The validity of PPP: evidence from Lagrange multiplier unit root tests for ASEAN countries

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Abstract

The univariate and panel Lagrange Multiplier (LM) unit root tests with one and two structural breaks proposed by Lee and Strazicich (2003, 2004) which are considerably more powerful than traditional tests are employed to investigate whether the purchasing power parity (PPP) theory holds true for ASEAN countries by using both black market and official exchange rates. We find strong evidence in favour of long-run PPP for six ASEAN countries namely, Indonesia, Malaysia, Myanmar, Philippines, Singapore and Thailand.

1. Introduction

The Association of Southeast Asian Nations (ASEAN) was inaugurated on 8 August 1967 and celebrated its 42 th anniversary in August 2009. Although ASEAN has a long history, the East Asian economic crisis of 1997–99 which is started with Thailand and spread rapidly into the rest of region and beyond makes this association is well known in the world. Since ASEAN located at the center of a number of Asia Pacific regional initiatives, including the ASEAN Plus Three (APT), the ASEAN-China Free Trade Agreement (ACFTA), the Asia Pacific Economic Cooperation (APEC) forum, and the East Asian Summit (EAS), these initiatives also makes ASEAN upswing.

This regional power makes also an interesting area to test Purchasing Power Parity (hereafter, PPP) which is the most popular theories for explaining the long-run behavior of exchange rates (Beker 2006).

According to PPP, in the absence of transportation costs, tariffs and other barriers to trade, and with free trade, the exchange rate between two countries should reflect the relative purchasing power of the two countries. Markets enforce the law of one price, because the pursuit of profit tends to equalize prices of identical goods in different countries. Even though short run deviations from PPP may occur, the PPP relationship is expected to hold in the long run. PPP states that the exchange rate between two countries should reflect the relative purchasing power of the two countries. Purchasing Power Parity (PPP) is the most conventional and fundamental means through which the long-term equilibrium exchange rate can be explained (Feridun 2005).

Studying whether PPP holds is important for policy makers. Such as if PPP holds, and then the effects of a shock to the real exchange rates would be only transitory, meaning that real exchange shocks have no unenviable effects on trade flows at least in the long run. Besides, if PPP holds within a region, for example, for the Euro zone in European Union, this would imply price level convergence across the member states, suggesting minimal real exchange rate risk. Many studies have been undertaken to examine the validity of PPP by taking monetary shocks into account[1].

The studies, based on neither the time series or panel data analysis, focused on developed countries; Thus, leaving developing countries such as ASEAN with very few studies. For example, Manzur and Ariff (1995) examined the presence of the PPP for ASEAN countries. Although, the hypothesis of unit root for these countries failed to be rejected when classical unit root tests were used, they rejected unit root hypothesis as soon as the Sim's test is applied. Wu (1996) found support for the PPP hypothesis with respect to the bilateral Taiwan exchange rate relative to the United Kingdom, but rejected the PPP hypothesis for bilateral exchange rates relative to Canada, France, the United States and West Germany. Using both the traditional unit root tests and error-correction model (ECM), Daniel Lee (1999) examined the validity of PPP in thirteen Asia Pacific economies. He provided that the PPP exists for most of the sample economies when the ECM procedure was applied. Bahmani and Mirzai (2000) and Azali et al. (2001) found the evidence of PPP for most of 20 developing countries and Southeast Asian currencies, respectively.

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[1] For excellent discussions on PPP, see Taylor (1998) (2006) and Goux and Cordahi (2007).

In another study, Enders and Chumrusphonlert (2004) provided enough evidence to exist the validity of long-run PPP for most of the Asian nations. In contrast, Doganlar (1999) investigated the validity of PPP for developing Asian countries, such as India, Indonesia, Pakistan, Philippines and Turkey. The exchange rate and relative price series do not appear to be cointegrated for most of the countries, inconsistent with PPP hypothesis for India, Indonesia, Pakistan, Philippines. Using a panel cointegration technique, Basher and Mohsin (2004) found that PPP for 10 selected Asian countries can be rejected. Based on the data of black market exchange rates for eight Asian countries, Bahmani and Goswami (2005) revealed that PPP can be rejected even if the exchange rate and the relative price have a cointegrating relationship. Alba and Papel (2007) reported that PPP holds for panels of European and Latin American countries, but not for African and Asian countries.

