPP hypothesis for the bilateral real exchange rates of Euro, Indonesia rupiah, Malaysia ringgit, and Singapore dollar. This finding is found to be relevant for 'de-dollarization' strategy in Cambodia, and in responding to recent global financial crisis (2007-2008).

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1. Introduction

Purchasing Power Parity (PPP) is an essential hypothesis, and it has received a great attention by the researchers in the field of open macroeconomics. Perhaps the popularity of this hypothesis is mainly due its fundamental contribution to exchange rate determination. The PPP hypothesis is considered as the simplest framework to explain the long-run behaviour of exchange rate. The PPP explains that the nominal exchange rate between two currencies can be determined by the price differential or relative price of a basket of identical goods and services across the two corresponding countries. The fundamental idea is that the same prices are assumed for an identical basket of goods and services in different countries in a common currency. If price differential exists, arbitrage activity will take place in an efficient market, allowing the nominal exchange rate to adjust to differences of the prices across countries. The validity of PPP allows policy-makers and exchange rate market participants to evaluate the position of exchange rate on whether it is over-valued or under-valued.[1] By the same token, the PPP can be interpreted as a basic forecasting framework to analyze the future movements of exchange rates. In this context, the PPP hypothesis is practically evaluated by time series econometrics methods that are to examine whether the nominal exchange rate and relative prices are cointegrated or not. Another testing procedure is to examine whether the real exchange rate is mean reverting (stationary) or not. To date, a huge amount of empirical studies are available with substantial contribution to the knowledge of PPP. Among them, Taylor and Taylor (2004) and Taylor (2006) have provided sufficient theoretical discussion and literature survey on the PPP hypothesis. Again, Taylor (2009) has provided a comprehensive review for the recent empirical studies[2]

The objective of this study is to re-investigate the PPP hypothesis for an economy in transition in East Asia, namely Cambodia.. In the recent decade, Cambodia has implemented a series of macroeconomics reforms in the era of transition from a developing socialist economy to a market economy.[3] Between the Sihanouk period (1953-1970) and the Democratic Kampuchea period (1975-1978) (and post-Democratic Kampuchea period), the Cambodia's exchange rate systems have undergone several revolutions.[4] Of late, two exchange rate systems were introduced by the government in 1990, namely official rate and parallel rate. The official rate is classified by International Monetary Fund (IMF) as managed floating, and it is mostly used for external

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[1] PPP could be considered as a long-run equilibrium condition for exchange rate, if PPP holds in the long-run (Taylor, 2009).
[2] According to the survey of Taylor (2009), most of these studies provide evidence supportive of long-run PPP.
[3] A review of policy reforms implemented by the Cambodian government is available in Joyeux and Worner (1998, p.426-430). Again, Cambodia was one of the first least developed countries to join the World Trade Organization (WTO) in 2004.
[4] http://intl.econ.cuhk.edu.hk/exchange_rate_regime/index.php?cid=13 accessed 17/9/09.

transactions. Meanwhile, the parallel rate is tolerated by the government, and it actually dominates interbank and most other transactions (IMF, 1997, p.154). Interestingly, dollarization policy was suddenly introduced in the early 1990s. The dollarization has resulted in a high share of the US dollar (USD) to a total currency of approximately more than 70% (Kang, 2005). Consequently, the US dollar circulates freely in Cambodia by means of daily transaction (payment) (IMF, 1998, p. 166). However, for a highly dollarized country Cambodia, economy policies (i.e., monetary, fiscal, and international trade policies) are not fully available for implementation (Kang, 2005, p. 201). Again, the market economy which was started in 1980s helps to promote exchange rate volatility (or uncertainty) in Cambodia (Wong and Tang, 2008). Hence, it is the motivation to grant a better understanding of the fundamental of exchange rate determination, at least by means of examining the PPP hypothesis.

Table 1 shows a basic idea about the bilateral exchange rates for nine Cambodia's trading countries namely, US, Euro member countries, UK, Indonesia, Japan, Malaysia, the Philippines, Singapore and Thailand based on data availability from the data source (*CEIC* Asian Database). It is interesting to highlight that the bilateral exchange rates fluctuate from time to time as a result of either appreciation (nominal exchange rate decreases) or depreciation (nominal exchange rate increases).[5] For example, in between 2001 and 2004, there was an obvious trend of depreciation for Cambodia riel against US dollar, Euro, British pound, Japanese yen, Malaysia ringgit, Singapore dollar, and Thai baht. An appreciation of Cambodia riel against US dollar occurred in between 2006 and 2007 and it can be explained by the recent global financial crisis. Similarly, an appreciation of Cambodia currency against Euro, British pound, Indonesia rupiah, Malaysia ringgit, Philippines peso and Thai baht has been observed for the period 2007-2008. The episode of strong Cambodian riel can be attributed to the consequence of improved foreign relations such as imports, exports, tourism, foreign investments, loan projects, non-governmental organization (NGO) activities, and so on (Kang, 2005, p. 206), that have strengthen the Cambodian macroeconomics fundamental and fostered the integration of Cambodian economy with the globalised economies in the world.[6] Again, exchange rates volatility (Cambodia riel against US dollar) does affect tourist arrival to Cambodia (Wong and Tang, 2008). The tourism sector is considered an important as engine of growth for Cambodia. For policy implication, it is worth to understand the basic factors that explain the exchange rates for Cambodia. It can be achieved by testing the validity of PPP hypothesis.

