The Purchasing Power Parity Puzzle in Developing Countries

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ABSTRACT

Purchasing power parity (PPP) is one of the oldest theories of exchange rate determination which has received great deal of attention in the literature. The attention has grown recent years due to advances in time series econometrics. Whether an old or a new method is applied to testing PPP, its validity has not yet been settled among researchers. In this chapter we make another attempt at testing PPP for 20 developing countries by incorporating structural breaks into the testing procedure. We find support for a modified version of PPP in nine countries.

I. Introduction

Attempts to establish the validity of Purchasing Power Parity (PPP) as a theory of exchange rate determination have a long history which continues to puzzle researchers. Neither time nor an abundance of empirical papers have been able to satisfactorily resolve the conflicting results reported in the literature. In this chapter we investigate two sources for the persistence of the puzzle. The first considers the empirical methods used and the second considers the measure of the real exchange rate used.

We employ Perron's (1997) test for a unit root that allows for a structural break in the data. The test is applied to the real effective exchange rate for 20 developing countries constructed and published by Bahmani-Oskooee and Mirzai (2000). Perron's technique represents an improvement over previous econometric techniques used to determine the validity of PPP. It offers a resolution to some of the contradictory evidence by allowing for the endogenous identification of departures from PPP by distinguishing between permanent departures (unit roots, mean shifts) and temporary departures. In addition, it will differentiate between permanent shifts in the underlying process from mere shifts in the trend.

The second source of difficulty when verifying the validity of PPP concerns the exchange rate used. We provide a discussion of the challenges and potential problems with using a constructed real exchange rate index. In particular we discuss the importance of selecting the base year when constructing the effective exchange rate indices. The rest of the chapter is organized as follows. In section II we discuss the PPP puzzle. Section III discusses the testing procedures for PPP with the importance of structural break identified in Section IV. The empirical results for developing countries are reported and discussed in Section V with index number problems in Section VI. Finally Section VII concludes.

II. The PPP Puzzle

The search for verification of the Purchasing Power Parity (PPP) theory continues to puzzle researchers. While the first empirical investigation was done by Gustav Cassel in 1916[1] and repeated by many researchers after 1916, recent advances in time series methods cast doubt on the appropriateness and results of the older research. Armed with more appropriate time series techniques legions of researchers have taken up the challenge presented by this problem. Unfortunately, even with the recent resurgence in empirical work, little consensus has been established on the existence of PPP. In this chapter we investigate two related reasons for the persistence of the puzzle. The first considers the empirical methods used and the second considers the form of the real exchange rate used in the analysis.

Purchasing power parity's appeal as a theory of exchange rates can be explained by its' simple elegance. Derived from the law of one price and applied to a basket of goods it gives us a prediction for the nominal exchange rate which, if arbitrage is complete, should result in the exchange rate equaling the ratio of prices between countries. The real exchange rate should then be equal to 1 if PPP is to hold, which is often called absolute or strict PPP. A relaxed version of PPP, called weak or relative PPP doesn't require the real exchange rate to be one, but rather requires any changes in the relative price levels be proportional to changes in the nominal exchange rate. Therefore the real exchange rate will be constant, but not necessarily equal to one.

[1] See (Rogoff, 1996)

III. Testing for PPP

Empirical tests of PPP have largely focused on the weaker version by testing the real exchange rate's deviations from its' mean, where permanent deviations from the mean are evidence that the exchange rate follows a unit root process and thus relative PPP fails to hold. The rapid innovation in time series methods which test for the existence of a unit root, (for a primer see Phillips & Xiao, 1998), is responsible for an explosion in research. However, the application of unit root tests to the PPP puzzle have so far failed to yield conclusive results, although the picture is becoming clearer. The initial modern attempts to test the theory of PPP relied on a unit root test proposed by Dickey and Fuller (1979; 1981) where the null hypothesis is that the series contains a unit root. Unfortunately, it has been shown to have low power against the alternative, particularly in small samples; see for example Phillips and Perron (1988), Faust (1996), and Campbell and Perron (1991). Using the augmented Dickey Fuller (ADF) test several authors fail to reject the null and find little evidence in favor of PPP. This led Bahmani-Oskooee (1998), and Bahmani-Oskooee and Mirzai (2000), among others, to use an additional test suggested by Kwiatkowski, Phillips, Schmidt, and Shin (1992) known as KPSS which switches the null and alternative hypotheses of the ADF test. The results of these studies have perpetuated the puzzle, as the KPSS test suffers from its own power problems, often leading to conflicting results.