Although the above-mentioned studies examined the validity of PPP by using the official exchange rate except Bahmani and Goswami (2005), they reached mixed results. A common feature of the available empirical studies above is that the majority of them have relied upon the official exchange rates in testing PPP. However, using the official rates for countries with significant black or parallel market activities may significantly bias the inferences regarding the validity of PPP as the black market or parallel exchange rates serve as a better proxy for floating exchange rates (Bahmani and Gelan 2006).

In order to cope with the problem, it has been suggested that the black market exchange rate better represents market forces, compared to the administrated official exchange rate, when testing for PPP. A black market exchange rate arises when governments try to restrict capital flow by imposing various types of restrictions on the purchase of foreign currencies. These restrictions contain such as licensing, waiting time, and various taxes (Hassanain 2005). It is argued that in many countries the volume of transactions in black markets may exceed that in the official market (Cerrato and Sarantis 2007). Despite the importance of the black market exchange rates in emerging market economies, only a few papers in the PPP literature use this major source of information to investigate the long-run PPP hypothesis. Following the pioneering work of Agénor and Taylor (1993), who examined nineteen developing countries, Baghestani (1997), Phylaktis and Girardin (2001) Aslan et al. (2009) investigated India, China and Turkey, respectively.

This study contributes to this literature by testing the PPP hypothesis for six ASEAN countries namely Indonesia, Malaysia, Myanmar, Philippines, Singapore and Thailand using univariate and panel Lagrange Multiplier (LM) unit root tests with one and two structural breaks proposed by Lee and Strazicich (2003, 2004) and Im et al. (2005) by taking black market into account which represents market forces, compared to the administrated official exchange rate.

The remainder of the article is set out as follows. Section 2 presents the analytical framework. The data and the empirical results with both one and two structural breaks are reported and discussed in Section 3. Section 4 concludes the study.

2. Theoretical Model of the Real Exchange Rate and the Theory of Purchasing Power Parity

According to the strong form of PPP, the nominal exchange rate is proportional to the relative price so that the real exchange rate remains constant overtime.

$$ER_R = NE_r \frac{P^*}{P}$$ (1)

where ER_R is the real exchange rate, NE_r is the nominal exchange rate and P* and P are the foreign and domestic prices, respectively.

In logarithmic form, the real exchange rate can be represented by

$$\log(ER_R) = \log(NE_r) + \log(P^*) - \log(P)$$ (2)

Following equation shows the model of mean reverting real exchange rate

$$\log(ER_R)_t = \sigma + \phi \log(ER_R)_{t-1} + \varepsilon_t$$ (3)

where σ and ε are constant and error term, respectively. PPP suggest that real exchange rate series should be stationary. If real exchange rate is stationary this exhibit that any percentage changes in the price level between two countries would be offset by an equal depreciation/appreciate on of the nominal exchange rate.

If there is a unit-root in the real exchange rate this implies that shocks to the real exchange rate are permanent and PPP does not exist between two countries

3. Data and Empirical Results

The black market exchange rates data are taken from the study of Reinhart and Rogoff (2004). Price levels are defined as the logarithm of the price ratio generated by the each country's consumer price index (CPI) divided by the US CPI (IFS line 64) and taken from the International Monetary Fund's International Financial Statistics (IMF-IFS) database.

Due to the lack of data for ASEAN countries such as Indonesia, Malaysia, Myanmar, Philippines, Singapore and Thailand before 1973 and unavailability of data beyond 1998 for black market, the data spans from 1973-1998.

As a result, 'spurious rejections' in the use of ADF-type endogenous break tests can lead researchers to conclude that a time series is trend-break stationary when, in fact, the series is non-stationary with break(s) in testing unit root.

Lee and Strazicich (2001) further investigated this issue and discovered the source of the size distortions. They propose a two break minimum Lagrange Multiplier (LM) unit root test in which the alternative hypothesis clearly implies the series is trend stationary.