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[5] Exchange rate is defined as the Cambodia price (in riel) of per unit foreign currency.
[6] Many forms of economic policies such as monetary, fiscal, international trade policies and so on are not fully available to Cambodia because of the dollarization phenomenon (Kang, 2005, p. 201).

Table 1. Bilateral Nominal Exchange Rates in Cambodia, 2001-2008

KHR/	USD	EUR	GBP	1000 IDR	100 JPY	MYR	100 PHP	SGD	THB
Dec 2001	3895	3436	5643	373	2963	1025	7534	2104	88.1
Dec 2002	3930	4117	6305	439	3317	1034	7380	2266	90.8
Dec 2003	3976	4995	6842	469	3716	1046	7185	2327	100
Dec 2004	4027	5483	7750	432	3917	1060	7165	2461	103
Dec 2005	4112	4871	7089	418	3488	1088	7750	2469	100
Dec 2006	4057	5389	7975	447	3520	1128	8243	2651	113
Dec 2007	3999	5896	7986	425	3563	1207	9683	2768	131
Dec 2008	4077	5762	5890	368	4512	1175	8590	2829	117

Notes: USD = US dollar, EUR = Euro, GBP = British pound, IDR = Indonesia rupiah, JPY = Japanese yen, MYR = Malaysia ringgit, PHP = Philippines peso, SGD = Singapore dollar, and THB = Thai baht. The data is obtained from the *CEIC* Asian Database.

From the literature search, the PPP study for the case of Cambodia is extremely limited. Using applied cointegration techniques, Joyeux and Worner (1998) find that the relative version of the PPP hypothesis holds for the bilateral exchange rate between Cambodia and Thailand for the period between January 1991 and April 1997. On the other hand, Liew and Tang (2009) find a long run relationship among nominal exchange rate riel per US dollar (riel/USD), Cambodia consumer price index (CPI) and the world CPI for the period 2001 (May)-2009 (February), thus supporting the PPP hypothesis.

However, two limitations are identified from the two studies. The first concern is about the testing procedures available. Two testing approaches are available. Cointegration techniques are used to test for cointegration between nominal exchange rate and relative prices. A cointegration among these variables supports the PPP hypothesis. While the alternative approach is to test the stationary property of real exchange rate.[7] The PPP hypothesis holds, if the null hypothesis of real exchange rate has a unit root can be rejected or real exchange rate is stationary in levels, $I(0)$. There is no clear advantage of one approach over another, and they can at best be regarded as complementary approaches.   Second, both studies employed the single bilateral exchange rates such as riel per baht (Joyeux and Worner, 1998) and riel per USD (Liew and Tang, 2009) in order to validate the PPP hypothesis for Cambodia. In fact, this practice makes it vulnerable to

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[7] Bahmani-Oskooee *et al.* (2009) examine the stationarity of the real effective exchange rates of 113 countries to validate PPP. Applying KPSS stationary tests (Kwiatkowski-Phillips-Schmidt-Shin) on real effective exchange rates for 113 countries, Bahmani-Oskooee *et al*. (2009) find some empirical support of PPP for 75 sample counties including Cambodia. For the case of Cambodia, this finding is based on the support of null hypothesis of stationary (or trend stationary) of KPSS tests for the lag length of 21 and 24, respectively. In fact, the test statistics with other lag structures (0, 3, 6, 9, 12, 15, and 18) do reject the null hypothesis of stationary, thereby rejecting the PPP hypothesis.

conclude that the PPP holds without further considering other bilateral exchange rates, since it is relevant for a country like Cambodia with improved international relations such as exports and imports in the recent decade. Again, Cambodia is heavily dependent on foreign *aid* for economic development. By and large, the motivation of this study is based on the second concern. In this study, nine Cambodia's bilateral real exchange rates are employed by taking into account of structural break in the unit root testing approach. The nine bilateral exchange rates of Cambodia's trading partners are riel with USD, Euro, British pound, Indonesia rupiah, Japanese yen, Malaysia ringgit, Philippines peso, Singapore dollar, and Thai baht. This study also compares its findings with those documented in the previous studies, which used cointegration methods (i.e., Joyeux and Worner, 1998; Liew and Tang, 2009).