Overcoming the problems of low power resulted in attempts to increase the sample size, either through adding to the cross sectional dimension in a panel model or through increasing the time span of data. The increased number of observations along the time dimension helped overcome the low power problems, largely finding support for the

PPP in the long run, thus overturning the results from smaller samples (see for example Abuaf & Jorion, 1990; Lothian & Taylor, 1996). Still other studies (Lothian, 1997; MacDonald, 1996; Oh, 1996) overcame the power problem by increasing the sample along the cross sectional dimension and employing panel unit root techniques. Here the initial results again supported PPP in the long run, but recent challenges have emerged due to the difficulty of handling the cross sectional dependence in panel models (O'Connell 1998).

Rogoff (1996) reviews the recent advances, but as evidence for PPP, he finds them lacking. He believes that the convergence to PPP takes too long to be considered a verification of the theory. Even after allowing for potential nominal frictions, as in the exchange rate overshooting model proposed by Dornbusch (1976), convergence to PPP takes more than twice as long as expected. Hegwood and Papell (1998) propose a solution to this puzzle by demonstrating the exchange rate process may be typified by structural breaks. After accounting for potential structure breaks they find convergence to PPP occurs at a rate consistent with Dornbusch's model.

IV. PPP and Structual breaks.

Perron (1989) recognized that stationary series can masquerade as non-stationary if they experience a structural break. Perron (1989) alters the traditional ADF test to allow for a structural break(s) through the inclusion of time specific dummy variables selected by the researcher. Applying Perron's method to the Australian real effective exchange rate Corbae and Ouliaris (1991) fail to support PPP, even after allowing for structural breaks in 1922 and 1973. However, they find support for PPP when they use a bilateral exchange rate between Australia and the UK, using the same break dates. Still other authors using various methods to identify structural breaks in the exchange rate generally find support in favor of PPP (see for example Clemente, Montanes, & Ponz, 1999; Hegwood & Papell, 1998; Wu, 1997)

Unfortunately Perron's method gives little guidance on selecting the number and location of the break points. Dating them becomes arbitrary and dependant upon the particular researcher. In fact several authors (see for example Christiano, 1992; Zivot & Andrews, 1992) argued that Perron's method of exogenously determining the break point through data inspection, generates biased results, as it is invariably correlated with the data. Perron (1997), Christiano (1992), and Bai and Perron (1998) answered this problem with alternative methods of endogenously determining the break point.

Hegwood and Papell (1998), using the alternative method of Bai and Perron (1998) found many of the bilateral rates can be classified as stationary around one or more structural breaks. Using real bilateral exchange rates for the US against the rest of the G-7 they considered their findings a refutation of the PPP hypothesis even though the series is stationary. Since it is stationary around a mean which changes over time, they refer to it as Quasi Purchasing Power Parity (QPPP).

V. PPP and Developing Countries

In most of the work done on PPP relatively little attention is given to developing countries (some notable exceptions Bahmani-Oskooee, 1993; Bahmani-Oskooee & Mirzai, 2000). In this section we apply a recent technique, proposed by Perron (1997), to the real effective exchange rate indices of 20 developing countries[2]. The data for the real effective exchange rates come from Table 1 in Bahmani-Oskooee and Mirzai (2000). They construct quarterly real effective exchange rate indices from 1973:1 to 1997:3[3] The real effective exchange rate for home country j is constructed according to equation 1.

$$\sum_{i=1}^{n} \alpha_{ji} \left(\frac{(P_j R_{ji} / P_i)_t}{(P_j R_{ji} / P_i)_{95}} \times 100 \right) \qquad (1)$$

Where n is the number of trading partners and P_j is the price level in home country j and P_i is the price level in trading partner i. The nominal exchange rate, R, is defined as the number of units of i's currency per unit of j's currency. Therefore an increase in the index indicates a real appreciation of country j's currency. The trade shares, α_{ji}, are based upon the 1995 import shares from trade between country j, and countries i, where i represents: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway Spain, Sweden, Switzerland, UK and the US.