In this study, the endogenous break LM unit root test[2] derived in Lee and Strazicich (2003) is employed in PPP testing for ASEAN countries.

The break minimum LM unit root can be described as follows. According to the LM principle, a unit root test statistic can be obtained from the following regression:

$$\Delta r_{it} = \delta' \Delta Z_t + \phi \bar{S}_{t-1} + \mu_t \tag{4}$$

Here, Δ is the first difference operator;

$\bar{S}_t = r_t - \hat{\Psi}_x - Z_t \hat{\delta}_t$ t= 2,.....T; $\hat{\delta}$ are coefficients in the regression of Δr_t on ΔZ_t ; $\hat{\Psi}_x$ is given by $r_t - Z_t \delta$ .If real exchange rate has a unit root for country i then ϕ $t = 0$, which is the null hypothesis tested using the t-test against the alternative hypothesis that $\phi t < 0$. The panel LM test statistic is obtained by averaging the optimal univariate LM unit root t-test statistic estimated for each country. This is denoted as LM_i^{τ}

$$LM_{barNT} = \frac{1}{N} \sum_{i=1}^{N} LM_i^{\tau} \tag{5}$$

Im et al. (2005) constructed a standardized panel LM unit root test statistic by letting $E(L_T)$ and $V(L_T)$ denote the expected value and variance of LM_i^{τ} respectively under the null hypothesis. Im *et al.* (2005) then compute the following expression:

$$\Psi_{LM} = \frac{\sqrt{N}\,[LM_{barNT} - E(L_T)]}{\sqrt{V(L_T)}} \tag{6}$$

The numerical values for $E(L_T)$ and $V(L_T)$ are in Im *et al.* (2005). The asymptotic distribution is unaffected by the presence of structural breaks and is standard normal.

We begin our empirical analysis by examining the univariate LM test without any structural breaks. These results are reported in Table 1.

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[2] Beginning with a maximum of *lag is* 8 lagged terms, if the last lag is significant, the upper bound is chosen. If not, the lag length is reduced by one until the last lag becomes significant. If no lags are significant, the lag length is set equal to zero. We use the 10% asymptotic normal value of 1.645 to determine the significance of the *t*-statistic on the last lag.

Table 1. LM unit root test without structural break

ASEAN Countries	Official Exchange Rate LM test statistic	Black Market LM test statistic
Indonesia	-5.375 [1]***	-4.788 [1]***
Malaysia	-4.002 [0]***	-3.613 [1]***
Myanmar	-2.314 [5]	-1.658 [6]
Philippines	-2.216 [5]	-1.892 [5]
Singapore	-2.012 [3]	-3.329 [7]***
Thailand	-1.594 [3]	0.435 [8]
Panel LM test statistic	-3.815***	-2.340***

Note: The 1, 5 and 10% critical values for the LM test without a break are −3.63, −3.06, −2.77, respectively. The corresponding critical values for the panel LM test are −2.326, −1.645 and −1.282. *,**and *** denote statistical significance at the 10%, 5% and 1% levels respectively. The lag length which was selected using the 't-sig' approach is reported in parentheses

The unit root null is rejected for Indonesia and Malaysia at the 1 per cent level. The four countries for which we cannot reject the unit root null are Myanmar, Philippines, Singapore and Thailand. Further examination of these results reveals that black market rate is significant in Singapore, whereas it is insignificant in the official rate.

In addition to individual LM statistics, we explore the panel version of the LM test to the group of six countries in our sample. The panel LM statistics obtained are -3.815 and -2.340, which are smaller than the critical value (-2.326) at the 1 percent level of significance. The panel LM statistics imply that the null hypothesis of a unit root can be rejected, consistent with PPP hypothesis for both exchange rate series.

The failure to find stationarity in exchange rate series may be due to the fact that univariate unit root tests have low power when structural breaks are ignored. To cope with this problem, we investigated the validity of PPP by LM unit root test with one structural break.

