Revisiting Purchasing Power Parity of Papua New Guinea

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Abstract- **Studies on long-run Purchasing Power Parity (PPP) for Papua New Guinea (PNG), one of the least developed countries in the world, is limited. Unlike the two existing studies, which consistently show no support for PPP, this note uncovers evidence of PPP for Papua New Guinea (PNG). Results from further analysis indicates that nominal exchange rates and relative prices are nonlinearly interrelated. This PPP in nonlinear dynamic fails to be detected in previous studies that did not include nonlinear analysis. Frictions in international trade could be behind the establishment of the above-mentioned nonlinear relationship.**

Keywords: Purchasing power parity; Cointegration; Nonlinear; Rank tests; Least Developed country; Papua New Guinea.

I. INTRODUCTION

Purchasing power parity (PPP) hypothesis suggests that exchange rates between two currencies are determined by the relative prices of the corresponding two countries. Its empirical validity has important implications for policy-makers who based their decision on PPP. Among others, PPP provides policy-makers a benchmark to judge whether a currency is over- or under-valued, and to monitor the movement of exchange rate. This is particularly vital in less developed countries (Wickremasinghe 2005; 2009).

The question whether PPP holds or not is usually answered with linear testing procedures and a considerable studies have been done for both developed and developing countries[1]. Two exceptional studies of Wickremasinghe (2005; 2009) are worth-mentioning. In a novel study, Wickremasinghe (2005) examines the validity of PPP for Papua New Guinea (PNG), one of the least developed countries according to Committee for Development Policy Report (United Nations 2006). Using the residual-based test for cointegration procedures, the author found evidence against PPP based on more recent unit roots tests of Ng and Perron (2001), which have better size and power propoeties than the commonly adopted Dickey-Fuller types test statistics. This finding of no long-run relationship between exchange rate and relative price was not overturned even with the adoption of several panel unit root tests, which have been found more powerful than those based on individual time series (Wickremasinghe 2009).

Note that, the above findings against PPP by the testing procedures formulated based on linear econometric frameworks, imply two possibilities. First, exchange rate and relative price are not interrelated at all. Second, exchange rate and relative price exhibit nonlinear relationship, which can only be uncovered by nonlinear testing frameworks. In this respect, market frictions, costs of arbitrage in international goods, and government intervention, among others have been identified in the literature as plausible sources of nonlinear dynamic in PPP relationship. For the case of PNG, Wickremasinghe (2009) mentions that the transportation costs prevailing in international trade may lead PPP to follow a nonlinear stochastic process. To formally examine if nonlinear PPP really exist in PNG, the current study revisits the long-run validity of PPP hypothesis for this country using the rank tests advanced by Breitung (2001), which is not only capable in the detection of cointegration, but can further distinguish linear from nonlinear relationship if cointegration exists[2]. The remainder of this note is organised as follows. Section II describes the rank tests for cointegration and for neglected nonlinearity. Section III presents the data and empirical results, while the final section concludes this letter.

II. ECONOMETRIC METHODOLOGY

To test for the long-run relationship between nominal exchange rate (e_t) and relative price (r_t), the following bivariate rank test statistics are proposed by Breitung (2001):

$$B_1^* = \frac{\sup\limits_{1<t<T} |d_t|}{T\hat{\sigma}_{\Delta d}} \quad \text{and} \quad B_2^* = \frac{\sum\limits_{t=1}^{T} d_t^2}{T^3 \hat{\sigma}_{\Delta d}^2}, \qquad (1)$$

where e_t is defined as foreign price of PNG currency (kina) and r_t the relative price measured as the ratio of foreign consumer price index (CPI) to CPI of PNG. $d_t = R(e_t) - R(r_t)$, for $R(x_t) =$ Rank of x_t among ($x_1, x_2, ..., x_T$) where T is the sample size and $x_t = \{e_t, r_t\}$. Meanwhile, $\hat{\sigma}_{\Delta d}^2 = T^{-2} \sum\limits_{t=1}^{T} (d_t - d_{t-1})^2$ serves to adjust for possible correlation between the two series of interest.

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[1] See Taylor (2003; 2006; 2009) for a comprehensive overview on the recent development on long-run PPP studies. See also *Applied Economics Letters*, 16:1, 5 – 107 for a collection of the most recent empirical evidences supportive of the long-run PPP.

[2] Thus far, Liew *et al.* (2009a, b) are able to uncover evidence of PPP for East and Central Asian countries respectively by these rank tests.