Following Bahmani-Oskooee and Mirzai (2000) we first test each series for unit root using the KPSS test. Table 1 reports the results for the ε_τ test where the null is trend stationary[4].

Table 1 goes about here

It is clear from Table 1 that most of the series can not be considered stationary

[2]The countries included were: Colombia, Costa Rica, Ecuador, Egypt, Greece, India, Indonesia, Korea, Malaysia, Mexico, Pakistan, Philippines, Portugal, Singapore, South Africa, Srilanka, Thailand, Tunisia, Turkey, Ethiopia

[3] Except Ethiopia which ends with 1996:3

[4] Results for the ε_μ test for mean stationarity are available from the authors upon request.

around a linear trend. There are 6 cases, including Korea, Malaysia, Pakistan, Singapore, South Africa, and Thailand where we can not reject the null hypothesis of stationarity around a linear trend. Combining these results with those of the ADF test in Bahmani-Oskooee and Mirzai (2000), we have good evidence of stationarity for Korea, Pakistan, and Singapore, leaving us to puzzle over Malaysia, South Africa, and Thailand.

Returning to the results of the KPSS test, in 14 of the cases, using 4 as the lag truncation parameter, we can reject the null hypothesis of trend stationarity. However, as we previously noted, this is not necessarily evidence in favor of the unit root hypothesis as the series may contain a structural break. In order to test for this possibility we turn to the method proposed by Perron (1997). It is similar to the Dickey -Fuller test and involves estimating:

$$y_t = \alpha y_{t-1} + \mu + \theta DU_t + \beta t + \delta D(T_b)_t + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \qquad (2)$$

Where y is the series of interest and T_b is the date of the structural break. Perron (1997) provides three methods for selecting the break date. We use the method which involves maximizing the t-statistic used to test $\alpha = 1$. The other methods focus on choosing the break point that maximizes the t-statistic on the intercept break point or the slope break point. Since we choose a model where both the slope and intercept are allowed to change, neither of the alternative methods provide us with an obvious choice between testing the intercept or testing the slope. Once the break date is selected, the test reduces to the traditional ADF test, where a rejection of the null hypothesis suggests that the series is stationary around a structural break. The results of this step are reported in Table 2.

Table 2 goes here

From Table 2 we gather that in nine of the cases, including: Costa Rica, Ecuador, Egypt, Greece, Indonesia, Korea, Mexico, Srilanka, and Tunisia where the KPSS test provided good evidence against stationarity, we can reject the hypothesis of a unit root, after we allow for a structural break. Following Hegwood and Papell (1998) we refer to this as Quasi Purchasing Power Parity. In fact, since we include a linear trend in our test this is even further from the traditional concept of relative PPP than their work. In their case the exchange rate reverts to a shifting mean, whereas in our case both the mean and slope are changing. Including a shifting mean and trend may help to account for the impact that productivity differentials have on the exchange rate as noted by Balassa (1964).[5] The trend may capture the difference in productivity growth rates between the developing countries and their developed trading partners.

Looking at the break dates selected by Perron's test 11 of them lie between the fourth quarter of 1984 and the third quarter of 1985. As Hegwood and Papell (1998) noted this roughly coincides with the Plaza Accord, a time when the real value of the US dollar was quite high relative to its' recent value. There are many other reasons that may explain the structural breaks, such as a change in trade barriers, or a shift in transportation costs. Another reason could be the exchange rate that we use. As Corbae and Ouliaris (1991) note, a non-stationary effective exchange rate index can disguise a stationary bilateral exchange rate.