As mentioned above, this study considers a unit root testing method with an unknown level shift ((Lanne *et al.* (2002), and Saikkonen, and Lütkepohl (2002)). [8] However, for comparison purpose, univariate unit root tests (such as ADF and PP) on the individual bilateral exchange rates and panel unit root tests are also carried out. The results of this study do add a fresh dimension to the existing empirical literature of PPP hypothesis in a transition economy - Cambodia, at least by supplying richer results. Also, the results obtained from this study are expected to enhance the understanding of Cambodia's exchange rates phenomenon, in particular, de-dollarization and to improve the discussion on the government responses to the recent global financial crisis 2007-2008.

The next section describes the theoretical framework of PPP hypothesis, and also documents a list of the relevant empirical literature. Section 3 reports the empirical results. Concluding remarks are available in the Section 4.

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[8] Recently, Assaf (2008) has employed these state-of-the-art tests in US dollar-based real exchange rate series for the following countries: Canada, France, Germany, Japan, United Kingdom, Sweden, Switzerland and Netherlands, and is able to confirm the nonstationary property of these real exchange rates.

2. Theoretical Expression of PPP Hypothesis

In general, PPP is the oldest and simplest theory to explain the exchange rate determination. It was popularized by Cassel (1916), but the basic concept of PPP had developed much earlier than that. Conceptually, the PPP hypothesis explains that nominal exchange rate in terms of home to foreign currency should be equal to the ratio of domestic to foreign price level (i.e., relative price). A mathematical form of PPP can be written as follow:

$$NER_t = \frac{P_t}{P_t^*},$$
(1)

where *NER* is the nominal exchange rate and *P* refers to the general price level. The asterisk (*) indicates the foreign component, whereas the subscript *t* shows that the value of the variable is time-dependent.

The Law of One Price (LOP) states that in an efficient market, identical goods in two countries must have only one price, when stated in the same currency. Following this principle, a basket of identical goods in two countries should face the same price when stated in a common currency. Hence, exchange rate should be equal to relative price. If, exchange rate deviates from the relative prices in the short-run, arbitraging opportunity would be exploited. In an efficient market, misalignment would be self-corrected in the market through arbitraging activities. Eventually, equalization between exchange rate and relative price would be achieved. Hence, the PPP hypothesis is true in the long-run rather than in the short-run. Undoubtedly, the long-run PPP is a crucial assumption of modern theories of the exchange rate and open macroeconomics.

The long-run PPP can be empirically tested by means of stationary of the exchange rate deviations (Rogalski and Vinso, 1977; Taylor, 1988). In this context, the real exchange rate (*RER*) can be constructed as:

$$RER_t = NER_t \times \frac{P_t^*}{P_t}.$$
(2)

r, applying natural logarithm (*ln*) to both sides of the equation, we have:

$$lnRER_t = lnNER_t + lnP_t^* - lnP_t.$$

(3)

Theoretically, PPP holds if $RER_t = 1$, or $lnRER_t = 0$ for all t. However, due to the short-run deviations of exchange rate from the relative price, $lnRER_t$ may not be zero at all times. Therefore, the concept of market self-correcting adjustment on the deviations suggests that the short-run deviations are temporarily, and real exchange rate is mean-reverting in the long-run. Subsequently, $lnRER_t$ must be a zero-mean stationary process, or $I(0)$ (Taylor, 1988).

Over the past decades, the concern of whether the real exchange rate is stationary or not is dependent on the statistical tests applied (i.e.Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) stationary or unit root tests of Dickey and Fuller (1979) and Said and Dickey (1984)). The empirical findings obtained from previous studies, in general rejected the PPP hypothesis (see, for instance, Caporale and Carrato, 2006). However, these tests have been criticized of having low power against stationary alternatives, especially for small sample study (Cheung and Lai, 1994; Lothian and Taylor, 1996; Oh, 1996; Maddalla and Kim, 1998, Ng and Perron, 1999). In order to further re-affirm the PPP hypothesis, a group of international economics researchers have applied the so-called panel unit root approach developed by Levin and Lin (1992), Maddala and Wu (1999) and *Im et al*. (2003). [9] They include Abuaf and Jorion (1990), Oh (1996), MacDonald (1996), Lothian (1997), FlÔres *et al.* (1999), Wu and Wu (2001), Chiu (2002), Alba and Papell (2007), Kalyanco and Kalyanco (2008), Aslan and Korap (2009), to name a few. Overall, these studies support the PPP hypothesis and conclude that the panel unit root tests do offer richer results compared to univariate unit root tests..

