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DOES PURCHASING POWER PARITY HOLD IN THAILAND?

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ABSTRACT

The main objective of this study is to use disaggregate data between Thailand and its major trading partners to examine the validity of the purchasing power parity (PPP). Bilateral exchange rates between domestic currency (Thai baht) and each currency of major trading partners as well as the relative prices during the period of July 1997 to December 2007 are used to investigate the existence of stationary real exchange rates and cointegration between nominal exchange rates and relative prices. The results from various unit root tests and cointegration test show that PPP does not seem to hold in Thailand.

1. INTRODUCTION

Nominal bilateral exchange rates in Thailand have long been fixed until June 1997. Occasional devaluations were observed during the pegged exchange rate regime. When a small open economy tries to devalue its currency, its trade balance could be improved. Since the Asian financial crisis in July of that year, the country has decided to let the exchange rates float. As a result, the floating (with some degrees of management) regime has created exchange rate fluctuations, which cause uncertainty that affects importers and exporters as well as investors in the Thai financial market. In the short run, exchange rate risk faced by local and foreign economic agents could distort economic decision. Bodnar, Dumas, and Marston (2002), for example, found that exchange rate fluctuations imposed a

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substantial impact on the pricing behavior of exporting and importing enterprises while Nieh and Lee (2001) found that expected currency values could affect both domestic and foreign interest rate, and thus caused the present value of firms' assets to change. Therefore, exchange rate changes could play a crucial role in its impact on the stock markets.

The purchasing power parity (PPP) hypothesis asserts that movements in the nominal exchange rate and their respective price levels between two countries will adjust over time to leave a constant relative purchasing power.[1] The relative PPP states that the rate of depreciation of one currency relative to another matches the difference in inflation between the two countries.

The main objective of this study is to investigate the validity of PPP using disaggregate data of the country's six major trading partners, namely U.S.A., United Kingdom, Japan, Singapore, Malaysia, and Indonesia.[2] The outline of the paper is as follows. Section 2 reviews empirical studies related to PPP. In section 3, the methodology for testing the validity of PPP is described. Section 4 presents the results, and Section 5 has the conclusions.

2. Review of the Literature

Empirical studies have generally provided inconclusive results on the validity of the PPP hypothesis. In other words, some studies tend to support PPP while others do not support it. For examples, Balassa (1964) found the validity of PPP, but Dornbusch (1980) and Frenkel (1981) found no evidence in favor of PPP.[3] Hakkio (1984) reexamined the PPP theory in a multiple exchange rate world. Using a time series-cross sectional estimation procedure, the results showed that PPP was supported in several currencies simultaneously. The studies on PPP have been extended to developing countries, and the emphasis is also on the difference between high and low inflation countries. Using a long span of annual data of real exchange rate between the United States and many countries to examine this notion, Dornbusch and Vogelsang (1991) found that real exchange rates did not contain a unit root. This implies that each real exchange rate is stationary

[1] This is the mild version of the PPP hypothesis (as explained in Dornbusch, 1988).

[2] Germany and the Netherlands are excluded due to a switch from their national currencies to Euro currency.

[3] These studies used the data from developed countries.

over a long period and the results support the mild version of PPP hypothesis. However, Perron and Vogelsang (1992) found that the null hypothesis of stationarity in the real exchange rate was accepted when a change in mean was allowed in unit root test. Their result was contradictory to the evidence using the standard Dickey-Fuller test, which rejected the null hypothesis.[4] Papell (1997) investigated long-run PPP by testing for unit root in real exchange rate of industrial countries under the floating exchange rate regime. The results as a whole supported the PPP. In addition, Cheung and Lai (1998) gave the evidence in favor of PPP in the post-Bretton Woods era. Holmes (2001) employed unit root test in heterogeneous panel data, and found that the evidence was against the PPP hypothesis for most of less developed countries. Most recent study by Darne and Hoarau (2007) gave no support for PPP in the case of Australia using the American exchange rate.

Besides testing for the null hypothesis of stationarity for the bilateral real exchange rate or real effective exchange rate to validate or invalidate the PPP hypothesis, an alternative test is the test for cointegration between nominal exchange rate and different measures of relative prices between the two countries. Earlier study by McNown and Wallace (1989) using Engle and Granger cointegration test between bilateral exchange rate and relative prices showed evidence in favor of PPP for four high inflation countries. However, empirical evidence on the PPP hypothesis based on the results of unit root and cointegration tests is mixed. For example, Conejo and Shields (1993) gave evidence in favor of PPP, but Hoque (1995) rejected this hypothesis. An empirical investigation by Liu (1992) using Johansen maximum likelihood technique for estimating cointegrating vectors proposed by Johansen (1988) in ten Latin-American countries gave the evidence in favor of the PPP hypothesis. Similarly, Mahdavi, and Zhou (1994) applied the Johansen (1988) technique and found that the PPP hypothesis is valid among high inflation countries. Huang and Yang (1996) used the residual based test for cointegration and Johansen technique to examine the long-run PPP. They found that the residual based test tended to reject the long-run PPP while the other test tended to support it. There are many studies concerning the Asian economies, for example, Fujii (2002) found that the results from cointegration test showed that the long-run PPP had remained