VI. Index Number Problems

The index number problem is not new, and not particular to tests of PPP, but it is

[5] For more on PPP and productivity differentials see Bahmani-Oskooee (1992) and Bahmani-Oskooee and Nasir (2001, 2002).

worth noting. The real exchange rate consists of two price indices which represent both domestic and foreign prices. It is clear that these indices likely do not contain the same goods or the same relative weights, and they often include non-tradables. Rogoff (1996) discusses the difficulty with testing PPP using these measures, and the attempts to overcome the problem. The problem is potentially more serious when using effective exchange rates as it creates still another index.

While employing effective exchange rate indices can be extremely useful in capturing international relative prices, care must be used. In Bahmani-Oskooee and Mirzai (2000) they choose the trade shares in 1995. Fixing the trade shares, as with any Laspeyres index, results in a substitution bias. If the US dollar rapidly appreciates against the Indian rupee, the share of India's imports from the US is likely to fall, however the exchange rate index will not capture this. This phenomenon may be exactly what the structural break tests detect. Since 1995 saw the dollar at historically low values against other currencies, and 1984 historically high, the break may not have been a break at all. It may simply be a failure to measure the obvious substitution that must have occurred.

There are several studies, (see for example Bahmani-Oskooee, 1993; Bahmani-Oskooee, 1998; Bahmani-Oskooee & Mirzai, 2000) that utilize real effective exchange rates to test PPP and several others also account for potential structural breaks (Clemente et al., 1999; Corbae & Ouliaris, 1991; Wu, 1997).

VII. Conclusions

In this chapter we highlighted the progress made in the empirical methods applied to the PPP puzzle. Newer techniques allow us, in many cases, to find periods of stationary exchange rate fluctuations for the effective exchange rate. This predictability leads us to reject PPP in favor of a new variant called Quasi-PPP.

The failure to find conclusive empirical results in favor of traditional PPP isn't such a puzzle. Exchange rates shocks have a long memory, too long to be explained by nominal rigidities. However, allowing for structural breaks reduces the length of time the remaining shocks persist, resulting in something more accordant with Dornbusch's (1976) overshooting hypothesis. The structural breaks are most likely the result of large real shocks which frequently buffet the economy. This includes changes in trade policies, acceleration or deceleration of productivity growth rates, all of which have consequences for exchange rate. These factors conspire against finding consistent evidence in favor of PPP.

Table 1: KPSS Test ε_{τ}

Colombia	0.247*	Pakistan	0.073
Costa Rica	0.346*	Philippines	0.167*
Ecuador	0.290*	Portugal	0.366*
Egypt	0.495*	Singapore	0.128
Greece	0.349*	South Africa	0.094
India	0.170*	Srilanka	0.402*
Indonesia	0.210*	Thailand	0.112
Korea	0.094	Tunisia	0.264*
Malaysia	0.119	Turkey	0.239*
Mexico	0.266*	Ethiopia	0.357*

Notes: Source: Author's calculations using the KPSS test with 4 lags
Data: (Bahmani-Oskooee & Mirzai, 2000) 1973:1-1997:3
Critical Values: 1% 0.216; 5% 0.146; 10% 0.119

Table 2: Perron's Test

Country	t alpha (k)	Break Date
Colombia	-3.97 (6)	1984:4
Costa Rica	-10.92(9)*	1980:3
Ecuador	-6.76(1)*	1985:3
Egypt	-6.00(7)*	1990:1
Greece	-5.80(4)*	1985:2
India	-3.84(12)	1976:2
Indonesia	-6.88(11)*	1985:3
Korea	-6.29(7)*	1984:4
Malaysia	-5.02(12)	1989:2
Mexico	-5.84(0)*	1976:1
Pakistan	-3.99(9)	1984:4
Philippines	-5.14(2)	1984:4
Portugal	-4.77(7)	1976:3
Singapore	-4.92(4)	1984:4
South Africa	-4.46(3)	1984:1
Srilanka	-6.78(12)*	1977:1
Thailand	-4.41(2)	1985:2
Tunisia	-6.03(4)*	1985:4
Turkey	-4.10(0)	1979:1
Ethiopia	-4.57(11)	1983:4

Source: Author's calculations using 12 as the maximum lags
Data: Bahmani-Oskooee and Mirzai (2000) 1973:1-1997:3
Critical values for 100 observations at 5% -5.55

* Reject the unit root null at 5%

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