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[9]Another less attempted approach to tackle the problem is to employ long spans of data (over centuries) (see Edison (1987), Kim (1990), and Lothian and Talyor (1996, 2008)).

3. Data and Empirical Findings

Data

This study follows the unit root approach to test the stationarity of real exchange rate in order to validate the PPP hypothesis for a set of bilateral exchange rates of Cambodia's trading partners. The data for bilateral exchange rates are obtained from the *CEIC* Asian Database. They are riel per US dollar, Euro, British pound, Indonesia rupiah, Japanese yen, Malaysia ringgit, Philippines peso, Singapore dollar, and Thai baht. The domestic and foreign price levels are measured by consumer price indices (CPIs). The data cover monthly observations between May 2001 and February 2009.. All data have been converted into the natural logarithmic form, *ln*. The real exchange rate variable is expressed as nominal exchange rate multiplied by relative price, $P_j/P_{Cambodia}$ (where *j* is the foreign country) as the approach outlined in Equation (2). Figure 1 depicts the time series pattern of bilateral exchange rates, and a visual inspection of the time series plots suggests the existence of structural break(s) in majority of the real exchange rates over the sample period May 2001 – February 2009.
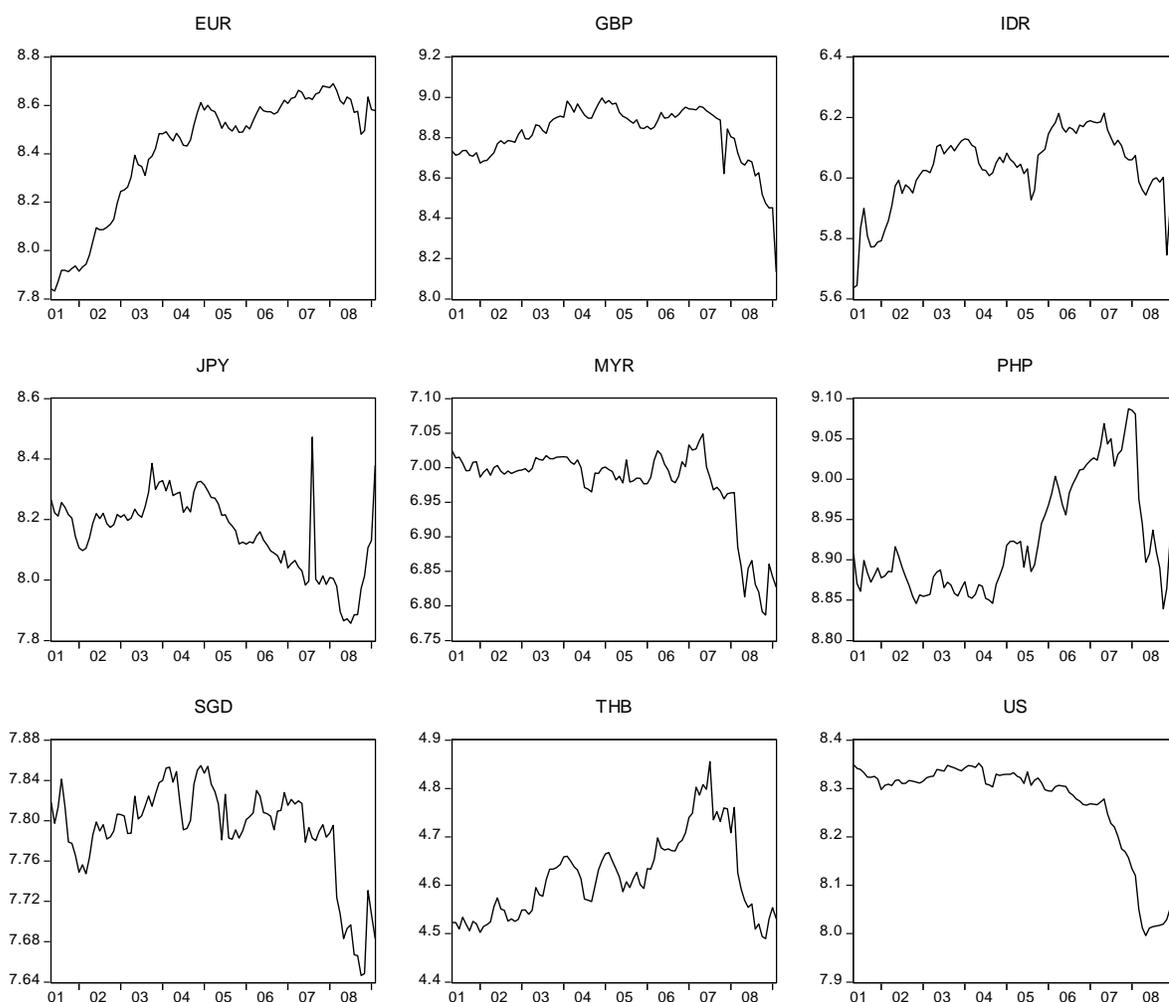
Notes: USD = US dollar, EUR = Euro, GBP = British pound, IDR = Indonesia rupiah, JPY = Japanese yen, MYR = Malaysia ringgit, PHP = Philippines peso, SGD = Singapore dollar, and THB = Thai baht. The exchange rate is written as riel (KHR) per foreign currency (as above).