[4] See Rogoff (1996) to understand why the real exchange rate might follow a random walk hypothesis, and thus PPP fails to hold.

to dictate the exchange rate and price relationship in Korea, the Philippines, Singapore, and Thailand, except Indonesia. Barumshah, et al. (2004) investigated the validity of a mild form of PPP by using the data from six East-Asia countries, including Thailand, in relation to two major trading partners (U.S.A, and Japan). The results from autoregressive distributed lag (ARDL) cointegration procedures showed no evidence supporting PPP before the financial crisis, but strong evidence after the crisis was observed.

Empirical studies concentrate on testing the stationarity property of the real exchange rates (mean reversion), and cointegration tests. However, the results are still inconclusive as mentioned above.

3. Methodology

This section describes the framework of analysis, data, and the methods that are used in the study.

3.1 Conceptual Framework

Formally, the bilateral real exchange rate is defined as:

$$R_t = E_t\left(\frac{P_t^*}{P_t}\right) \tag{1}$$

where R denotes the bilateral real exchange rate,
E denotes the nominal exchange rate (domestic currency/foreign currency),
P* denotes the foreign price level, and
P denotes the domestic price level.
In the logarithmic form, equation (1) becomes:

$$q_t = s_t + (p_t^* - p_t) \tag{2}$$

where $q_t = \log(R_t), s_t = \log(E_t), p_t^* = \log(P_t^*), p_t = \log(P_t)$.

The nominal exchange rate is the domestic price of foreign currency. The foreign and domestic price levels are the price indexes, which may be

the consumer price index, the wholesale price index, or GDP deflator. If the purchasing power parity hypothesis holds, the real exchange rate will be a constant. In other words, the PPP hypothesis states that the real exchange rate will revert to a constant mean. Therefore, movements in the real exchange rate can be interpreted as a deviation from PPP.

In terms of the rate of change, equation (2) can be rewritten as:

$$\Delta q_t = \Delta s_t + \Delta p_t^* - \Delta p_t \tag{3}$$

Equation (3) shows that if PPP holds, the rate of change of nominal exchange rate in a given period will offset inflation differential of the two countries in the same period.

From equation (1), if real exchange rate is constant in the long run, the relationship between nominal exchange rate and relative price levels should be in the form:

$$E_t = R_t\left(\frac{P_t}{P_t^*}\right) \tag{4}$$

Therefore, $\log(E_t) = \log(R_t) + \log\left(\frac{P_t}{P_t^*}\right)$, and in regression form, the equation should be specified as:

$$\log E_t = \alpha + \beta \log RP_t + \varepsilon_t \tag{5}$$

where $RP_t = \left(\frac{P_t}{P_t^*}\right)$, which is the log of the ratio of domestic to foreign price level. The error term will capture deviations from PPP. In the case, there should be systematic co-movements between the two variables in equation (5). In other words, the validity of PPP implies that perfect

international arbitrage is likely to force the nominal exchange rate and the price level ratio to move together.

3.2 Data

The data used in this study are monthly from July 1997 to December 2007. Bilateral exchange rates[5] are obtained from the Bank of Thailand while the price levels are obtained from International Financial Statistics of IMF (CD-ROM). The price levels used are PPI instead of CPI because some countries reported CPI only from the capital cities.

Bilateral real exchange rate between Thai baht and trading partner i's currency is defined as $(E_i P_i^*)/P$, where P_i^* is the producer price index (PPI) in country i, E_i is the nominal exchange rate between baht and trading partner i's currency, and P is Thailand's PPI. There are 126 observations in this study.

3.3 Method

a. Unit Root Tests

The power of the popular unit root tests is open to question. Many researchers posit that the failure to reject the null hypothesis of nonstationarity of the series, including real exchange rate for PPP, might be due to the low power of the tests used in empirical studies. Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests proposed by Dickey and Fuller (1981) and Philips and Perron (1988) are now well understood since these two tests are widely used in the time-series econometrics. The alternative methods proposed by Elliott, et.al. (1996) and Ng and Perron (2001) are believed to be more efficient and have higher power of the tests for unit root.