Table 2. LM unit root test with one structural break

ASEAN Countries	Official Exchange Rate LM test statistic	Break Year	Black Market LM test statistic	Break Year
Indonesia	-5.304 [1]***	1994	-4.815 [1]***	1985
Malaysia	-4.238 [0]**	1986	-4.440 [1]***	1984
Myanmar	-4.004 [7]**	1991	-3.397 [6]	1991
Philippines	-6.844 [8]***	1989	--7.885 [2]***	1986
Singapore	-5.819 [2]***	1989	-3.936 [7]***	1987
Thailand	-5.533 [2]***	1988	-4.346 [2]***	1986
Panel LM test statistic	-12.353***		-10.692***	

Note: Critical values for the LM test statistic from Lee and Strazicich (2004) at the 10%, 5% and 1% significance levels are -3.211, -3.566, -4.239. **and *** denote statistical significance at the 5% and 1% levels respectively. And the 1%, 5% and 10% critical values for the panel LM unit root tests with structural breaks are -2.326, -1.645 and -1.282 respectively. The lag length which was selected using the 't-sig' approach is reported in parentheses

When we consider LM unit root test with one structural break for official exchange rate, the unit root null is rejected for Indonesia, Philippines, Singapore and Thailand at the %1 level and for Malaysia and Myanmar at the 5% significance level.

Although the null hypothesis of a unit root cannot be rejected, inconsistent with PPP hypothesis for Myanmar in black market, the unit root null is rejected for Indonesia, Philippines, Singapore, Thailand and Malaysia at the %1 level which provides strong evidence for the validity of PPP as panel LM unit root test with one structural break confirmed.

In addition to one break test, the LM univariate and panel tests are experimented further by conducting with two structural breaks to avoid the lack of ability to reject the unit root null hypothesis may be due to the failure to allow for more than one structural break for especially Myanmar.

Table 3. LM unit root test with two structural breaks

ASEAN Countries	Official Exchange Rate LM test statistic	Break Years	Black Market LM test statistic	Break Years
Indonesia	-7.630 [7]***	1983-1988	-7.298 [8]***	1989-1994
Malaysia	-10.330 [8]***	1983-1994	-9.593 [7]***	1983-1993
Myanmar	-17.234 [8]***	1985-1991	-5.629 [2]***	1988-1994
Philippines	-11.065 [8]***	1984-1994	--6.753 [7]***	1989-1992
Singapore	-9.933 [2]***	1986-1991	-17.839 [7]***	1986-1990
Thailand	-7.555 [7]***	1985-1989	-6.844 [5]***	1986-1989
Panel LM test statistic	-28.941***		-24.340***	

Note: The 1, 5 and 10% critical values for the panel LM test with a break are −2.326, −1.645 and −1.282, respectively. The 1, 5 and 10% critical values for the minimum LM test with two breaks are −4.545, −3.842 and −3.504, respectively. (*, **, ***) denote statistical significance at the 10, 5 and 1% levels, respectively. The lag length which was selected using the 't-sig' approach is reported in parentheses.

When we considered two structural breaks in the LM unit root tests, for both sets of real exchange rate series, we found strong evidence of stationarity, consistent with PPP.

The outcome of the break dates has some signals for the validity of PPP hypothesis. For example on 30 March 1983, the effective rate for the Indonesian Rupiah was depreciated 27.6%, from 702 to 970 per U.S. Dollar and in 1986 the effective rate for the Rupiah was devalued 31% in terms of U.S. Dollar and commercial banks were free to determine and quote exchange rates for all currencies in Malaysia. In 1989 Thailand was considered to be pegged to composite basket of currency.

4. Conclusion

In this article, the validity of PPP in ASEAN countries is examined by using both the official as well as the black market exchange rates. The motivation comes from the fact that many papers consider official exchange rates to investigate the PPP. Since, the ability to test for consistency of the PPP hypothesis in emerging economies is prevented by the frequent changes in the exchange rate arrangement, resulting in long periods of fixed exchange rates, the black market exchange rate better represents market forces may be more suitable rates

compared to the administrated official exchange rate, when testing for PPP. The validity of PPP in ASEAN countries is examined by taking structural break into account and provides strong evidence for both rates.

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