Figure 1 Plots of Bilateral Exchange Rates

Empirical Findings

This section reports the empirical results from a range of unit root tests–such as augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979, Said and Dickey, 1984), Phillips-Perron (PP) (Phillips and Perron, 1988), as well as the panel unit root framework (Levin, Lin and Chu, 2002; Breitung, 2000; Im, Pesaran and Shin, 2003; Maddala and Wu, 1999; Choi, 2001). Apart from that, results from the unit root test with an unknown level shift (Lanne *et al.*, 2002; Saikkonen, and Lütkepohl, 2002)–the preferred testing methodology in this study, are also presented. Structural break(s) is visually observed from the time series plots as shown in Figure 1. This

observation supports the use of unit root test with structural break in order to obtain a more reasonable results than other unit root tests (ADF, PP and so on). A brief description of these unit root tests with structural break has been briefly outlined in Appendix A.[10] Nonetheless, the ADF, PP and the panel unit root tests are carried out for the purpose of comparison. The descriptive explanation of the ADF and PP unit root tests and panel unit root tests are not documented here since they have been widely applied by a huge number of empirical studies earlier on.[11]

Table 2 reports the *p*-values of ADF and PP unit root tests.[12] The large *p*-values (greater than 0.10) indicte the rejection of the null hypothesis that real exchange rate has a unit root. It allows for a conclusion that the PPP hypothesis does not hold for all the exchange rates of Cambodia with her trading partners, except for KHR/EUR (significant at 10 percent level). Using cointegration approach, both Joyeux and Worner (1998), and Liew and Tang (2009) have found empirical support for the PPP hypothesis using bilateral exchange rate of KHR/THB, and KHR/USD, respectively. Overall, both ADF and PP tests reject the PPP hypothesis, and this finding is against the previous works.

Table 2   Univaraite Unit Root Tests (ADF and PP)

	ADF			PP		
	Constant	Constant and trend	None	Constant	Constant and trend	None
KHR/EUR	**0.085**	0.950	0.993	**0.072**	0.897	0.993
KHR/USD	0.919	0.827	0.268	0.931	0.864	0.143
KHR/GBP	0.996	1.000	0.314	1.000	1.000	0.251
KHR/IDR	0.420	0.423	0.944	0.439	0.491	0.439
KHR/JPY	0.994	0.998	0.173	0.910	0.481	0.264
KHR/MYR	0.880	0.990	0.238	0.910	0.886	0.184
KHR/PHP	0.453	0.720	0.760	0.450	0.417	0.728
KHR/SGD	0.528	0.992	0.409	0.604	0.656	0.393
KHR/THB	0.543	0.949	0.698	0.392	0.858	0.679

Notes: USD = US dollar, EUR = Euro, GBP = British pound, IDR = Indonesia rupiah, JPY = Japanese yen, MYR = Malaysia ringgit, PHP = Philippines peso, SGD = Singapore dollar, and THB = Thai baht. The value reported is *p*-value. The lag length is computed based on modified AIC for ADF and Newey-West Bandwidth for PP.

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[10] See also, Assaf (2008).

[11] A straightforward consideration of employing panel testing approach is the small sample size issue in time series data, in which the combination of both cross-sectional and short time span increases the total observations.

[12] Only the *p*-value is reported for simplicity. The test statistics are available from authors upon request.

To take into account the potential bias of using a data set of small size (94 observations), panel unit root tests apply. From the *p*-values as reported in Table 3, suggest that all the panel unit root tests consistently fail to reject the null hypothesis of a unit root. It shows a unit root in Cambodia's bilateral real exchange rates - the PPP hypothesis does not hold.[13]   In a nut-shell, all the ADF, PP and panel unit root tests reject the weak form PPP hypothesis for Cambodia.