The test proposed by Elliott, et. al., (1996) is called Dickey-Fuller generalized least squares (DF-GLS) test, which is a unit root test based on a

[5] They are the average between buying and selling rates by commercial banks in Bangkok metropolitan area.

quasi-difference detrending of the series in order to increase the power of Dickey-Fuller test proposed by Dickey and Fuller (1979). According to DF-GLS test, the regression is in the form:

$$\Delta X_t^d = \beta_0 X_{t-1}^d + \sum_{i=1}^{k} \beta_i \Delta X_{t-i}^d + e_t \tag{6}$$

where X_t^d is the locally detrended series X_t. The test is designed to test the null hypothesis that the series is non-stationary against the alternative hypothesis that the series is stationary.[6]

Ng and Perron (NP) test is a modified PP test, which is a non-parametric approach to correct the residual autocorrelation. This test is based on the specified regression as:

$$\Delta X_t^d = (\delta - 1) X_{t-1}^d + \sum_{i=1}^{k} \phi_i \Delta X_{t-i}^d + u_t \tag{7}$$

The series is defined as the one in equation (6). The null hypothesis is $H_O : \delta = 1$ or the series is non-stationary. The test statistic is MZ_a and MZ_t. They also recommend the use of modified information criterion, such as modified AIC, to determine the optimal lag length in equation (7). The reason is that AIC and SIC tends to select the lag length that is too small for unit root tests to have good size.

Kwiatkowski et al. (1992) proposed the test with the null hypothesis of stationarity around a constant called KPSS test. The regression of this test is of the form:

$$X_t = \alpha + e_t \tag{8}$$

[6] The test is similar to ADF test except for the detrended series in DF-GLS test is used instead of original series.

The test statistic is obtained from this regression. To obtain robust results Caner and Kilian (2001) suggest the application of DF-GLS and NP tests plus KPSS test.

b. Bounds Testing for Cointegration

If equation (5) is estimated by OLS method, the results will show the impact of the right-hand side variable on the dependent variable. The long-run relationship between bilateral nominal exchange rate and relative price levels can be assessed. Time-series econometrics (i.e. Unit root tests and cointegration tests) can be used to determine if there exists the long-run relationship between the two variables.

Following Pesaran et al. (2001), equation (5) can be rewritten in the autoregressive distributed lag (ARDL) model, which is specified as

$$\Delta \log E_t = \mu + \sum_{i=1}^{p} \gamma_i \Delta \log E_{t-i} + \sum_{j=0}^{q} \varphi_i \Delta \log RP_{t-j} + \delta_1 \log E_t + \delta_2 \log RP_t + \eta_t \tag{9}$$

Without lagged level variables, equation (9) is a standard vector autoregressive (VAR) model. By adding the lagged level variables to the VAR, the F-statistic can be computed. Then the computed F-statistic is used to test for the joint significance of the lagged level variables. It should be noted that the F test in this context is non-standard and has its own new critical values. Pesaran et al. (2001) provided the upper bound critical value for all I(1) variable, and the lower bound critical value for all I(0) variables in the estimated equation. The advantage of this procedure is that there is no need for testing for unit root before estimating the equation since integrating properties of the variables are incorporated in calculation of the critical values. The variables in the equation can be I(0) or I(1) or combination of the two. Cointegration exists when the computed F-statistic is greater than the upper bound critical value. If the computed F-statistic is smaller than the lower bound critical value, no cointegration will exist. However, when the computed F-statistic takes the value between the upper and lower bound critical values, the result is inconclusive.

4. Results

By visually inspecting the plots of log real exchange rate series, it can be seen that all series do not exhibit linear trends. Therefore, the tests for unit root around a constant should be enough to investigate the mean reversion in six real bilateral exchange rates. The results are reported in Table 1.

Table 1. Results of Unit Root Tests of Bilateral Real Exchange Rates

Trading Partners	ADF Test	PP Test	DF-GLS Test	Ng-Perron (MZ_α) Test	KPSS Test
U.S.A. (Baht/US Dollar)	-0.158 [4]	-1.212 [3]	-0.869 [4]	-1.871 [4]	0.542* [9]
U.K. (Baht/Pound)	-0.919 [0]	-2.693 [6]	-1.292 [10]	-1.702 [10]	0.557* [8]
Japan (Baht/100Yen)	-0.014 [12]	-0.325 [4]	-0.243 [12]	-2.331 [12]	0.982* [9]
Singapore (Baht/Dollar)	-2.835 [1]	-2.338 [1]	-2.806* [1]	-16.095* [1]	0.393 [9]
Malaysia (Baht/Ringgit)	-2.125 [0]	-2.215 [1]	-0.674 [0]	-1.437 [0]	0.471* [9]
Indonesia (Baht/1,000Rupiah)	-2.586 [5]	-2.119 [4]	-1.969* [3]	-8.602* [3]	0.674* [9]
Critical Value (5%)	-2.886	-2.885	-1943	-8.100	0.463

Note: The number in bracket is the optimal lag length and bandwidth. Optimal lag length for ADF test is determined by AIC. Modified AIC is used determined the lag length in DF-GLS and NP tests. The optimal bandwidth is determined for PP and KPSS tests. * denotes the 5% level of significance.

