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The role of structural breaks, nonlinearity and asymmetric adjustments in African bilateral real exchange rates☆

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ABSTRACT

This paper examines the validity of the purchasing power parity, PPP for six African countries of Botswana, Ghana, Kenya, Nigeria, South Africa and Tanzania using the countries' bilateral real exchange rates with their fifteen major trading partners for the period 1960–2011. It uses the Lagrangian multiplier, LM, which accommodates up to two endogenous structural breaks in addition to conventional unit root tests. The paper also uses the threshold cointegration tests to explore nonlinearity and asymmetric adjustments of the series. Results from the LM unit root tests indicate that the exchange rates of Botswana, Ghana, Kenya and Nigeria relative to their major trading partners are stationary. The results from the threshold cointegration suggest that there is a long-run relationship between the series and that the adjustments are asymmetric. Appreciation is faster than depreciation in most of the countries. This is consistent with suggestions that countries are intolerant of depreciation.

1. Introduction

The purchasing power parity, PPP, hypothesis has been a major topical issue over the years and a huge amount of empirical work has been done in the area for both developed and developing countries. The major reason for this interest is because of an important implication it has on trade and capital movements. Over the years, the evidences presented by the empirical literature are generally mixed, which were largely attributed to differences in methodology and the sample period covered by these studies. This is because the sample period may contain structural breaks that could be due to policy regime shifts and structural shocks, which were largely overlooked.

The empirical literature on the PPP can be classified into four groups based on the methodology used. The first group is the literature that used univariate unit root tests to examine the PPP hypothesis, but arrived at different conclusions. For example, Grilli and Kaminsky (1991) reported evidence that supports the validity of the PPP whereas Doganlar, Bal, and Özmen (2009) and Flynn and Boucher (1993) did not find evidence that supports the PPP. Furthermore, results from sub-sample of the data studied are also at variance with one another. For example, Grilli and Kaminsky (1991) find that the PPP holds for the entire

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sample period, but not for the sub-samples of floating and fixed regime periods while Odedokun (2000) reports that the PPP holds in 17 out of 35 countries studied.

The second group consists of those who applied panel unit root techniques. Frankel and Rose (1996), Papell and Theodoridis (1998), O'Connell (1998), Fleissig and Strauss (2000) and Taylor (2002) fall within this group. Their findings are generally supportive of the PPP hypothesis. The third one is a sub-set of the literature that used nonlinear unit root techniques. This includes Taylor, Peel, and Sarno (2001), Chortareas, Kapetanios, and Shin (2002), Kilian and Taylor (2003), Sarno, Taylor, and Chowdhury (2004) and Yilanci and Eris (2013). The results from this group have indicated that there is evidence of nonlinear mean reversion.

The fourth one includes those who have applied linear and nonlinear cointegration to investigate the PPP hypothesis. This literature looks into symmetric and asymmetric long run relationship between nominal exchange rate and the domestic and foreign price levels. Those that applied linear cointegration include Karfakis and Moschos (1989), Kim (1990), Mahdavi and Zhou (1994) and Kargbo (2006) and they found support for the PPP hypothesis. Enders and Dibooglu (2001), Enders and Chumrusphonlert (2004), Holmes and Wang (2006) and Karoglou and Morley (2012), on the other hand, have used asymmetric cointegration techniques to look into the relationship between nominal exchange rate and the domestic and foreign price levels. They have also found evidence that is supportive of the PPP hypothesis.

This study tests for the long-run PPP hypothesis in six African countries by analysing their bilateral exchange rates relative to their trading partners.[1] These are Botswana, Ghana, Kenya, Nigeria, South Africa and Tanzania. These countries have undertaken reforms in the 1980s and the 1990s, from which trade and foreign exchange liberalization were part of. The main aim was to have their exchange rates as close as possible to their long-run equilibrium rates. Thus, making the countries suitable for the PPP analysis as it will shed light on the equilibrium level of the countries' exchange rates.

The major contribution of the paper is three folds. First, we examine the numeraire currency in validating the PPP condition by expressing the six African real exchange rates with their main trading partners. This approach is a departure from the existing literature, which has used the exchange rates denominated in the US dollar. Instead, the paper uses the countries' bilateral real exchange rates based on the numeraire currency. Secondly, we examine the properties of the time series to identify the possibility of structural breaks in the data using the LM test that allows up to two structural breaks. Third, the study used Threshold Cointegration Tests of Enders and Siklos (2001) to investigate nonlinearity and asymmetric adjustments of the series. This is important as identified by various authors that authorities try to influence the behaviour of their exchange rates. It was found by this literature that countries are generally intolerant to exchange rate depreciation and therefore, they use monetary policy as well as direct intervention in the foreign exchange markets to prevent their domestic currencies from depreciating or appreciating.[2] These actions can lead to both nonlinearity and asymmetric adjustments in the series. Overlooking them may have serious implication for conclusion on whether the PPP holds or not.

The rest of the paper is structured as follows. The next section outlines and explain the methodology used in the paper. Section 3 discusses the data as well as analyses the estimated results while Section 4 concludes.

2. Methodology

2.1. The unit root tests

The LM test of Lee and Strazicich (2003), endogenously determines structural breaks in a series. It also addresses the problems of bias and spurious rejections which other tests are criticized of as shown in Lee and Strazicich (2003) that it is based on the LM principles. Furthermore, the tests correspond to Perron's (1989) exogenous structural break with a change in the level and the trend. Lee and Strazicich's (2003) model allows for two endogenous breaks both under the null and the alternative hypothesis.[3,4] The test has been shown to perform well as compared to other data-dependent procedures that select the number of lagged augmented terms. Advantages of the two-break minimum LM unit root test can be summarized as follows. First, the break points are endogenously determined from the data. Second, the test is not subject to spurious rejections in the presence of a unit root with break(s). Third, when the alternative hypothesis is true and spurious rejections are absent, Lee and Strazicich (2003) demonstrate that the two-break minimum LM test has greater or comparable power to the Lumsdaine–Papell, LP, Test.

2.2. Asymmetric cointegration tests

To examine the long-run PPP and also explore the possibility of non-linearity as well as asymmetric adjustments in the series, the study uses the Enders and Siklos (2001) asymmetric cointegration methodology. Relationship between nominal exchange rates and domestic and foreign price levels can be expressed as:

$$e_t = \beta_0 + \beta_1 p_t^* + \beta_2 p_t + \varepsilon_t \tag{1}$$

[1] The number of countries and the sample size are both determined by availability of data. This is discussed under the Data Section of the paper.

[2] See Calvo and Reinhart (2002) for full discussions.

[3] The LM unit root tests statistics is given by: $\tau = t$-statistics for testing the null of a unit root ($\phi = 0$). To endogenously determine the location of two breaks ($\lambda_j = \frac{T_{Bj}}{T}$, $j = 1, 2$), the minimum LM unit root selects all plausible break points for the minimum statistic. See Lee and Strazicich (2003) for the details of the model.

[4] In addition, we also run conventional unit root tests: augmented Dickey Fuller, ADF and Phillips Perron, PP. These are standard tests found in the literature and hence, they are not discussed here.