Table 3 Panel Unit Root Tests

Exogenous variables:	Individual effects	Individual effects & individual linear trends	None
Lag length:	0 to 6	0 to 8	0 to 6
Method			
Null: Unit root (assumes common unit root process)			
Levin, Lin & Chu (2002) t	-0.183 (0.428)	4.798 (1.000)	-0.748 (0.227)
Breitung (2000) t-stat	2.359 (0.991)	-2.189 (**0.014**)	2.066 (0.981)
Null: Unit root (assumes individual unit root process)			
Im, Pesaran and Shin (2003) W-stat	0.582 (0.720)	5.526 (1.000)	N.A
ADF - Fisher Chi-square	18.657 (0.413)	2.153 (1.000)	12.004 (0.847)
PP - Fisher Chi-square (Maddala and Wu, 1999 & Choi, 2001)	22.134 (0.226)	0.194 (0.925)	14.371 (0.705)

Note: the value in (.) is *p*-value. The lag length is computed based on modified AIC.

One potential *'technical'* explanation for the failure of detecting PPP using the ADF, PP and panel unit root tests can be explained by the ignorance of structural break in the testing procedure. Clearly, Figure 1 shows structural break(s) in majority of the real exchange rates under study. Therefore, a more careful empirical work is required to consider the issue of structural break(s) in examining the PPP hypothesis. In this conjunction, unit root test with unknown structural break is employed to study the PPP hypothesis for Cambodia. Table 4 illustrates the test statistics of the unit root tests (with an unknown level shift) proposed by (Lanne *et al.*, 2002; Saikkonen, and Lütkepohl, 2002).   As detected by the tests, structural beak(s) mostly occurred in the period of 2008, as a result of the appreciation of the riel against most of the currencies considered in this study. This phenomenon can be explained by the recent economic crisis in the US (2007-2008), prudent monetary policy by the National Bank of Cambodia (NBC), and surplus of balance of payment.[14]

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[13]An exceptional result is given by Breitung (2001) test, which shows that with the inclusion of individual effects and individual linear trends in the estimation, real exchange rates are trend-stationary, at 5% significant level. However, Chiu (2002) points out that time trend in real exchange rate is inconsistent with the long-run PPP.

[14] http://www.scribd.com/doc/19595519/Cambodia-Economic-Watch-October-2008. Accessed on 11/10/2009.

Interestingly, the unit root tests (Lanne *et al.,* 2002) provide richer findings on the PPP hypothesis for the bilateral exchange rates of Cambodia. It supports the importance of taking into account of possible structural break. As shown by the test statistics in Table 4, the null hypothesis of real exchange rate has a unit root with unknown level shift can be rejected, in general for the case of riel against Euro (KHR/EUR), Indonesia rupiah (KHR/IDR), Malaysia ringgit (KHR/MYR), and Singapore dollar (KHR/SGD). The stationarity of bilateral real exchange rates supports PPP (weak form) hypothesis. Again, this finding is found to be inconsistent with the works of Joyeux and Worner (1998), and Liew and Tang (2009) in which the PPP is found valid for riel against Thai baht and US dollar, respectively. [15]

Several economic explanations can be outlined to justify the case in which the PPP hypothesis does not hold. The PPP is based on the concept of arbitraging of goods prices across countries, but trade barriers may induce too high a transaction cost that results in no arbitraging profits. In this conjunction, Alba and Papell (2007) have found that PPP does not hold for countries which are the least open in terms of trade openness, rather the PPP holds for other countries which are characterized as "most open", "more open" and "less open".. In the present case, the economy of Cambodia has been closed for a long time, and the Cambodia's economy is opened up to foreigner countries since 1990s in the way of achieving an open and market based economy. Hence, deviations of nominal exchange rate from the relative prices may be persistence due to the low degree of trade openness of the country.

In addition, Cambodia entered the ASEAN Free Trade Area (AFTA) in 1999, and became a member of the World Trade Organization (WTO) in 2003. These moves do offer Cambodia a substantial potential for her economy to integrate with other Southeast Asian economies as well as economies of other regions (Huot and Kakinaka, 2007). It may partially explained the findings that PPP holds for Cambodia's trading partners such as Indonesia, Malaysia, Singapore and the Euro zone. Besides, it is worth to note that the degree of dollarization in riel is too high, so that the fundamentals of the bilateral riel exchange rates are disregarded. In particular, the adoption of dollarization that has resulted in a high share of the USD to the total currency (more than 70%) may lead to the finding of no long-run riel per USD exchange rate and the relative prices relationship, as the equilibrium relationship could have been off-balanced by the high degree of

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[15] In a multi-lateral setting, Bahmani-Oskooee *et al*. (2009) provide inclusive results (depending on lag structures of the test statistics) on the PPP for riel against a basket of currencies of Cambodia's trading partners.

dollarization. Similarly, the PPP relationship for riel and other currencies examined in this study may be distorted in the era of dollarization.