The results of non-stationarity tests on six bilateral real exchange rates show that PPP does not hold using the ADF and PP tests since the null hypothesis of non-stationary real exchange rate cannot be rejected at the 5% level of significance. The more powerful tests give somewhat different results. The DF-GLS and NP tests give the same results as those of the ADF and PP tests for the baht per US dollar, British pound, Japanese yen, and Malaysian ringgit. So does the powerful KPSS test for stationary real exchange rate series. However, PPP seems to hold between Thailand and Singapore since the three powerful unit root tests support the stationary

baht/Singapore dollar series. For the baht/Rupiah series, DF-GLS and NP tests show that it is stationary, but the KPSS test rejects the stationary property of the series. It can be said that the baht/Rupiah real exchange rate series is stationary because two of the more powerful tests indicate that it is stationary in level.

Based upon the more powerful unit root tests, i.e., DF-GLS, NP, and KPSS tests, the results show that PPP does not hold for the majority of bilateral real exchange rate series, i.e., four out of six real exchange rate series have no mean reversion.

The ARDL model is estimated between Thai baht/each currency of major trading partners and their relative price levels. The AIC criterion is used to select the optimal number of lags of each first differenced variable in equation (9). By adding lagged level variables to the equation, the computed F-statistics are obtained from all six estimated equation. The results are reported in Table 2.

Table 2. Bounds Testing for Cointegration between Nominal Bilateral Exchange Rate and Relative Price Levels

Trading Partner	Computed F-Stat	Optimal Lags (logE, logRP)	Serial Correlation Test
USA	3.410	8, 6	χ^2=2.482, p=0.324
UK	2.758	6, 5	χ^2=24.010, p=0.000
Japan	3.240	7, 3	χ^2=5.271, p=0.072
Singapore	9.520*	2, 3	χ^2=1.350, p=0.937
Malaysia	4.330	5, 3	χ^2=0.754, p=0.686
Indonesia	20.005*	6, 6	χ^2=8.029, p=0.018

Note: a. From Table CI(iii) Case III of Pesaran, et al. (2001), The upper bound critical value is 5.73, and the lower bound critical value is 4.94 at the 5% level.

b. * denote significance at the 5% level.

The results from Table 2 indicate that there is a long-run relationship or cointegration between nominal bilateral exchange rate and relative price levels only in the cases of Singapore and Indonesia as major trading partners since the computed F-statistic is greater than the upper bound critical value. The results are the same as those of the stationarity tests. It should be noted that the F-test in this case is sensitive to the lag length of first differenced variables in the model. Even though the AIC criterion deems appropriate, serial correlation is still present in the cases of UK and Indonesia.

5. Conclusion

This study investigates the validity of the purchasing power parity theory. Monthly data from July 1997 to December 2007 are used. The methods used in this study are (1) unit root tests of bilateral real exchange rate series of Thailand and its major trading partners: U.S.A., United Kingdom, Japan, Singapore, Malaysia, and Indonesia, and (2) bounds testing for cointegration between bilateral exchange rate and relative price levels. The results show that only two out of six cases support PPP, and thus PPP does not seem to hold in Thailand. However, it should be noted here that the failure of PPP might be due to (1) the size of major trading partners compared to that of Thailand, such as U.S.A, and Japan, and (2) the period of study might be too short for testing the validity of PPP theory. By comparing the results of cointegration test in this study with those of Barumshah, et al. (2004), the results of this study shows no cointegration between the Thai nominal exchange rates in terms of US dollar and Japanese yen with their respective price ratios after the Asian crisis while those of Barumshah et al. showed strong evidence. However, their time span is 60 months shorter than that of this study and their data was up to 2002 and included years for Thailand when it was under pegged exchange rate regime.

Based on the results of this study, the unpredictability of the bilateral real exchange rates with major trading partners, especially the US and Japan, will distort decisions by domestic exporting firms. In the year 2006, the country's share of exports to the two trading partners accounted for more than 25 percent of overall exports. In addition, the lack of co-movements between nominal exchange rates and relative prices implies that an appreciation or depreciation in exchange rates will not be offset by a

matching decline or rise in relative prices. This might create uncertainty for firms in the foreign sector and foreign investors in the financial market.

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