According to Breitung (2001), the sequences of $R(e_t)$ on $R(r_t)$ evolve similarly under cointegration between e_t and r_t (long-run PPP is valid), otherwise they tend to diverge[3]. If on e_t and r_t are cointegrated, the linearity nature of the cointegration relationship may then be determined upon estimating the following regression:

$$\tilde{u}_t = c_0 + c_1 r_t + c_2 R(r_t) + \upsilon_t \qquad (2)$$

where $\tilde{u}_t$ stands for the residuals of regressing e_t on a constant and r_t, and compute the score test statistic $T \cdot R^2$, where R^2 is the coefficient of determination of Equation 2. The null hypothesis of linear relationship may be rejected in favor of the alternative hypothesis of nonlinear relationship if the computed statistic exceeds the χ^2 critical values with one degree of freedom.

III.   DATA AND EMPIRICAL RESULTS

For the purpose of comparison, this study follows the novel studies of Wickremasinghe (2005; 2009) and employs quarterly data spanning from 1994Q1 to 2004Q3 for PNG, and its trading partners, i.e., Australia, Japan, U.K. and U.S.A. The exchange rates per unit of PNG kina for the Australia dollar, Japan yen, U.K. pound and U.S. dollar, and consumer price index (CPI) for PNG were obtained from the *Quarterly Economic Bulletin* of the Bank of Papua New Guinea[4], while CPIs for the trading partners are taken from *International Financial Statistics* of the International Monetary Fund. The results of the Breitung rank tests for cointegration and nonlinearity are summarised in Table 1.

It is obvious from Table 1 that, in sharp contrast to the finding against PPP based on all those linear testing procedures employed by Wickremasinghe (2005; 2009), one of the bivariate rank tests statistics used in this study (B_1^*) is able to detect the existence of PPP for PNG, for all the exchange rates under study. Moreover, the result of rank test for nonlinearity, which is also shown in Table 1 suggests that the above discovered PPP exists in nonlinear dynamic. This finding of nonlinear dynamic in PPP may explain the finding of no PPP as reported in Wickremasinghe (2005; 2009), which adopts various tests that implicitly assume linear PPP relationship.

TABLE I.   RANK TESTS RESULTS (1994:1 – 2004:4)

Currency	Cointegration Test[a]		Linearity Test (lag)[b]
	B_1^*	B_2^*	
Australian dollar	0.149 ***	1.187	7.823 *** (4)
Japanese yen	0.141 ***	0.034	4.228 * (4)
U.K. pound	0.155 ***	0.041	3.010 ** (4)
U.S. dollar	0.197 ***	0.064	2.785 *** (4)

Critical Values			
10%	0.394	0.023	2.706
5%	0.364	0.019	3.841
1%	0.317	0.013	6.635

Notes: [a] Null Hypothesis: exchange rate and relative price are not cointegrated. Alternative hypothesis:otherwise. Reject the null hypothesis when test statistic is less than critical values given in Table 1 of Breitung (2001).
[b] Null hypothesis: linear relationship exists between exchange rate and the corresponding relative price. Alternative hypothesis: nonlinear relationship exists between exchange rate and the corresponding relative price. Reject the null hypothesis if computed $T \cdot R^2$ value exceeds the critical value. Optimal lag is selected based on Akaike's information criterion.
Superscripts ***, ** and * indicate the rejection of null hypothesis of no cointegration at 1, 5 and 10% significance level.

Additionally, to see if the relationship has changed over time, this study updates the data set to 2008Q4. The results as reported in Table 2 show consistent results even with a data set of few years longer. This implying that the nonlinear PPP relationship detected earlier is sustainable over the more recent time horizon.

TABLE II.   RANK TEST RESULTS (1994:1 – 2008:4)

Currency	Cointegration Test		Linearity Test (lag)
	B_1^*	B_2^*	
Australian dollar	0.081 ***	0.023 *	11.970 *** (4)
Japanese yen	0.064 ***	0.062	3.756 * (3)
U.K. pound	0.074 ***	0.035	4.716 ** (4)
U.S. dollar	0.097 ***	0.175	4.230 ** (4)
Critical Values			
10%	0.394	0.023	2.706
5%	0.364	0.019	3.841
1%	0.317	0.013	6.635

Note: See Table 1.

IV.   CONCLUSIONS

Amongst the enormous literature on PPP, Wickremasinghe (2005; 2009) conduct a novel PPP study for Papua New Guinea, a least developed country. Using first univariate and then panel time series analysis that assume linear PPP relationship, the author concluded that PPP does not hold for PNG. The current study re-examines the PPP issue from a different perspective. Based on Breitung (2001) testing procedures, which can detect both linear and nonlinear PPP relationships, this study found evidence of nonlinear dynamic in PPP for PNG. This finding is in sharp contrast to the findings of Wickremasinghe (2005; 2009), but it supports the conjecture of Wickremasinghe (2009), who mentions that PPP may follow a nonlinear stochastic process due to frictions such as transportations costs prevailing in international trade. This finding provides empirical foundation for policy-makers whose exchange rate determination and related decisions for PNG are based on PPP.

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