Table 4   Univaraite Unit Root Tests with Structural Break (Lanne *et al*., 2002)

	Impulse dummy	Shift dummy	Exponential shift	Rational shift
KHR/EUR	**-2.966[**]** (0)**	**-2.713[*] (0)**	**-2.823[*] (0)**	**-2.915[*] (2)**
	[2003M5]	**[2008M10]**	**[2008M10]**	**[2008M10]**
KHR/USD	-0.514 (1)	-0.438 (1)	-0.862 (1)	-0.225 (1)
	[2005M7]	[2008M3]	[2008M3]	[2008M3]
KHR/GBP	3.009 (1)	-0.239 (2)	0.268 (2)	2.784 (2)
	[2007M11]	[2007M11]	[2007M11]	[2007M11]
KHR/IDR	-1.991 (3)	-2.294 (1)	-2.010 (1)	**-3.338[**]** (3)**
	[2008M11]	[2008M11]	[2008M11]	**[2008M11]**
KHR/JPY	-1.296 (1)	-1.199 (1)	-1.243 (1)	-1.267 (1)
	[2007M8]	[2007M8]	[2007M8]	[2007M8]
KHR/MYR	-0.331 (0)	-1.303 (6)	**-2.941[**]** (6)**	-1.478 (0)
	[2008M5]	[2008M3]	**[2008M3]**	[2008M3]
KHR/PHP	-1.521 (5)	-0.354 (10)	1.342 (10)	0.652 (5)
	[2008M2]	[2008M3]	[2008M3]	[2008M3]
KHR/SGD	-1.313 (0)	**3.005[**]** (0)**	**-3.264[**]** (0)**	**-3.864[***]** (0)**
	[2005M7]	**[2008M3]**	**[2008M3]**	**[2008M3]**
KHR/THB	-1.807 (2)	-1.750 (1)	-1.296 (2)	-1.018 (1)
	[2008M2]	[2008M3]	[2008M3]	[2008M3]

Notes: USD = US$, EUR = Euro, GBP = British pound, IDR = Indonesia rupiah, JPY = Japanese yen, MYR = Malaysia ringgit, PHP = Philippines peso, SGD = Singapore dollar, and THB = Thai baht. No time trend and seasonal dummies in the unit root specifications. Lanne, *et al* (2002) -3.58 (1%)[***], -2.94 (5%)[**], and -2.62 (10%)[*] for T = 100. The lag order (.) is suggested by AIC (with maximum of 10), and [.] is the suggested break date searched endogenously using the method proposed by Lanne *et al*. (2003).

4. Concluding remarks

This study re-examines the PPP hypothesis for nine bilateral real exchange rates of Cambodia by using a battery of unit root tests. They are univariate unit root tests with and without structural break and panel approach The PPP hypothesis is rejected by the ADF and PP unit root tests, and similar conclusion is obtained from panel unit root tests. However, the unit root tests with unknown structural break (Lanne *et al.*, 2002) support the PPP hypothesis for the bilateral exchange rates of Euro, Indonesia rupiah, Malaysia ringgit, and Singapore dollar.

Of course, other testing approaches for the validation of PPP hypothesis are available in the literature. By and large, a simple and straightforward methodology (as applied in this study) may serve as preliminary analysis for PPP hypothesis in a country such as Cambodia that is lacking of relevant literature. This study does provide basic understanding of PPP in a transition economy - Cambodia, especially in its policy relevance. It is interesting to relate the results of PPP hypothesis to the 'prospective' policy concerns in Cambodia since many forms of economic policies such as monetary, fiscal, international trade policies and so on are not fully available to Cambodia because of the dollarization phenomenon (Kang, 2005, p. 201)[16]. If PPP holds, it does suggest that for Cambodia to de-dollarize, Cambodia have strong fundamental support for her to associate the Cambodian riel to a basket of the trading partners' currencies. Otherwise, Cambodia has a problem to find currency to attached with, when Cambodia wants to reduce the dependence of US dollar. However, PPP does not hold for the Cambodian riel against British pound, Japanese yen, the Philippines peso and Thai baht. More surprisingly, PPP does not even hold for riel against US dollar, although US remained the top trading partner of Cambodia for the period 2000-2004 (Huot and Kakinaka (2007, p. 307, Table 1). Nonetheless, PPP holds for other currencies, thereby suggesting that de-dollarization in Cambodia is possible but it requires a careful planning and implementation. There is limited fundamental support for Cambodia to associate riel to a basket of foreign currencies (i.e. Euro, Indonesia rupiah, Malaysia ringgit, and Singapore dollar) since the countries involved are not consistently the major trading partners of Cambodia[17]. Therefore, from the results obtained, this study shows that the effectiveness of policy in reducing the dependent of Cambodian riel on US dollar is not clear-cut. Looking from

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[16] Nevertheless, because of the strong dependency of Cambodia to US dollar in an era of dollarization, the current global financial crisis (2007-2008) has had only indirect impact on the Cambodian economy. See, http://www.cdc-crdb.gov.kh/cdc/second_cdcf/session2/moef_global_financial_crisis.htm. Accessed on 15/10/2009.

[17] Euro as a whole is the third trading partners of Cambodia, Singapore ranked seventh, whereas Malaysia and Indonesia falls outside the list of Cambodia's top 10 trading partners.

another perspective, the PPP relationship for riel and other currencies examined in this study may be distorted in the era of dollarization. The substantially high degree of dollarization in riel may not reflect the fundamentals of the bilateral riel exchange rates. If the riel bilateral exchange rates are persistently misaligned with the fundamentals (in this case, the equilibrium conditions determined by relative prices) due to extensive dollarization, it is not illogic to foresee with the experience of 1997-1998 Asian currency crisis that the riel currency will eventually be subjected to currency attack. As such, it is necessary to de-dollarize the riel, so that the bilateral exchange rates of riel will be more reflective of the fundamentals.

The findings PPP study obtainedin this study serve to help the government of Cambodia in the formulation of exchange rate systems and international trade policy in future, especially with respect to her trading partners. This study also contributes to the existing knowledge by adding new findings of PPP for a transition economy – Cambodia. Moreover, the fact that PPP fails to hold due to high degree of dollarization as in the case of Cambodia provides another perspective toward the understanding of the puzzle of PPP literature. Having said that, this study is by no mean perfect. It does not consider a variety of testing strategies and modeling frameworks for PPP. Therefore, there are still rooms for further investigation on this fundamental issue in international macroeconomics.

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Appendix A: Unit Root Testing Method with an Unknown Level Shift

In brief, Saikkonen and Lütkepohl (2002) and Lanne *et al.* (2003) developed a unit root test that allows for an unknown structural break with a model of $y_t = \mu_0 + \mu_1 t + f_t(\theta)'\gamma + x_t$, which is based on first estimating the deterministic term by a generalized least squares (GLS) procedure under the unit root null hypothesis and then subtracting it from the original series. Following this, an Augmented Dickey-Fuller (ADF) type test is performed on the adjusted series which also includes terms to correct for estimation errors in the parameters of the deterministic part. As in the case of the ADF statistic, the asymptotic null distribution is non-standard. Critical values are tabulated in Lanne *et al.* (2002). Because the break date is unknown, Lanne *et al.* (2002) have recommended choosing a reasonably large autoregressive order (AR) in the first step and then selecting the break date which minimizes the GLS objective function used to estimate the parameters of the deterministic part. A shift function, which is here denoted by $f_t(\theta)'\gamma$, may be added to the deterministic term μ_t of the data generation process. Hence, a model $y_t = \mu_0 + \mu_1 t + f_t(\theta)'\gamma + x_t$, is considered, where θ and γ are unknown parameters or parameter vectors and the errors x_t are generated by an AR(p) process with a possible unit root. Three possible shift functions can be implemented which are:-

1. A simple shift dummy variable with shift date T_B, $f_t^{(1)} = d_{1t} := \begin{cases} 0, t < T_B \\ 1, t \geq T_B \end{cases}$. This function does not involve an extra parameter θ. In the shift term $f_t^{(1)}\gamma$, the parameter γ is a scalar. Differencing this shift function leads to an impulse dummy.

2. The second shift function is based on the exponential distribution function which allows for a nonlinear gradual shift to a new level starting at time T_B, $f_t^{(2)}(\theta) = \begin{cases} 0, t < T_B \\ 1 - \exp\{-\theta(t - T_B + 1)\}, t \geq T_B \end{cases}$. In the shift term $f_t^{(2)}(\theta)\gamma$, both θ and γ are scalar parameters. The first scalar parameter is confined to the positive real line ($\theta > 0$), whereas the second scalar parameter may assume any value.

3. The third shift function can be expressed as a rational function in the lag operator applied to a shift dummy d_{1t}, $f_t^{(3)}(\theta) = \left[\dfrac{d_{1,t}}{1 - \theta L} : \dfrac{d_{1,t-1}}{1 - \theta L} \right]'$. The actual shift term is $\left[\gamma_1 (1 - \theta L)^{-1} + \gamma_2 (1 - \theta L)^{-1} L \right] d_{1t}$, where θ is a scalar parameter between 0 and 1 and $\gamma = (\gamma_1 : \gamma_2)'$ is a two-dimensional parameter vector.

Note here that both $f_t^{(2)}(\theta)\gamma$ and $f_t^{(3)}(\theta)'\gamma$ can generate sharp one-time shifts at time T_B for suitable values of θ. Thus $f_t^{(2)}(\theta)\gamma$ and $f_t^{(3)}(\theta)'\gamma$ are more general than $f_t^{(1)}\gamma$.